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Political economics of gender relations in information and communication technologies in agricultural development. The case of knowledge-based platforms for farmers in Kenya.

Thèse de doctorat de l'Université Paris-Saclay
préparée à AgroParisTech (l'Institut des sciences et industries du vivant et de l'environnement)

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Thèse soutenue à Paris, le 24 Septembre 2018, par

Madeleine Jönsson

Composition du Jury :

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Cécile Blatrix Professeure, AgroParisTech (UMR GVSP)	Examinatrice
Guy Faure Chercheur, HDR, CIRAD (UMR Innovation)	Rapporteur
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Thèse de doctorat

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[1] Any errors are of the responsibility of the author.

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THESIS ABSTRACT

Low-income sub-Saharan African countries are confronted with demographic explosion since the last 60 years. Consequently, agriculture plays a key role in ensuring food security. The agricultural sector is also the main source of employment in this region. Women are the major contributing labour force in agriculture in these sub-Saharan African countries. Connected to their key role in the agricultural sector, women farmers are prioritised in policy intervention. Moreover, agricultural extension services are necessary to adapt to different constraints in these countries. Transfer of knowledge is also required to guarantee farm yields and consequently improve small-scale farmers' livelihoods. Lately, information and communication technologies (ICTs) have enabled the development of new tools, aimed at improving the scope and the effectiveness of advisory services. Policy makers in sub-Saharan African countries are nonetheless confronted with critical questions regarding the impact of these tools, which can also contribute to a 'digital gender gap'. These issues particularly concern women farmers.

This PhD research analyses how ICT tools take into account gender relations, and the situation of women farmers. The thesis is based on the case of Kenya. The dissertation particularly focuses on the development of knowledge-based platforms in agriculture, an ICT policy instrument used by the Kenyan Government to achieve public policy objectives. This country is emblematic because it believes in the assumption that platforms can be inclusive of women farmers'. To answer to this research question, the work is based on three different institutional economic research approaches: feminist economics, the French regulation theory, and economics of services. A conceptual and methodological framework is presented to analyse the inclusion of gender equality in knowledge-based platforms at macro-, meso-, and micro- level.

The results provide evidence that gender equality objectives is a fundamental guiding principle to the Government of Kenya. The analysis show that platforms are considered as new tools of inclusiveness in farm advisory services innovation. Observations from a developed platform typology framework show however that platforms can be source of gender inequality. It especially concerns women farmers unequal access to these instruments and the standardised services that they offer. This is essentially related to the institutional nature of the platform. Indeed, as it turns out, a high number of these instruments are based upon complex partnerships, and financed by multi-national corporations and/or foundations from the agrifood industry based in the Northern hemisphere. Combining institutional economic approaches allowed to bring out critical points of inclusion to be considered by policy makers and platform developers. Disregarding these specificities may make these platforms into new vectors of exclusion. Recognising and taking into account the conditions for inclusion can bring to light powerful levers for improving the efficiency of platforms.

Key words: gender relations, farm advisory service, knowledge-based platform, woman farmer, ICT, Kenya

RÉSUMÉ DE LA THÈSE

Face à l'explosion démographique des pays à faible revenu en Afrique sub-saharienne, l'agriculture joue un rôle primordial pour garantir la sécurité alimentaire. Le secteur agricole est de plus la principale source d'emploi dans cette région. Les femmes constituent la principale main-d'œuvre agricole de ces pays. En raison de leur rôle clé dans le secteur agricole, les agricultrices sont prioritaires dans les interventions politiques. Par ailleurs, dans ces pays, le conseil agricole et le partage des connaissances sont nécessaires pour s'adapter à de nouvelles contraintes. Depuis quelques années, les technologies de l'information et de la communication (TIC) ont permis le développement de nouveaux outils visant à améliorer la portée et l'efficacité du conseil. Les gouvernements de ces pays sont cependant confrontés à des critiques concernant l'impact de ces outils, qui peuvent également contribuer à une fracture numérique touchant plus particulièrement les femmes qui travaillent dans les exploitations agricoles familiales.

La thèse de doctorat analyse comment les outils TIC tiennent compte des rapports de genre, et de la situation des femmes qui travaillent sur l'exploitation agricole familiale. La thèse est fondée sur le cas du Kenya. Elle est focalisée sur le développement des plateformes de connaissances, un instrument TIC utilisé par le Gouvernement kenyan pour atteindre les objectifs de politiques publiques. Ce pays est emblématique car il fait l'hypothèse que les plateformes peuvent être inclusives des agricultrices.

Pour cette recherche, le travail s'appuie sur trois approches d'économie institutionnelle : l'économie féministe, la théorie de la régulation, et l'économie des services. Il présente un cadre méthodologique et conceptuel, développé pour analyser l'intégration des rapports de genre dans les plateformes aux échelles macro, méso et micro.

Les résultats montrent que les rapports de genre sont présentés associés à un objectif d'équité pour le Gouvernement Kenyan. L'analyse confirme que les plateformes sont considérées comme de nouveaux outils d'inclusion du système de vulgarisation du gouvernement. La typologie de plateformes développée dans ce travail montre cependant que ces instruments peuvent être une source d'inégalité. Il s'agit en particulier de l'inégalité d'accès pour les agricultrices et de services standardisés qui ne correspondent pas aux attentes de ces femmes. La conjugaison de différentes approches économiques institutionnelles a permis d'analyser comment les évolutions institutionnelles affectent l'inclusion des objectifs d'égalité des sexes dans l'intervention publique et dans le fonctionnement effectif des plateformes. Les résultats présentent des leviers d'action pouvant être pris en considération par les politiques et les concepteurs des plateformes, pour une tenir compte des rapports de genre dans ce système de vulgarisation agricole et éviter d'engendrer de nouvelles discriminations. L'analyse révèle l'importance de disposer d'un espace d'intervention publique et de coordination dans ce nouveau système de conseil agricole basé sur les TICs.

Mots clés : rapports de genre, conseil agricole, plateformes de connaissances, agricultrice, TIC, Kenya

EXTENDED RESEARCH ABSTRACT OF PHD THESIS IN FRENCH

Titre : Économie politique des rapports de genre dans les technologies de l'information et de la communication du développement agricole. Le cas des plateformes de connaissances accessibles en ligne destinée aux agriculteurs au Kenya.

Mots clés : rapports de genre, conseil agricole, plateforme de connaissance, agricultrice, innovation sociale, le Kenya

L'émergence d'une fracture numérique entre les agricultrices et les agriculteurs ?

Face à l'explosion démographique des pays à faible revenu en Afrique sub-saharienne, l'agriculture joue un rôle primordial pour garantir la sécurité alimentaire (Godfray et al. 2010). Les gouvernements de cette région doivent mettre en œuvre des politiques adéquates afin que leur population agricole puisse produire suffisamment de nourriture (Hazell et al. 2010; Collier & Dercon 2014).

Le secteur agricole est la principale source d'emploi dans cette région. Par ailleurs, selon les statistiques de l'Organisation Internationale du Travail (2016), les femmes y constituent la principale main-d'œuvre agricole. En raison de leur rôle clé dans le secteur agricole, les agricultrices sont prioritaires dans les politiques publiques, par exemple par le biais du Protocole de Maputo de 2003. « L'intégration des politiques d'égalité entre hommes et femmes[2] » et « l'action positive[3] » sont des principes spécifiques pour tenir compte des rapports de genre dans les politiques. Ce type d'intervention ciblée dans les politiques est lié au rôle clé des femmes dans le secteur agricole et à leurs exigences en matière de connaissances agricoles. Le conseil agricole et le partage des connaissances sont cruciaux à cet égard (Hazell et al. 2010; Garforth et al. 2003), et nécessaires pour que les agricultrices puissent s'adapter à de nouvelles contraintes.

Depuis les années 1980, cependant, les aides financières gouvernementales destinées au système du conseil agricole ont diminué de façon importante dans le monde entier (Davis 2008; Birner et al. 2009). Cela s'est traduit par une réduction substantielle du nombre de conseillers agricoles et de la variété des services offerts aux agriculteurs (Snapp 2004; Poulton et al. 2010).

Parallèlement, d'importants changements technologiques et le développement des technologies de l'information et de la communication (TIC) se multiplient à l'échelle mondiale, y compris dans les pays en voie de développement (Indjikian & Siegel 2005; Martin 2016).

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[2] Se traduit par « gender mainstreaming » en anglais et peut être définie comme *« la (ré)organisation, l'amélioration, le développement et l'évaluation des processus politiques, de sorte qu'une perspective d'égalité de genre soit incorporée dans toutes les politiques à tous les niveaux et à tous les stades, par les acteurs normalement impliqués dans l'élaboration des politiques. »* (traduction personnelle de Debusscher 2011, p.40).

[3] Se traduit par « affirmative or positive action » en anglais et peut être définie comme suit : *« des mesures qui impliquent un certain type de traitement préférentiel pour les membres du groupe dans une position socialement défavorisée. Elle repose sur l'hypothèse implicite que l'action positive doit remettre en cause la conception formelle de l'égalité des sexes, qui insiste sur le principe selon lequel les hommes et les femmes doivent être traités de manière cohérente selon la même norme de traitement. Les mesures d'action positive doivent être destinées aux membres du groupe défavorisé. Elles impliquent toujours, au moins implicitement, une préférence fondée sur le sexe. »* (traduction personnelle de Selanec & Senden 2011, p.4).

Selon les statistiques de l'Union internationale des télécommunications (2018), en 2016, 96% des habitants des pays en développement étaient abonnés à la téléphonie mobile cellulaire[4] et 44% étaient abonnés à la téléphonie mobile à large bande. De plus, 34% des ménages possédaient un ordinateur, 40% avaient accès à Internet à la maison, et 39% de la population totale utilisaient Internet. Ces chiffres varient néanmoins d'un continent à l'autre, l'utilisation des TIC étant généralement plus faible en Afrique que dans d'autres régions. Environ 20% de la population totale de l'Afrique a utilisé les services Internet en 2016, contre 82% en Europe. Cependant, ces pourcentages sont en augmentation.

Dans ce contexte, depuis quelques années, les technologies de l'information et de la communication (TIC) ont permis le développement de nouveaux outils visant à améliorer la portée et l'efficacité du conseil (Martin 2016).

Parallèlement, il ressort de la littérature scientifique et de la littérature grise que les TIC dans le conseil agricole sont en cours de développement. Les agences de développement internationaux ont également de grandes attentes à l'égard des différentes TIC dans la fourniture de services et de connaissances techniques aux agriculteurs, en particulier les plateformes de connaissances.

En se basant sur des études antérieures (Zack 1999; Purvis et al. 2001), une plateforme de connaissance peut être définie comme un dispositif accessible via Internet (assurant un accès permanent aux connaissances disponibles) et fournissant plusieurs fonctions pour un secteur donné : (1) un répertoire partagé pour divers types de ressources cognitives ; (2) un espace ou forum virtuel où (a) les fournisseurs et les utilisateurs de connaissances peuvent interagir, et (b) des critères d'évaluation de la qualité des connaissances qui peuvent être discutés, stockés et diffusés. Une plateforme de connaissance peut également servir de portail, donnant accès à d'autres types de ressources, y compris des liens vers d'autres sites Web et services (par exemple, la fourniture d'informations sur les prix actuels des produits agricoles).

Des rapports récents d'agences de développement telles que la FAO ou la Banque Mondiale font l'hypothèse d'une importance croissante des plateformes basées sur la connaissance dans l'agriculture (The Food and Agriculture Organisation 2014; George et al. 2011). Ils raisonnent autour de la substitution éventuelle des formes traditionnelles de services de conseil par ces dispositifs. L'analyse de la littérature scientifique montre que plusieurs chercheurs considèrent aussi que les plates-formes TIC en agriculture ont un rôle clé à jouer dans la diffusion des connaissances techniques (Karippacheril et al. 2013; Courtois & Subervie 2015; Nakasone et al. 2014).

Une revue méthodique de la littérature scientifique sur le développement de plateformes montre que la plupart des documents identifiés, supposent que les plateformes TIC ont la capacité de fournir des connaissances techniques à des groupes défavorisés vivant dans des zones rurales

[4] *« Les abonnements à la téléphonie mobile cellulaire sont des abonnements à un service public de téléphonie mobile qui donne accès au RTPC à l'aide de la technologie cellulaire. L'indicateur comprend (et est divisé en) le nombre d'abonnements postpayés et le nombre de comptes prépayés actifs (c'est-à-dire qui ont été utilisés au cours des trois derniers mois). L'indicateur s'applique à tous les abonnements de téléphonie mobile cellulaire qui offrent des communications vocales. Sont exclus les abonnements par cartes de données ou modems USB, les abonnements à des services de données mobiles publics, les radiocommunications mobiles privées à ressources partagées, le télépoint, les services de radiomessagerie et de télémétrie ».* (traduction personnelle de The International Telecommunication Union 2018). Cela implique que le ratio moyen d'abonnement au cellulaire mobile par personne est de 1 : 1, mais que certaines personnes ont plusieurs abonnements auprès de différents opérateurs de télécommunications, tandis que d'autres n'ont pas d'abonnement.

isolées, et ce plus efficacement que les services de conseil traditionnels. Cependant un nombre limité d'articles analysent les aspects institutionnels des plateformes et fournissent des preuves des mécanismes d'inclusion et exclusion sociale fondés sur des recherches empiriques.

De fait, il y a encore peu de recherches empiriques pour confirmer que les attentes à l'égard de ces outils sont justifiées[5]. De plus, certains auteurs défendent l'idée que les plateformes fondées sur la connaissance pourraient accroître l'écart d'inégalité déjà existant entre les femmes et les hommes (Antonio & Tuffley 2014; Hafkin & Huyer 2008; Rodriguez et al. 2015), ce qui pourrait conduire à une nouvelle « fracture numérique » (Alozie & Akpan-Obong 2017; Hilbert 2011; Mumporeze & Prieler 2017; Fuchs & Horak 2008).

C'est donc sous des formes assez exploratoires que plusieurs gouvernements d'Afrique subsaharienne s'aventurent dans ces innovations technologiques afin de fournir aux agricultrices des services de conseil plus efficaces.

La position emblématique du Kenya dans ce contexte

Le Kenya est emblématique dans ce contexte puisqu'on y observe un fort développement des dispositifs TIC (Kabura Nyaga 2012; Mukhebi & Kundu 2014; Ogutu et al. 2014). De plus, la connectivité Internet a fait des progrès significatifs au cours de la dernière décennie (Ndemo 2015). Le Gouvernement oriente en particulier les initiatives en matière de TIC vers les zones rurales et l'agriculture. Parallèlement, le nombre total de conseillers agricoles du secteur public a diminué de plus de moitié au cours des deux dernières décennies (Ministry of Agriculture of Kenya 2012), alors que la population a rapidement augmenté. A cet égard, l'objectif spécifique est de transférer des connaissances à une vaste population de manière plus efficace qu'avec l'intervention des services traditionnels de vulgarisation agricole. Les agricultrices sont explicitement priorisées, par le biais de « l'intégration des politiques d'égalité entre hommes et femmes » (The Government of Kenya 2010).

Selon les documents administratifs du Gouvernement kenyan, on estime que les TIC sont en mesure de fournir des connaissances techniques aux agricultrices (Ministry of Agriculture of Kenya 2012; The Government of Kenya 2010). Néanmoins, certains résultats de recherche indiquent des disparités entre les femmes et les hommes en ce qui concerne l'accès aux dispositifs TIC au Kenya (Wawire et al. 2017; Awuor et al. 2016). L'inaccessibilité et un contenu inadéquat des dispositifs TIC sont deux facteurs d'exclusion possibles. Même si les agricultrices kenyanes sont prioritaires dans l'intervention publique, cela ne signifie pas nécessairement que les politiques agricoles et les technologies émergentes sont socialement inclusives. Cette thèse de doctorat examine à quelles conditions les plateformes TIC peuvent-ne pas engendrer de fracture numérique entre hommes et femmes.

Choix théoriques : Les technologies de l'information et de la communication dans l'agriculture et la dimension de genre dans la littérature économique

L'état de l'art présente les perspectives théoriques qui permettent d'analyser les nouvelles formes d'inégalités qui peuvent apparaître entre les femmes et les hommes à travers l'utilisation des plateformes de connaissances. La thèse mobilise les acquis de trois approches économiques institutionnelles différentes à l'intersection (1) de l'économie féministe, (2) la théorie de la

[5] Dans la littérature économique, je n'ai pas trouvé de document analysant spécifiquement la contribution des plateformes TIC (dans le conseil agricole) à la fracture numérique entre hommes et femmes.

régulation, et (3) de l'économie des services. Ces cadres théoriques permettent d'analyser les dimensions qui doivent être prises en compte à différents niveaux pour une intégration concrète des rapports de genre dans l'utilisation des plateformes, en conformité avec les objectifs de politique publique. En particulier :

- Les analyses de la littérature montrent un lien intrinsèque entre les concepts économiques fournis par la théorie de la régulation et la définition des rapports de genre de l'économie féministe (Ferber & Nelson 2003; Barker & Feiner 2004; Agarwal 1997). Les rapports de genre y apparaissent comme un élément déterminant de la croissance économique et de la cohésion sociale d'un pays. La thèse s'appuie sur une conception des rapports de genre sont une dimension de relations sociales toujours situées.
- La théorie de la régulation souligne en particulier les fonctions complémentaires des mécanismes autres que les forces du marché pour contribuer à la croissance économique d'un pays (Boyer 1986; Jessop & Sum 2006). Il s'agit notamment des institutions, des identités collectives, des visions communes, des valeurs communes, des normes, des conventions, des réseaux, des procédures et des modes de calcul (Petit 2008). En d'autres termes : comment les relations sociales, et leur dimension de genre, structurent les activités économiques.
- Les résultats de l'économie des services ont montré que la façon dont se combinent innovations technologiques (et le choix technologique) et organisationnelles est importante pour comprendre les dynamiques d'inclusion sociale dans l'intervention politique dans le secteur des services (Gadrey 1990). Ceci s'observe notamment dans le secteur des services de conseil agricole (Sutherland et al. 2013; Labarthe 2006). Les chercheurs en économie des services ont développé un cadre pour analyser la performance des services (Gadrey & Gallouj 1998). Ce cadre analytique à également permis d'analyser l'efficacité des services de conseil agricole (Labarthe 2006), et fournit une méthode pour étudier les logiques de performance des plateformes de connaissances analysées dans cette thèse de doctorat.

Pour comprendre comment les relations de genre, en tant que relation sociale fondamentale, interfèrent avec les innovations technologiques, la recherche analyse donc quatre points principaux :

(1) Comment les rapports de genre sont intégrés dans les plateformes TIC dans la sphère des politiques publiques par l'utilisation spécifique des principes de genre (des politiques d'égalité entre hommes et femmes, la discrimination positive),
(2) L'intégration des rapports de genre dans les plateformes TIC soutenues par les politiques publiques,
(3) Comment les femmes sont spécifiquement associées à l'élaboration du contenu des plateformes de connaissance, et
(4) La capacité des femmes d'accéder aux services des plateformes qui dépend de leur intégration sociale.

La méthodologie découle de ces choix.

Cadres méthodologiques et collecte de données

Une méthodologie d'analyse multi-niveaux a été conçue pour relier trois échelles : macro, méso et micro, soit (1) les politiques publiques et les cadres stratégiques en ce qui concerne l'inclusion des rapports de genre dans le système du conseil agricole reposant sur les TIC, (2) l'offre des services fourni par une sélection de plateformes TIC, et (3) la demande des agricultrices.

Les données qualitatives et quantitatives proviennent de diverses sources : (i) une revue de la littérature scientifique et des rapports administratifs, ainsi que des recherches sur Internet pour l'identification des plateformes, (ii) des données statistiques du recensement de la population Kenyane de 2009, (iii) des entretiens institutionnels avec des employés du Ministère de l'agriculture, de l'Université, des coopératives agricoles et des ONG, (iv) des entretiens avec les personnes responsables de la conception et de la mise en œuvre de deux plateformes TIC, et (v) des entretiens individuels avec des agricultrices Kenyanes.

Mise en évidence de cinq résultats principaux

Tout d'abord, je démontre que les rapports de genre sont affirmés comme un objectif d'équité par le Gouvernement Kenyan. Les résultats montrent également que les plateformes sont considérées comme devant être des outils d'inclusion dans les interventions publiques. Le rôle des plateformes pour ce gouvernement est de fournir aux agricultrices des connaissances techniques plus efficacement que lorsqu'ils sont fournis par les services du conseil agricole traditionnels. Les plateformes TIC sont plus que de simples outils techniques : elles sont en effet utilisées comme instruments d'intégration sociale des femmes, comme des instruments de politique. Pour soutenir ce système émergent de conseil agricole reposant sur les TIC, avec une place centrale accordée aux plateformes, le Gouvernement kenyan développe des partenariats avec des gouvernements étrangers et/ou des acteurs privés. Ces parties prenantes ont cependant leur propre vision de l'égalité des sexes, et cela pourrait avoir des conséquences sur l'inclusion des agricultrices dans les services et le contenu technique de ces instruments.

Le deuxième résultat correspond à une typologie des plateformes. Il existe plusieurs types de plateformes (par exemple, les plateformes appartenant à l'État, les plateformes basées sur des partenariats publics-privés, les plateformes basées sur des partenariats publics-privés-ONG). On observe que plusieurs plateformes sont financées par des sociétés multinationales et/ou des fondations de l'industrie agroalimentaire, situées dans l'hémisphère nord. Ces constats soulèvent plusieurs questions quant à la façon dont les rapports de genre peuvent être pris en compte dans les plateformes. (i) Lorsque des plateformes sont financées par des acteurs associés à des intérêts économiques puissants, ne vont-elles pas donner la priorité à leurs propres intérêts plutôt qu'aux aspects d'inclusion sociale (et donc aux rapports de genre) ? (ii) Est-il possible pour le Gouvernement Kenyan de surveiller l'impact de la diffusion du contenu des connaissances par les plateformes étrangères, sur les agricultrices et leurs projets agricoles ? (iii) . Dans quelle mesure le type de contenu technique diffusé est, dans certains cas, lié aux intérêts économiques du secteur agroalimentaire ? Les intérêts des principaux acteurs ont-ils des conséquences sur le contenu technique mis à la disposition aux agricultrices Kenyanes ?

En troisième lieu, je présente les résultats d'une analyse approfondie des logiques de performance de deux plateformes de connaissances qui présentent des logiques d'inclusion de la dimension du genre. Cette analyse révèle les difficultés de la mise en œuvre opérationnelle des objectifs d'égalité entre les sexes, au-delà de l'affichage des logiques de performances en matière d'égalité entre les sexes. De plus, l'analyse montre que les attentes des femmes à l'égard de ce type d'instrument diffèrent de celles des hommes parce qu'elles sont inscrites dans des relations sociales différentes. Les entretiens menés auprès des agricultrices Kenyanes montrent en effet une insuffisance de « coproduction » des connaissances. Par conséquent, les résultats suggèrent que les agriculteurs peuvent être réticents à utiliser les plateformes. Les raisons invoquées sont les suivantes : (1) l'information n'était pas suffisamment pertinente pour leurs besoins précis, (2) certains services étaient fastidieux et coûteux (par exemple, les appels

vocaux), et (3) les agricultrices ne se sentaient pas suffisamment impliquées dans le développement du contenu des services.

L'accessibilité à l'Internet est une question clé pour la fourniture d'un soutien technique agricole par le biais de plateformes TIC. Ainsi, pour étayer mon quatrième résultat, je donne des indices pour comprendre comment ces outils peuvent atteindre les agricultrices Kenyanes. Les analyses statistiques du recensement de 2009 montrent que les niveaux d'éducation, les activités économiques et l'accès aux TIC ont un lien significatif avec les niveaux d'utilisation d'Internet des agricultrices Kenyanes. Les résultats révèlent également que l'accès limité des agricultrices à l'Internet n'est peut-être pas seulement dû aux inégalités entre les sexes. Certaines difficultés d'accès aux services Internet pourraient être liées au fait que les TIC permettant l'accès à Internet (par exemple, les ordinateurs) ne sont pas introduites dans des espaces collectifs priorisés par les agricultrices (par exemple, les groupes et les centres communautaires).

Enfin, je présente des éléments qui prouvent que les agricultrices sont capables de s'organiser pour accéder aux ressources disponibles dans les plateformes TIC. Ces résultats peuvent servir de base à des nouvelles formes d'accès aux connaissances techniques. L'analyse des données statistiques et des enquêtes qualitatives montre l'importance des espaces collectifs pour les agricultrices. Les résultats des entretiens avec les agricultrices confirment l'importance des groupes de femmes pour accéder et échanger des connaissances. De plus, discuter avec les pairs et des conseillers est une priorité pour ces femmes. Conformément à ces pratiques, il est possible d'entrer en usage avec les plateformes TIC dans les mêmes types de configurations (par exemple, où ils peuvent discuter collectivement des connaissances dans les plateformes dans ces groupes, à condition d'avoir accès à un ordinateur, tablette ou téléphone portable). De même, sur la base des résultats des entretiens avec les conseillers agricoles, je soutiens qu'ils devraient se voir attribuer un nouveau rôle innovant, agissant comme des « passerelles de connaissances » entre les agricultrices et les plateformes TIC.

Discussion : Définir les rapports de genre comme une relation sociale fondamentale fait ressortir les conditions d'intégration pour les instruments TIC de l'agriculture.

Cette recherche confirme que l'application d'une approche institutionnelle à échelle macro, méso et micro a révélé les conditions pour lesquelles les plateformes de connaissance seraient inclusives pour les agricultrices Kenyanes. Les résultats de la revue de la littérature économique sur le développement des plateformes montrent qu'il existe encore peu d'analyses empiriques sur les aspects de l'inclusion sociale dans ces outils. D'une autre manière, cette analyse m'a permis de prouver la valeur heuristique de cette recherche.

Définir les rapports de genre comme une relation sociale fondamentale a rendu possible : (1) la mise en lumière les enjeux concernant les aspects de l'inclusion sociale qui émergent avec les plateformes TIC, et (2) l'articulation les points critiques d'inclusion, permettant aux agricultrices d'accéder et d'utiliser ces innovations technologiques. La recherche économique féministe a donc fourni des méthodes pour la prise en compte et l'interprétation des rapports de genre dans le cadre d'interventions politiques et de plateformes de connaissance. Les études d'économies institutionnelles montrent la nécessité de prendre en compte les différents groupes sociaux au sein du public cible, ainsi que les règles collectives structurant les activités économiques, afin d'éviter des processus d'exclusion dans les services de conseil. Cela garantit également que les connaissances produites et diffusées sont socialement pertinentes. L'économie des services a montré l'importance des interactions entre les fournisseurs de services et les clients pour garantir la qualité du service.

Des enjeux émergeants émanent de cette thèse de doctorat, ouvrant un nouvel agenda de recherche contenant un ensemble de questions sensibles : (a) La nature institutionnelle des plates-formes, où il existe un risque que les objectifs économiques passent avant les aspects de l'inclusion sociale lorsque les plateformes ne sont pas mises en œuvre avec des moyens publics, (b) Leur modèle économique et leur fragilité lorsque la viabilité financière n'est pas assurée et, (c) Les moyens d'organiser les flux de connaissances entre l'hémisphère Nord et l'hémisphère Sud, où le contenu technique des plateformes de connaissance pourrait contribuer à d'éventuels effets de verrouillage. Ensemble, ces points critiques révèlent une nouvelle sphère d'intervention politique pour le gouvernement kenyan. Les résultats de la thèse montrent en effet que l'on attend des plateformes TIC qu'elles aident le gouvernement kenyan à atteindre ses objectifs politiques en matière d'égalité entre les sexes. Les résultats fournissent des preuves d'une grande diversité de types de plateformes et de configurations de financement, où les acteurs les plus dominants des plates-formes pourraient imposer leurs visions des relations de genre. Ignorer ces spécificités peut faire de ces outils de nouveaux vecteurs d'exclusion par le biais d'une fracture numérique substantielle entre hommes et femmes. Les résultats montrent que cela résulte principalement de la dimension institutionnelle des plateformes TIC, à savoir les modèles de partenariats publics-privés sur lesquels reposent ces dispositifs. D'autre part, la reconnaissance des différentes conditions d'inclusion et leur prise en compte peut mettre en lumière des leviers puissants pour améliorer l'efficacité de ces instruments de politiques publiques.

LIST OF ACRONYMS

AEFC	The Africa Enterprise Challenge Fund
AES	Agricultural Extension Services
AEZ	Agricultural-Ecological Zone
APF	AgriProFocus
ASDS	The Agricultural Sector Development Strategy
ASDSP	The Agricultural Sector Development Support Programme
ASGMG	The Agricultural Sector Gender Mainstreaming Guideline
BMI	The Business Monitor International Research
CABI	Centre for Agriculture and Bioscience International
CSO	Civil Society Organisation
EU	The European Union
FAO	The Food and Agricultural Organisation of the United Nations
FARA	Forum for Agricultural Research in Africa
FAS	Farm Advisory Services
FBO	Farmer Based Organisation
FCS	Farmers' Cooperative Society
FO	Farmer Organisation
GDP	Gross Domestic Product
GM	Genetically modified
GNH	The Gross National Happiness Index
GSI	The Gender and Social Inclusion Guideline
GSMA	Groupe Speciale Mobile Association
HH	Household
HQ	Head Quarters
ICT	Information and Communication Technologies
ICRAF	World Agroforestry Centre
ILO	The International Labour Organization
IT	Information Technology
ITU	International Telecommunication Union
IVRS	Interactive Voice Response Service
KACE	Kenya Agricultural Commodity Exchange
KALRO	The Kenya Agricultural and Livestock Research Organization
KIBS	Intensive Knowledge-Based Services
KMT	Kenya Markets Trust
KNBS	Kenya National Bureau of Statistics
MNC	Multi-National Corporation
Nafis	The National Farmers Information Service
Nalep	The National Agriculture and Livestock Extension Programme
NARS	The National Agricultural Research Systems
Nasep	The National Agricultural Sector Extension Policy
NGO	Non-Governmental Organisation
PAFO	Pan-African Farmers Organization
PanAAC	Pan-African Agribusiness Agroindustry Consortium
PHC	Population and Housing Census
PPP	Public-private partnership
Q&A	Questions and Answers
R&D	Research and Development
RML	Reuters Market Light services

Sida	The Swedish International Development Agency
SMS	Short Message Service
SSA	Sub-Saharan Africa
SSPK	Seed Sector Platform Kenya
T&V	Training and Visit
TRAC	The Trade Mark East Africa Challenge Fund
TV	Television
Wi-Fi	Wireless Fidelity
UK	The United Kingdom
US	The United States of America

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Introduction

Agriculture plays a key role in ensuring food security in low-income sub-Saharan African countries, as they are confronted with demographic explosion. In these countries, farm advisory services are needed to adapt to new constraints (climate change, environmental degradation, health concerns). Knowledge transfer is also required to guarantee farm yields and consequently improve small-scale farmers' livelihoods. In recent years, information and communication technologies (ICTs) have enabled the development of new tools to improve the scope and the effectiveness of extension services. Policy makers in sub-Saharan African countries are however confronted with critical questions regarding the impact of these tools, which can also contribute to a 'digital divide' and become a new source of exclusion. These issues particularly concern women farmers.

This thesis project emerged from field experiences in Kenya, where I had the opportunity to work as project manager for the Swedish NGO 'We Effect'. During my time as a development worker, I realised that there are emerging issues around stakeholder interests in technology innovation and knowledge dissemination in agriculture. I also wished to explore the question of whether new technologies used in farm advisory services integrate gender equality and could be comprehensive of women farmers.

The objective of my research project is therefore to examine whether ICTs in agriculture can be inclusive of female farmers and their demands. The thesis is based on the case of Kenya. I focus particularly on the development of knowledge-based platforms in agriculture, a type of policy instrument used by the Kenyan Government to achieve public policy objectives.

Why women farmers?

Sub-Saharan Africa (SSA) has experienced the world's largest population growth over the last 55 years (United Nations Population Division 2018b). SSA governments are under intense pressure to ensure the implementation of adequate agricultural policy objectives, so that their farming population can produce enough food (Hazell et al. 2010; Collier & Dercon 2014). The agricultural sector is an important contributor to GDP growth, and is the main source of employment in SSA (The World Bank 2017). The statistics show that women are the major contributing labour force in agriculture in this region (International Labor Organization 2016a). In view of their key role in the agricultural sector, female farmers are prioritised in public policy intervention in agriculture, for instance via the 2003 Maputo Protocol. As such types of targeted policy intervention in the agricultural sector are linked to women's key role in farming, they also concern their demands. Evidence from various studies show that women have particular demands when it comes to type of agricultural knowledge (Deen-Swarray et al. 2012; Meinzen-Dick et al. 2014), and thus need help to inform their technical choices. Agricultural extension services are crucial in this respect.

Many studies have however shown, in various contexts, that some farmers are excluded from the benefit of farm advisory services (e.g. in the definition of target groups for specific programmes, or due to the cost when consulting services are managed on a commercial basis). Certain authors are of the opinion that ICTs, such as platforms, are more inclusive tools which allow marginalised farm groups better access to available knowledge (Karippacheril et al. 2013), for example female farmers (Munyua et al. 2009; Kadiyala et al. 2016; Mittal 2016). As such, governments are exploring new methods via information and communication technologies (ICTs) in farm advisory intervention.

Why information and communication technologies in agriculture?

ICTs could create new opportunities in agriculture. They certainly have the potential to increase small-scale farmers' ability to access the knowledge, networks, and institutions they need to improve farm productivity. In this regard, the development of ICTs in agriculture has been discussed by Kaushik & Singh (2004); Aker et al. (2016); and Deichmann et al. (2016). ICT developments in agriculture could compensate for the reduced governmental financial support for public farm extension services (Davis 2008; Birner et al. 2009).

ICTs and internet[6] connectivity is developing rapidly in Africa. Sixty-nine percent of individuals had mobile cellular subscriptions in 2016, as opposed to 16% in 2006 (International Telecommunication Union 2018a). Whereas in 2006, 2% stated that they used the internet, ten years later this number had risen to 18%. ICTs may therefore represent a major transformation opportunity for the rural population in SSA (Martin 2016; Van Campenhout 2017; Aker 2011).

In this context, it is expected that ICTs in farm advisory intervention will emerge. There is consequently a necessity to analyse the conditions of accessibility and usability of such developments, based on a concrete example. In this thesis, I examine the case of 'knowledge-based platforms'.

Based on earlier studies (Zack 1999; Purvis et al. 2001), a knowledge-based platform can be defined as a device accessible via the internet (ensuring sustained access to available knowledge) and providing several functions for a given sector: (1) as a shared repository for various types of cognitive resources; and (2) as a virtual space or forum where (a) knowledge suppliers and users can interact, and (b) criteria for assessing the knowledge quality may be discussed, stored, and disseminated. A knowledge-based platform can also be used as a gateway providing access to other types of resources, including links to other websites and services (e.g. providing updated market information).

Governments have been advised to invest in ICT platforms, based on multi-actor partnerships, such as public-private partnerships (PPPs), as a way of replacing traditional types of farm advisory services (Karippacheril et al. 2013). The arguments behind in favour of this substitution typically cite the high costs of sustaining traditional farm advisory systems (Nakasone & Torero 2016); their unequal accessibility to different social groups (Kadiyala et al. 2016); and the difficulty in meeting the changing demands of a growing population, especially women farmers (Rodriguez et al. 2015).

Recent reports have stressed the importance of ICT platforms as having the potential to address current gaps in access to technical knowledge in agriculture, especially for female women (George et al. 2011). Due to women farmers' unequal access to advisory services, several governments in SSA are venturing into the adoption of these technological innovations.

The issue is highly controversial. The cost of computers and/or the literacy levels required for internet use appear to be insurmountable obstacles for many farmers, especially women farmers. As a result, several authors consider that the increased use of these tools could increase

[6] *"The Internet is a worldwide public computer network. It provides access to a number of communication services including the World Wide Web and carries e-mail, news, entertainment and data files irrespective of the device used (not assumed to be only via a computer - it may also be by mobile telephone, tablet, PDA, games machine, digital TV etc.). Access can be via a fixed or mobile network."* (International Telecommunication Union 2017, p.2).

gender inequalities (Hafkin & Taggart 2001; Walby 2011) and generate a digital gender divide (Alozie & Akpan-Obong 2017; Scheerder et al. 2017; Mumporeze & Prieler 2017).

However, while some of the scientific community and certain development agencies also have high expectations as regards platforms' ability to be inclusive of women farmers, other literature insists that ICT platforms can increase inequalities between women and men. The hypotheses put forward on both sides of the spectrum are nevertheless supported with very limited empirically-based evidence. At times, there are complete gaps in the literature, especially concerning ICT platforms' potential contribution to a gender divide. It is therefore difficult to identify general rules as to how female farmers can make the most of these new devices. Robust empirical evidence implemented in specific situations is required. Given the numerous issues at stake, the present dissertation aims at providing empirically-based evidence to fill this gap. As such, it explores how knowledge-based platforms, used as means to attain public policy objectives, can be a source of inclusion of women farmers in Kenya.

Why Kenya?

Kenya is emblematic in this respect since there is a significant growth in the use of ICT devices (Kabura Nyaga 2012; Mukhebi & Kundu 2014; Ogutu et al. 2014). Moreover, internet connectivity has made significant progress over the last decade (particularly since 2009, when the country first introduced optic fibre) (Ndemo 2015). The Government directs ICT initiatives towards rural areas and agriculture, in particular. At the same time, the total number of public advisors has decreased by more than half over the last two decades (Ministry of Agriculture of Kenya 2012), even as the population has rapidly increased, with a compound annual growth rate of 3.2% (United Nations Population Division 2018a). The population has multiplied 5.7-fold over the past 55 years (from 1960 to 2015). In this respect, the specific objective is to bring knowledge to a vast population more effectively compared to traditional agricultural extension services. Female farmers are explicitly prioritised by the Government (The Government of Kenya 2010).

Administrative documents of the Kenyan Government indicate that ICTs may be able to provide farm services and knowledge to this group of women (The Government of Kenya 2010; Ministry of Agriculture of Kenya 2012). The Government's assumption is that ICT platforms, as suppliers of new farm advisory services, are gender inclusive. Yet certain research findings point towards disparities between women and men farmers in Kenya with regard to access to ICT devices (Wawire et al. 2017; Awuor et al. 2016). Inaccessibility to and inadequate content within ICT devices are two possible exclusion factors.

Hence, even though Kenyan female farmers are prioritised in public intervention, it does not necessarily mean that agricultural policies and emerging technologies are socially inclusive. The question is then: do these emerging devices in agriculture have the ability to be inclusive of women farmers? Under which conditions? Or do they have the potential to create a new digital gender divide?

Chapter 1 shows that more traditional forms of farm advisory intervention are being replaced by ICTs in agriculture. It analyses empirical evidence reported by the scientific literature. Existing results stress that platforms in agriculture can provoke a digital gender divide. Reports and the scientific literature posit that the divide is caused by women's unequal access to platforms, and the ill-adjusted knowledge content provided on them. As a result, this type of substitution effect is becoming a matter of concern to the Kenyan Government. What then

would the conditions of substitutability of knowledge-based platforms in agriculture be, to be inclusive of gender equality dimensions and supply advisory services to female farmers?

There are a number of factors at different levels that must be taken into consideration for an effective integration of women farmers in the use of platforms. A relevant analytical framework is therefore necessary to assess the capacity of platforms to deliver agricultural advice, adjusted to the demands of women farmers and in line with public policy goals.

Chapter 2 presents the theoretical insights that make it possible to analyse new forms of inequalities that may emerge between women and men with regard to ICT knowledge-based platforms.

Institutional economic approaches provide guidelines to analyse the risks incurred by a government in dealing with platforms at the micro-level only, for fundamentally structuring aspects on a macro-level are not taken into consideration. Yet the economic models underpinning platforms and the technical content disseminated through them are strongly embedded in various institutions. I therefore base this dissertation on three different institutional economic approaches: (1) feminist economics (Barker & Feiner 2004; Ferber & Nelson 2003; Elson 1995; Agarwal 1997); (2) institutional economic regulation approaches (Boyer 1986; Jessop & Sum 2006); and (3) economics of services (Gadrey & Gallouj 1998; Gadrey 1990; Gadrey & De Bandt 1994). These theoretical frameworks make it possible to analyse the dimensions that must be taken into account at different levels for a concrete integration of gender equality objectives in ICT platforms, in line with public policy objectives.

- Feminist economists show how gender relations is built on social and power relations and contributes to defining element in a country's economic growth and social cohesion (Ferber & Nelson 2003; Barker & Feiner 2004; Agarwal 1997). Departing from earlier feminist economist research, the thesis stress that 'gender relations' should be considered as a fundamental social relation. Such methodological step will make it possible to decipher a complex reality.
- Institutional economic regulation approaches emphasises in the complementary functions of mechanisms other than market forces that contribute to a country's economic growth (Boyer 1986; Jessop & Sum 2006). These include institutions, collective identities, shared visions, shared values, norms, conventions, networks, procedures and modes of calculation (Petit 2008). In other words: social relations and their gender dimension structure economic activities.
- Economics of services studies emphasise that technological innovation (and technological choice) combined with organisational innovation is important for social inclusion in policy intervention in the service sector (Gadrey 1990). Also in the agricultural advisory services sector (Sutherland et al. 2013; Labarthe 2006). Researchers of this approach have developed a framework for analysing innovation performance (Gadrey & Gallouj 1998). This framework has also been used to analyse the effectiveness of agricultural advisory services (Labarthe 2006), and provides a method for studying the performance rationales of the knowledge-based platforms analysed in this PhD thesis.

Thus, to understand how gender relations interfere with technological innovations in public policy intervention, I structured the analysis on four foundations that consider, respectively: (1) how gender relations could be articulated into ICT platforms in the public policy sphere through the specific use of gender principles (i.e. gender mainstreaming, affirmative action); (2) the integration of gender equality objectives in ICT platforms supported by public policies; (3) how

women are considered in knowledge-based platform services supply; and (4) the idea that women's ability to access platform services depends upon their social integration. The methodology stems from these choices.

Chapter 3 presents a multi-level analysis methodology, designed to link the macro-, meso- and micro-levels of investigation. The methodology allows us to analyse: (1) public policy and strategic frameworks in relation to gender, farm extension and ICT goals; (2) the supply of agricultural extension services by a selection of knowledge-based platforms; and (3) the demand for extension services by female farmers.

Qualitative and quantitative data are obtained from various sources: (i) a review of the scientific literature and administrative reports, as well as internet research for platform identification; (ii) statistical data from the Kenyan Population and Housing Census 2009; (iii) institutional interviews with employees from the Ministry of Agriculture, the University, Cooperatives and NGOs; (iv) interviews with persons responsible for the design and implementation of two knowledge-based platforms; and (v) individual interviews with Kenyan female small-scale farmers.

Chapter 4 demonstrates that 'gender relations' is affirmed as an objective of equity by the Kenyan Government. Besides, the results also show that platforms are used as tools of inclusion in policy intervention. The targeted role of platforms used by the Government is to supply women farmers with technical knowledge more effectively, compared to traditional advisory services. The policy analysis thus reveals that knowledge-based platforms are more than mere technical tools: they are indeed used as instruments for the social integration of women. Platforms can therefore be considered as policy instruments. To support this emerging ICT-based advisory services system, with a central place given to platforms, the Kenyan Government develops partnerships with foreign-based governments and private actors. Such stakeholders however have their own vision of gender equality. This may have consequences upon the inclusion of women farmers in ICT platform services.

Chapter 5 describes the actual development of knowledge-based platforms in Kenyan agriculture. A typology of platforms is proposed. Results show that there are several institutional types of platforms (e.g. state-owned platforms, public-private partnership platforms, public-private-NGO platforms). The typology also shows that many of the analysed platforms are financed by multinational corporations, and/or foundations from the agrifood industry based in the northern hemisphere. Three outcomes raise questions about the inclusion of gender equality objectives in platforms. One, since platforms are defined and structured by powerful stakeholders, it is possible likely that they prioritise their own interests over aspects of social inclusion (and thus gender equality). Two, it becomes difficult for the Kenyan Government to monitor the impact of the dissemination of knowledge content by foreign-based platforms upon women farmers and their agricultural projects. Three, the type of technical content that is disseminated is, in some cases, linked to economic interests of the agribusiness sector.

Chapter 6 presents the results an in-depth analysis the performance rationales of two knowledge-based platforms that demonstrate logics of gender inclusion. This analysis reveal the difficulties of operational implementation of gender equality objectives, beyond the display of gender-equality performance rationales. The results moreover provides evidence in a gap between female farmers' multidimensional demands for services and platform management approaches resulting in standardised recommendations. The women farmers interviewed did

indeed report an insufficiency in interactive modalities of services. As a result, outcomes suggest that farmers may be reluctant to use platforms. Reasons given were that: (1) the information was not specific enough to their needs; (2) some of the additional services were tedious and expensive (e.g. voice calls); and (3) the women farmers did not feel sufficiently involved in the co-production of services and technical content.

Accessibility of internet services is a key issue for delivering technical agricultural support through knowledge-based platforms. **Chapter 7** provides clues to understanding how these tools can reach the targeted women farmers in Kenya. Statistical analyses from the Kenyan population and housing census data from 2009 show that levels of education, age, economic activities and access to ICT devices have a significant relationship to the levels of internet use of Kenyan women farmers. Results also reveal that women farmers' limited access to the internet could relate to the fact that ICTs enabling internet access (e.g. computers), are not introduced in collective spaces that women famers prioritise attending (e.g. groups).

Chapter 8 presents evidence on how women farmers are able to make the most of ICT platforms, which might provide a basis for new forms of access to technical knowledge. Analysis from statistical data and qualitative surveys show the importance that collective spaces have for women farmers. Results from interviews with female farmers confirm the importance of women's groups to access and exchange knowledge. Discussing with peers and extension agents is a key priority to these women. In keeping with these practices, they expect to use ICT platforms in the same kinds of configuration (e.g. where they can collectively discuss the information). Likewise, based on findings from interviews with extension officers, it appears that they should be given a new innovative role, acting as 'knowledge-bridges' between farmers and platforms.

Chapter 9 concludes this thesis and confirms that applying an institutional approach at macro-, meso- and micro-level help understand the conditions on which knowledge-based platforms could be inclusive of women farmers in Kenya. Defining gender relations as a fundamental social relation has made it possible to: (1) bring to light the stakes concerning aspects of social inclusion that emerge with ICT platforms, and (2) articulate critical points of inclusion, enabling women farmers to access and use technological innovations. Feminist economic research has thus provided methods for the consideration and interpretation of gender relations within policy intervention and knowledge-based platforms. Institutional economics studies show the need to consider different social groups within the target audience, as well as the collective rules structuring economic activities, in order to avoid processes of exclusion in advisory services. Service economics has shown the importance of interactions between service providers and clients in guaranteeing service quality.

Emerging stakes emanate from this research, opening a new research agenda containing a set of sensitive issues with regard to: (a) the nature of platforms, where there is an attendant risk that economic objectives are prioritised over aspects of social inclusion when platforms are not implemented with public means; (b) their business model and fragility when financial sustainability is not secured and; (c) ways of organising knowledge flows between the global North and the global South, whereby the technical content of platforms could be contributing to possible lock-in effects. Together, these critical points reveals a new sphere of policy intervention for the Kenyan Government. The thesis findings indeed show that it is expected of ICT platforms to support the Kenyan Government in achieving its gender equality objectives. The results provide evidence in a large diversity of platform types and financial patterns nonetheless, where the most dominant actors in platforms could impose their visions of what is

considered as gender equal. Thus, ignoring these specificities may make these platforms into new drivers of exclusion via a substantial digital gender divide. On the other hand, recognising different conditions for inclusion and taking them into account can bring to light powerful levers for improving their efficiency.

CHAPTER 1 - Emerging digital gender divide between farmers?

This thesis is based on the case of Kenya and the following research question: Are information and communication technologies in agriculture inclusive of women farmers?

As previously mentioned, the research question emerged through field experiences in Kenya, during my time as a development worker.

Certain development agencies and research studies emphasise that female farmers in developing countries are less prone to adopt certain agricultural practices compared to male farmers. In this respect, I found low adoption rates among small-scale female farmers in project evaluations by the NGO that I worked for at the time. To me, this implied that the knowledge and the type of methods for knowledge dissemination were most likely not adapted to these women's demands. Such a situation is problematic because of women's important role in agriculture in Kenya. Moreover, given that the population in this country has more than tripled over the last 50 years, food security is a top priority for the Kenyan Government. Therefore, how female farmers access and use knowledge that is relevant to them in order to sustain farm yields, has become a key concern.

In parallel, based on observations from conferences and meetings with government officials, researchers and development workers, and according to administrative reports from the Government of Kenya, women residing in rural areas and working on farms are prioritised in public intervention programmes. One particular objective is to ensure adequate access to technical knowledge.

In this regard, the Government of Kenya prioritises the dissemination of agricultural knowledge via information and communication technologies (ICTs). Farmers are supposed to access these technologies via the use of the internet. In Kenya, internet connectivity has made significant progress over the last decade (particularly since 2009, when the country introduced optic fibre). The Government also directs its initiatives towards rural areas and agriculture. Concomitantly, since the 1980s Kenya has reduced its ratio of frontline extension worker to farmers. The specific objective is to reach a rapidly increasing population with reliable and relevant knowledge in a more effective way compared to traditional agricultural extension services intervention. The Government explicitly prioritises female farmers.

Hence the question: do these emerging devices in agriculture have the ability to be inclusive of women farmers? Or do they have the potential to create a new gender divide? To get an understanding of the relevance of the issue, this chapter is divided into four main sections. The first section discusses research on female farmers' demands concerning agricultural knowledge, given women's important role in agriculture. The second section presents the debates related to the impacts of policy reforms in the agricultural advisory services sector, on the demands of farm women in developing countries. The third section analyses the literature dealing with the ability of ICTs in agriculture to include women farmers and their demands. The fourth section presents the case of Kenya.

1.1. Demands of women farmers and their role in the agriculture sector

The following section presents the reasons why female farmers are given increased importance in public policy intervention in sub-Saharan Africa, that is, as a result of their fundamental role in agriculture.

1.1.1. The key role of women in agriculture

At a global scale, the agriculture sector will need to produce 70 to 100 percent more food by 2050 to feed 9 billion individuals (Godfray et al. 2010). Sub-Saharan Africa has experienced the largest population growth in the world over the last 55 years (United Nations Population Division 2018b).

Figure 1.1 presents the annual growth rates from 1960 to 2015 in different regions. Figure 1.2 shows the population growth in absolute values from 1960 to 2050 in different regions (United Nations Population Division 2018b). Over 55 years, the sub-Saharan region had the highest compound annual growth rate (2.7%), followed by Middle East and North Africa (2.6%). Third comes Latin America and the Caribbean (1.9%), East Asia and Pacific (1.4%) and finally Europe and central Asia (0.6%). Over 55 years, the population in sub-Saharan Africa has multiplied by 4.4 (United Nations Population Division 2018b).

With its average annual growth rate at 2.7%, the sub-Saharan African population will continue to increase rapidly until 2050 (cf. Figure 1.2). Hence, governments in this part of the world are under pressure to ensure the implementation of adequate policy objectives for the agricultural sector, so that their farming population can produce enough food (Hazell et al. 2010; Collier & Dercon 2014). It is also the region with the highest risks of famine, implying that a food shortage crisis in this part of the world is a possible future situation (Dethier & Effenberger 2011).

In this context, Dethier & Effenberger's (2011) review of the economic literature on agriculture, focuses on subjects that are critical to agricultural productivity and poverty reduction in sub-Saharan Africa. They conclude that highly pressing problems for agricultural growth in this region related to property rights, agricultural extension, rural infrastructure and food price stabilisation must be dealt with. Moreover, farmers need improved ways to cope with unstable yields and price volatility, outlined through public policy intervention and implemented via institutional coordination[7]. Yet this is highly complex. *"The most pressing issue at present is to make progress on food security and put in place effective coping mechanisms for poor people…The best instrument to protect small farmers from income shocks is to increase agricultural productivity – but that is the most scientifically and institutionally difficult challenge."* (2011, p.200).

Undeniably, there are a number of challenges that must be dealt with urgently to avoid a food crisis in this part of the world. Hence, sustainable agricultural systems and production of food is fundamental.

[7] See Appendix 3 for further explanations on institutional coordination.

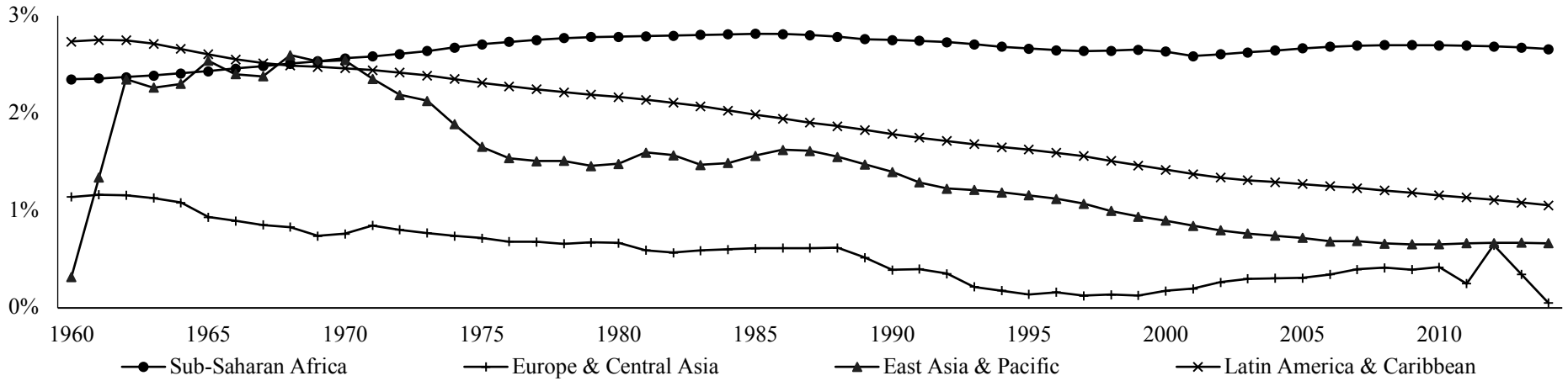

Figure 1.1: The annual growth rate in percent of absolute values of the population from 1960 to 2015 per region. Source: (United Nations Population Division 2018b).

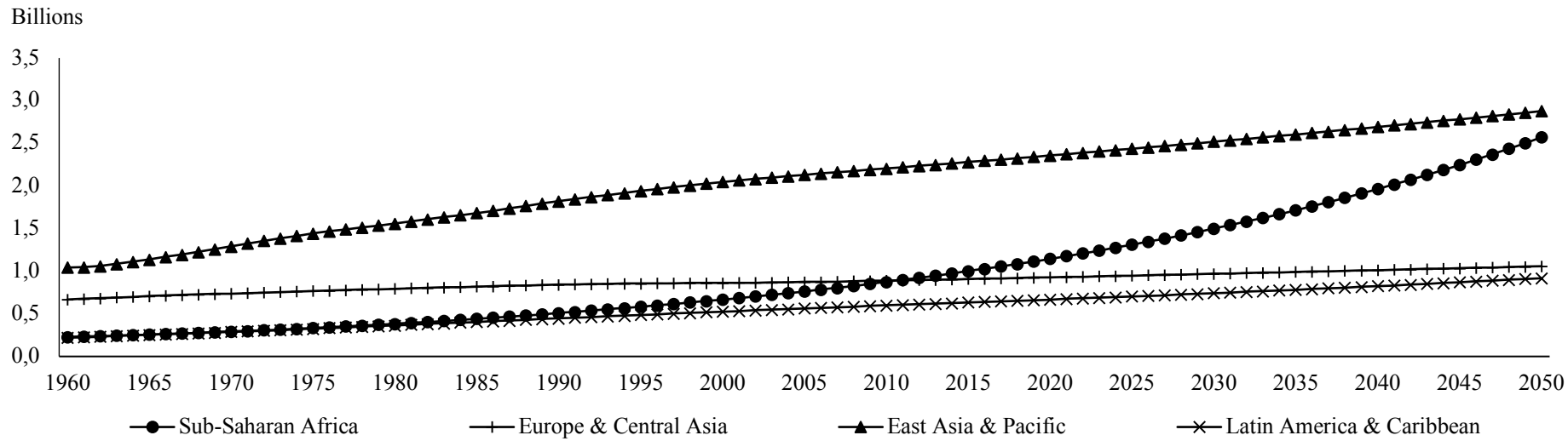

Figure 1.2: Population growth in absolute values from 1960 to 2050 per region. Source: (United Nations Population Division 2018b).

The agricultural sector is an important contributor to the GDP growth in this region. In average it accounted for 18% of the GDP growth in sub-Saharan Africa in 2015. In comparison, Latin America and the Caribbean or Europe and central Asia have an approximate GDP growth of 5% and 2% respectively (The World Bank 2017). In this context, Hazell et al. (2010) discuss the role of agriculture in development. They show that a limited number of countries have achieved economic development without significant growth in the agriculture sector. In most low-income countries, a majority of the population resides in rural areas and agriculture is the main (and sometimes only) source of income for rural households.

The agricultural sector is also the main source of employment in this region (The Food and Agriculture Organisation 2014). About 70 per cent of the world's population is employed in agriculture in low-income countries[8] according to statistics from the International Labor Organization (2016a). Women are the major contributing labour force in agriculture, especially in sub-Saharan Africa (Figure 1.3). Their contribution to the formal and informal economy in this region can therefore not be ignored.

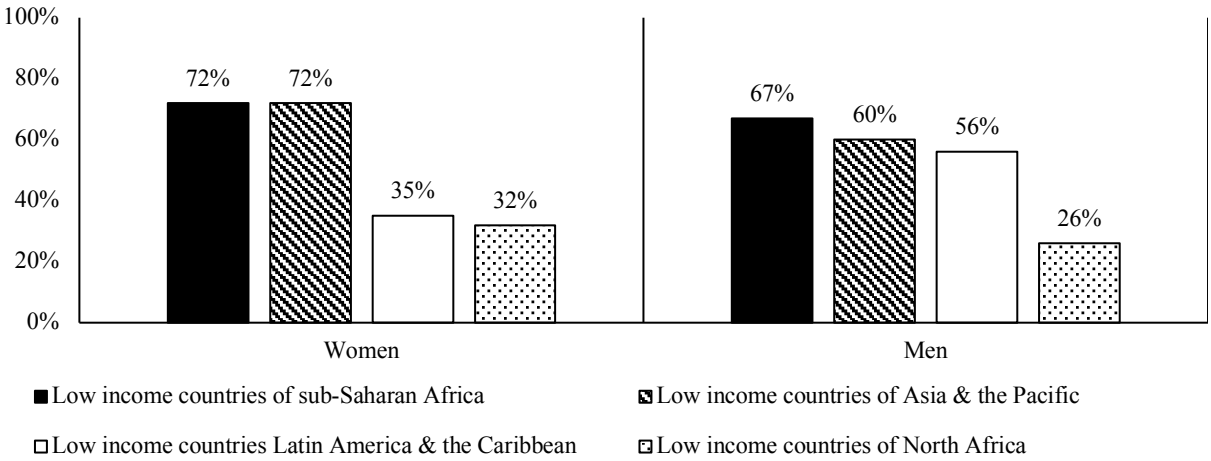

Figure 1.3: Estimated employment distribution rates in the agriculture sector[9] per working active women and men and region. ILO estimates and projections. Source: (International Labor Organization 2016a).

Connected to their key role in the agricultural sector, female farmers have been prioritised as targets of public policy intervention in agriculture by several governments in this region, particularly since the beginning of the 2000s.

[8] For the current 2018 fiscal year, low-income economies are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of $1,005 or less in 2016; lower middle-income economies are those with a GNI per capita between $1,006 and $3,955; upper middle-income economies are those with a GNI per capita between $3,956 and $12,235; high-income economies are those with a GNI per capita of $12,236 or more (The World Bank 2018)

[9] Methodological note: This indicator provides information on the importance of agriculture (as an economic activity) with regard to employment (ILO 2017). Employment comprises all persons of working age who during a specified brief period, such as one week or one day, were in the following categories: a) paid employment (whether at work or with a job but not at work); or b) self-employment (whether at work or with an enterprise but not at work). The figure presents the employment distribution rates in the agriculture sector per gender and aggregated countries, classified as low-income, in respective regions.

1.1.2. The importance of female farmers in policy intervention in agriculture

In most sub-Saharan African countries, women farmers in rural areas are prioritised in public policy intervention. Such priorities were outlined in the 2003 Maputo Protocol[10] and at the launch of the African Women's Decade during the International Day for Rural Women in Nairobi 2003 (UN-Non-Governmental Liaison Service 2010). The African Women's Decade was based on 13 critical thematic areas (in turn based on the 13 themes of the Beijing Platform for Action 1995) (UN-Non-Governmental Liaison Service 2010). These thematic areas are concentrated around:

- Fighting Poverty and Promoting Economic Empowerment of Women and Entrepreneurship
- Agriculture and Food Security
- Health, Maternal Mortality and HIV-AIDS
- Education, Science and Technology
- Environment and Climate Change
- Peace and Security and Violence Against Women
- Governance and Legal Protection
- Finance and Gender Budgets
- Women in Decision Making Positions
- Young Women's Movement

Through these conventions and networks, women are recognised as having a key role in agriculture.

Indeed, in several sub-Saharan African countries, public policy objectives target female farmers. Governments are encouraged to implement measures for integrating gender equality into policy intervention drawing on two different rationales: affirmative action and gender mainstreaming. These measures are in place to reduce the inequality gap between women and men.

Selanec & Senden (2011) define affirmative or positive action as: *"measures that entail some type of preferential treatment for members of the group in a socially disadvantaged position. It is based on the implicit assumption that positive action must challenge the formal understanding of sex equality, which insists on the principle that men and women ought to be treated consistently according to the same standard of treatment. Positive action measures must be intended to benefit members of the disadvantaged group. In that respect, they always entail, at least implicitly, a sex-based preference."* (2011, p.4).

Subject to different critiques related to the lack of consensus upon the definition of affirmative action, implementation strategies for gender equality integration shifted in 1995. At the Beijing Women's Conference, gender mainstreaming started to become incorporated across all fields of policy-making, replacing affirmative action in certain fields of intervention.

Gender mainstreaming can be defined as *"the (re)organisation, improvement, development and evaluation of policy processes, so that a gender equality perspective is incorporated in all policies at all levels and at all stages, by the actors normally involved in policy-making."* (Debusscher, 2011, p. 40, referring to Council of Europe, 1998, p. 13). Gender mainstreaming was developed for supporting policymakers to integrate gender equality into public policies

[10] The Protocol has been ratified by 36 out of 54 African countries. Kenya is one of them.

(Dauphin 2010; Walby 2005). The gender equality rationale has proven adequate in certain policy contexts, particularly as a constant reminder to integrate gender equality objectives into different types of activities across 'non-gender' projects or within the process of budgeting (Debusscher 2011).

Both affirmative action and gender mainstreaming have however been criticised for having a vague discourse (Verloo 2005; Stratigaki 2005), especially the latter (Woodford-Berger 2004; Bock 2015). As a result, the effectiveness of these two measures in ensuring gender equality in policy work remain under scrutiny.

Hitherto, such types of targeted policy intervention in the agricultural sector have been linked to women's key role in farming and, in this respect, their demands. Evidence from different studies show that female farmers have particular demands when it comes to agricultural knowledge.

1.1.3. Women farmers' demands for agricultural knowledge

When it comes to the types of access to and use of knowledge, women farmers' demands differ from those of men farmers. Even if we consider only a limited economic dimension of knowledge, the complementarity of the rationales behind the role attributed to this resource for women farmers has been highlighted by several authors (Doss 2001; Quisumbing & Pandolfelli 2010; Doss & Morris 2001). Access to and use of knowledge have been identified in the literature as components structuring the demands of women farmers.

Reports by development agencies posit that female farmers have unequal access to knowledge (The Food and Agriculture Organisation 2014; The World Bank 2009). Female farmers in low-income countries face various constraints to access to knowledge, inputs and services, as stated in the report by the Food and Agriculture Organisation (2014). The authors of the report stress that this results in a difficulty to innovate, making these women less likely to adopt different agricultural practices.

Similar findings are reported by the World Bank in the 'Gender in Agriculture Sourcebook' (World Bank 2009). Case studies presented in the report provide evidence of several factors generating this exclusion and hindering women farmers from accessing different types of resources, such as knowledge. These barriers relate primarily to social status and cultural dimensions. It is moreover highlighted that, based on biased representations of intra-household dynamics in public policies in developing countries, agricultural knowledge and technology transfer are not adapted to their needs. It is for instance assumed that husbands will transfer the knowledge to them, which is not necessarily the case, and if there is indeed a transfer, it might not meet women's demands.

Regarding technical content, female farmers have demands that differ from those of male farmers, because they are placed in particular social relations. As a result, women farmers use resources for different reasons relating to the social context in which they are embedded (Haile et al. 2012) and, in this particular case, knowledge. In a review of the literature, Doss (2001) shows that this economic resource is used by female farmers for producing nutritious food crops, increasing farm yields and ensuring food security for the family. Knowledge is also used for investment purposes (purchasing livestock, land, property) (Johnson et al. 2016), and for more personal reasons, enabling women farmers to integrate the community (for knowledge exchange via different farm groups) (Quisumbing & Pandolfelli 2010). The latter can also be a

strategic line of reasoning used by women to secure economic returns (Baden 2013) and to gain access other resources and markets, collectively or individually (Fischer & Qaim 2012).

Moreover, findings from Quisumbing & Pandolfelli's (2010) literature review stress that women farmers a triple role in agriculture (responsible for domestic, productive and often community management), which is an important aspect to consider for the construction of a knowledge dissemination system. As a result, they have different demands with regard to on-farm and off-farm activities. Such demands relate to:

(1) farm activities (crop farming, livestock advice, access to markets to sell their produce, crop prices);
(2) side-business activities (record keeping, opening of bank account, how to access affordable loans); and
(3) women's role as care workers (nutrition, health, child care).

The authors in this study posit that such divergence between demand and supply of services must be addressed to improve the livelihoods of this group of women. Similarly, in the report by Meinzen-Dick et al. (2014), the authors assume that content must be adjusted to the demands of female farmers, for them to increase agricultural productivity. Deen-Swarray et al.'s research report from 2012 concludes that farming represents a source of income for these women, as well as being a domestic activity and a source of security. Hence, as a result of women farmers' involvement in different economic activities, their demands for knowledge are diverse. In other words, because of their particular integration in social relations, their demands for technical knowledge vary and differ from those of male farmers.

In this respect, development actors and certain authors indicate that women farmers' demands for knowledge are not adequately considered in policy intervention. Hence, although interventions via gender principles have been made to address a gender bias in advisory services, the shortfall continues between the type of support and the demands of women farmers.

One key economic resource in agriculture and for this group of women is that of knowledge. Agricultural extension services are crucial in providing female farmers with technical content to sustain/increase farm yields.

1.2. Greater inequality for women farmers with regard to advisory services after policy reforms

Given women farmers' demands for certain types of agricultural knowledge and their key role in agriculture, they need help to inform their technical choices. Research studies show however that major policy reforms have increased gender inequalities, by not facilitating female farmers' access to advisory services and their use of the technical content. This is an outcome that became particularly evident after the policy reforms that occurred in the 1980s/1990s.

1.2.1. A profound alteration with the structural adjustments: increased privatisation of farm advisory systems

Agricultural extension services' support systems in sub-Saharan Africa were strongly impacted by the policy reforms that occurred via the structural adjustment programmes during the late

1980s/early 1990s, in the context of the Washington Consensus[11] (Rusike & Dimes 2004). As a result, several African governments shifted their interventions and Kenya was one of these countries. These large reforms profoundly altered the policy landscape in this region (Hugon 2013).

A substantial portion of the economic policy reforms and instruments were adopted by several sub-Saharan African countries (Hugon 2013). This included the dismantling of state marketing boards, trade liberalisation, reduced inflation, and increased privatisation of state enterprises and services. Regarding the latter, in the 1990s, more than 50% of the state-owned enterprises were divested in several African countries[12].

Rusike & Dimes (2004) shows that 40 out of the 47 African countries implemented economic policy reforms in agriculture in the early 1990s. In several of the sub-Saharan African countries, governments decided to introduce a mix of policies and public investment to encourage private sector development and new forms of public-private partnerships (PPPs). It also involved non-governmental organisations to speed up technological change. Due to the difficulties met by the public extension services system, donors started promoting private sector-driven agricultural research and development (R&D) and technology diffusion in African countries. The idea also became prevalent that markets could provide high-powered incentives motivating private-sector managers to work harder compared to public sector administrators. Thus, under the structural adjustments, it was expected of the private sector to increasingly take over in certain areas of policy intervention (Hugon 2013), in particular public farm advisory services (Rusike & Dimes 2004).

In this regard, the structural policy adjustments and reforms led to large budget cuts in public farm extension programmes (Rusike & Dimes 2004). In addition, there was a decline in donor support and private-sector funding. As a consequence, public sector extension services were dismantled, leading to an increased privatisation of these services. It also resulted in a substantial reduction in the number of extension officers and in a range of farm advisory services available to farmers (individual visits to the farm, face-to-face interaction, personalised advisory services). Demand-driven farm advisory services were introduced (Snapp et al. 2003; Ong'ayo et al. 2016), where it was expected of farmers to request for a service, based on their needs (Davis 2008). As such, demand-driven services depended on a farmer's ability to articulate her/his needs, to be aware of and have easy access to services which she/he believed could provide a solution to the problem at hand (Garforth et al. 2003b). These reforms created exclusion of certain social groups, however, especially female farmers (Elson 1995).

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[11] The Consensus was originally used to describe a list of ten economic policy reforms (Williamson 1993; Williamson 2004; Gore 2000; Stiglitz 1999). These instruments are: (1) fiscal deficits or budget deficits should be small enough to be financed without recourse to the inflation tax; (2) public expenditure priorities implying that public expenditure should be redirected from politically sensitive areas that are receiving more resources than their economic return can justify to neglected fields with high economic returns, having the capacity to improve income distribution, e.g. health, infrastructure and education; (3) tax reform in order to broaden the tax base and so to cut marginal tax rates; (4) market-determined interest rates for financial liberalisation; (5) unified exchange rates at a sufficiently competitive level to induce a rapid growth; (6) trade policy: trade tariffs should replace quantitative trade restrictions (at a rate of approximately 10-20%); (7) abolition of barriers implying a more promising entry of Foreign Direct Investment (FDI); (8) privatization of state enterprises; (9) deregulation, i.e. elimination of regulations that hinder the entry of new firms or that restrict competition; and (10) provision of secure property rights, mainly in regards to the informal sector.

[12] Namely: Central African Republic, Cote d'Ivoire, Gambia, Ghana, Guinea Bissau, Kenya, Mali, Tanzania, Togo, Uganda, and Zambia.

1.2.2. Changes in advisory services jeopardised female farmers' access to technical knowledge

Findings from the literature (Bergeron 2003; Barker & Feiner 2004; Elson 1999) show that certain social groups were excluded during the period of the structural adjustment programmes. Jiggins (1989) and Elson (1999) demonstrate that new forms of discrimination for women farmers emerged in the context of the structural adjustments. Empirical evidence show moreover that the demands of female farmers were inadequately taken into account after the reforms (Manfre et al. 2013; Ragasa 2014).

These limitations relate to how the structural adjustments altered the profession of female farmers (Elson 1999). Policy makers and development organisations assumed that farmers would maximise yields if they had access to fertilisers, improved seed varieties and the related advisory services – all of which farmers had to pay for, due to the structural adjustment policies. However, devaluation of the currency in a number of developing countries (e.g. Kenya) greatly decreased farmers' purchasing power (Elson 1993), especially for important agricultural inputs as the empirically-based research report by Ongile (1999) emphasised. As a result, their earning from the farm did not allow farmers to purchase the goods and services required. The result was male out-migration to urban areas to seek employment opportunities. According to Elson (1993) and Ongile (1999), the labour burden upon women farmers increased, and they were consequently not in a position to benefit from the reforms.

Elson (1993) moreover demonstrated that, with the reforms, the gender division of labour increased, as the majority of work was assigned to women and girls. The structural policy changes also restricted the way household expenditure could be used. It implied that: (1) with a heavier workload, women farmers were increasingly bound to the farm, so that they had a limited amount of time to travel to the local extension offices for advice, and (2) less income was available for purchasing services and accessing knowledge. With regard to the latter, female farmers' ability to purchase an advisory service decreased, as compared to male farmers (Ongile 1999). The author mentions that this was a consequence of women farmers generally not controlling the income generated by the household, since they were not the main decision-makers. They were therefore not in a position to purchase services even if these were provided.

This raises questions on the consequences of the reformed advisory methods on women farmers' access to extension services, and thus to technical knowledge. Such questions are particularly relevant in light of the fact that the structural adjustments reformed the main approach in advisory intervention, going from public intervention to a multi-stakeholder approach (Anderson 1999; Feder et al. 2011). The diverse and dissimilar demands of both female and male farmers for technical knowledge could therefore not always be adjusted for at individual level (depending on farm size, agroecological zone, type of cropping system, type of livestock) (Garforth et al. 2003a; Snapp et al. 2003).

In sum, the policy reforms taking place during the 1980s/90s in several developing countries placed female farmers in a difficult position for accessing the knowledge they required to sustain farm yields and to improve their livelihoods. Moreover, as shown in Section 1.1.3, certain aspects of farm advisory policy intervention still today need to be adjusted to fit the demands of female farmers. As a result, governments are exploring new methods via information and communication technologies (ICTs) in farm advisory intervention (The Government of Kenya 2010).

1.3. New information and communication technology devices in agriculture

1.3.1. ICTs in farm advisory intervention: a solution for providing a vast population of farmers with technical knowledge

Major technical changes and ICT developments are occurring worldwide, including in developing countries (Indjikian & Siegel 2005; Martin 2016). According to statistics from the International Telecommunication Union (2018a), in 2016, 96% of individuals in developing countries had mobile cellular subscriptions[13] and 44% had active mobile broadband subscriptions. Moreover, 34% of households had a computer, 40% had internet access at home and 39% of the total population used the internet. These figures do however vary by continent, with ICTs use generally being lower in Africa compared to other regions. Approximately 20% of the total population in Africa used internet services in 2016, compared to 82% Europe. Even though the numbers are lower in Africa compared to other regions, statistics show that the access to and use of various ICTs and internet services are steadily increasing.

Regarding extension services, the literature makes a number of hypotheses on the ability of ICTs to create new opportunities for remote and marginalised farmers (Zanello 2012; Munyua et al. 2009). In the ICT report published by the World Bank, an ICT is defined as: *"any device, tool, or application that permits the exchange or collection of data through interaction or transmission. ICT is an umbrella term that includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers."* (George et al. 2011, p.3). In theory, these technologies could improve the ability of small-scale farmers' in low-income countries to access the knowledge they need to improve productivity (Deichmann et al. 2016; Nakasone et al. 2014).

Based on these promises of ICTs, governments in the sub-Saharan African region are trying out innovative ways via these technologies and the use of the internet for providing their farming population with technical knowledge (Aker et al. 2016; Martin 2016). The use of ICTs is rapidly developing in the farm advisory services sector, particularly in certain sub-Saharan African countries, where it is reflected in public policy objectives. ICTs in farm advisory intervention include radio and television programmes, mobile phones combined with radio programmes, internet kiosks, call centres for farmers and rural tele-centres (Goyal 2010). This is the case of Kenya, Rwanda, South Sudan and Uganda. All countries emphasise the importance of ICTs in the agricultural extension services sector via national extension policies[14].

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[13] Per the International Telecommunication Union, *"Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service that provide access to the PSTN using cellular technology. The indicator includes (and is split into) the number of postpaid subscriptions, and the number of active prepaid accounts (i.e. that have been used during the last three months). The indicator applies to all mobile cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging and telemetry services."* (International Telecommunication Union 2018b). Hence, it implies that the ratio of mobile cellular subscriptions to one individual is 1:1, but that some individuals have multiple subscriptions with different telecom operators whilst some individuals do not have any subscriptions.

[14] Kenya, Rwanda, South Sudan and Uganda have the objective of improving access to markets via technology innovations (using ICTs) to increase agricultural productivity. Kenya and South Sudan are the two nation states that have an up-to-date ICT policy, with a link between the dissemination of knowledge via these tools and farm advisory services (Ministry of Agriculture of Kenya 2012; South Sudan Ministry of Agriculture and Forestry and Ministry of Animal Resources and Fisheries 2011; Ministry of Agriculture Animal Industry and Fisheries of Uganda 2016; Ministry of Agriculture and Animal Resources of Rwanda 2009).

In the empirically-based papers of Van Campenhout (2016) and Van Campenhout et al. (2017), the authors demonstrate that ICTs used in advisory services in selected regions in Uganda (248 households in the 2016 study and 570 households in the 2017 study) can reach a vast farming population. Mekonnen et al. (2015), who draw on data from 85 low-and middle-income countries between 2004-2011, explore ICTs capacity to increase technical efficiency. The only evidence they find in this regard is that ICTs have a 'sizeable' potential to improve farm productivity via more effective knowledge transfer. The authors cited above are nevertheless of the opinion that knowledge dissemination through ICTs is time saving compared to other more traditional farm advisory services approaches.

The above definition of an ICT device is largely defined however. This research is confined to internet-based ICTs in agricultural extension services intervention, which brings us to the following Section.

1.3.2. Internet-based ICTs and knowledge-based platforms in farm advisory services

George et al. (2011), in the report by the World Bank, posit that internet-based ICT solutions have the ability to provide services more cost effectively to a vast farming population (Box 1.1 presents the report). The authors of the report are of the point of view that ICTs should be developed on the basis of financial cost-sharing models, to guarantee their long-term sustainability. Such models are essentially based on different multi-actor set-ups. Here, Lele & Goswami (2017) indicate in their conceptual paper that ICT-based public-private partnerships have the ability to reduce information asymmetries between farmers and agricultural input suppliers.

Box 1.1: ICTs in agriculture and their potential in providing advisory services to marginalised farmers in developing countries

In 2011, the World Bank published the 'ICT in Agriculture e-Sourcebook report' in partnership with infoDev, with substantial contributions from outside experts. The report is part of the programme on 'Creating Sustainable Businesses in the Knowledge Economy'. The Government of Finland financed most of the work. The objective of the report is to provide new insights on ICT progress in agriculture in developing countries. The document was designed to support decision-makers, development organisations and practitioners working at the interface between agriculture and ICTs. The authors of the report have an *à priori* positive stance towards the capacity of ICTs in agriculture to provide female and male farmers in developing countries with technical knowledge. It presents, different types of financial models and solutions for ICT devices in agriculture, in particular PPPs involving international donors, foreign private financiers, non-governmental organisations and governments. To prove their case, studies from various developing countries are presented in the report relating to ICT development in agriculture (i.e. different ICT platforms and smartphone applications providing virtual advisory services to farmers, where some of these technologies are especially targeting women farmers).

These studies do not however provide substantial empirical evidence of the ability of ICTs to supply marginalised and remote farmers with technical content more effectively than traditional advisory services. This is because most case studies are based on small sample groups in scattered regions of developing countries, which makes it difficult to draw any conclusions based on evidence.

Source: (George et al. 2011).

ICTs are thus expected to provide new, innovative solutions at a reduced cost in farm advisory intervention. There is evidence from both the scientific and the grey literature showing that the

use of ICTs in agricultural advisory services is growing[15]. There are also high expectations from various ICTs for supplying services and technical knowledge to farmers in developing countries. A small proportion of this literature shows that ICTs are useful with regard to their effectiveness and performance. Therefore, to get a more in-depth understanding of the type of empirically-based evidence that exists in this field, I have decided to focus on 'internet knowledge-based platforms'. These devices are especially gaining importance in farm advisory services intervention in developing economies.

Recent reports from development agencies such as the FAO or the World Bank posit a growing importance of knowledge-based platforms[16] in agriculture (Food and Agriculture Organisation 2014; George et al. 2011). They reason around the eventual substitution of traditional forms of advisory services with these devices.

Analysis of the scientific literature shows that researchers make the assumptions that ICT platforms in agriculture have a key role to play in the dissemination of technical knowledge (Karippacheril et al. 2013; Courtois & Subervie 2015; Nakasone et al. 2014). A review of the scientific literature on platform development was conducted to cross-verify this hypothesis[17] (Table 1.1). 26 scientific articles and 2 reports from development agencies were identified in the economic literature from the EconLit search engine. All 28 papers focus on platform development in the agricultural sector in developing economies. One additional paper treating of knowledge-based platforms and gender has been added that is from the Google Scholar search engine (Munyua et al. 2009).

Throughout the identified papers, it is assumed that knowledge-based platforms have the ability not only to supply remote and marginalised rural groups with technical knowledge, but also to do so more effectively compared to traditional advisory services. Approximately half of the 29 papers are empirically based, where the authors draw conclusions based either on results from small samples sizes (Karippacheril et al. 2013; Rodenburg et al. 2016; Tata & McNamara 2016; Wawire et al. 2017; Ogutu et al. 2014; Okello et al. 2014; Courtois & Subervie 2015; Fafchamps & Minten 1999; Hudson et al. 2017; Munyua et al. 2009) or with an ambiguous number of respondents (Maarleveld & Dangbegnon 1999; Kadiyala et al. 2016; Jensen 2007; Ravnborg & del Pilar Guerrero 1999).

As a result, it becomes difficult to draw any general conclusions from these papers. 10 of the 16 empirically-based papers focus on platforms' capacity to provide effective services. Few papers in this category analyse the institutional aspects of platforms, or provide evidence on potential factors of social inclusion / exclusion.

[15] A search of the economic literature, using the EconLit search engine, yielded 2,268 papers on ICT development in agriculture, and 1,482 papers on farm advisory services.

[16] As stated in the introduction, based on earlier studies (Zack 1999; Purvis et al. 2001), a knowledge-based platform can be defined as a device accessible via the internet (ensuring sustained access to available knowledge), providing several functions for a given sector, such as: (1) a shared repository for various types of cognitive resources; (2) a virtual space or forum where (a) knowledge suppliers and users can interact, and (b) criteria for assessing the knowledge quality may be discussed, stored, and disseminated; and (3) gateways, providing access to other types of resources, including links to other websites and services (e.g. providing updated market information).

[17] Cf. Appendix 1 for the details of the literature review on knowledge-based platform development.

Table 1.1: Summary of the literature review of knowledge-based platforms in agriculture in developing countries.

Articles	**Target group and data collection**	**Main performance[18] dimension of papers**
Empirically based papers (16)		
Maarleveld & Dangbegnon (1999)	Fishing community in Benin. Group discussions, number of interviews not found.	Collective dimension of platforms [relational performance]
Ravnborg & del Pilar Guerrero (1999)	1,100 rural families part of a watershed users' association in Columbia.	Collective dimension of platforms [relational performance]
Jensen (2007)	300 sardine fishing units in India	Technical performance
Munyua et al. (2009)	Desk study, group interviews and 66 individual interviews with women and men farmers in Botswana, Ghana, Kenya and Uganda.	Inclusive of gender equality objectives [civic performance]
Goyal (2010)	Panel data analysis of the potential in internet-based solutions available to farmers in India	Technical performance
Fafchamps & Minten (2012)	1,000 farmers in India	Technical performance
Karippacheril et al. (2013)	31 individual interviews on working with platform services in developing economies	Technical performance and financial sustainability [financial performance]
Ogutu et al. (2014)	375 Kenyan farmers	Technical performance
Okello et al. (2014)	397 Kenyan farmers	Technical performance
van der Boor et al. (2014)	Panel data analysis	Technical performance
Courtois & Subervie (2015)	396 small-scale farmers in Ghana	Technical performance
Kadiyala et al. (2016)	Women's groups from 15 villages in India. Exact number of interviews not found.	Inclusive of gender equality objectives [civic performance]
Rodenburg et al. (2016)	Interviews with 13 individuals using a platform in sub-Saharan Africa.	Technical performance
Tata & McNamara (2016)	Focus group discussions with 30 extension agents. Based in countries in the Southern Africa region.	Technical performance
Wawire et al. (2017)	136 farmers where sampled and interviewed in two districts in Kenya.	Civic performance
Hudson et al. (2017)	2,313 households, 51.5% women covered, in Ethiopia, Malawi, Tanzania, Uganda	Civic performance
Literature review (7)		
Jensen (2010)	Farmers in developing countries	Technical performance
Aker (2011)	Small-scale farmers in sub-Saharan Africa	Technical performance
Nakasone et al. (2014)	Small-scale farmers in developing countries	Technical performance

[18] Methodological note to read the performance registers: The scientific literature on platform development has been analysed based on four different performance dimensions (i.e. to assess the performance of services supplied to farmers via platforms) (Gadrey & Gallouj 1998; Labarthe 2006; Labarthe & Laurent 2011). The financial performance dimension analyses the short- and long-term financial sustainability of platform services. It includes the profitability of the advisory service (e.g. the annual turnover, annual budget, in-kind contributions to ensure that the needs of social groups are considered in the development of knowledge outcome). It also focuses the type of financial partnerships and the different actors involved to ensure the provision of lasting services to farmers. The technical performance dimension considers the productivity of the advisory service, the level of standardisation and the direct impact of the platform service (i.e. access to the service; terms and conditions of the service). The relational performance dimension comprehends the degree of personalisation of the services, the client loyalty and the nature of the contract between farmer and platform services (e.g. a contract of monthly follow-up, with individual meetings at the farm). The civic performance dimension evaluate the impacts upon different social groups as a result of farm advisory services intervention, and thus in services ability to respond to civic goals. Here, the focus is on different controversies (the health, the environment, inequalities) that are generated because of the dissemination of certain types of technical knowledge, for instance over the use of harmful agricultural inputs, or unconsidered gender structures.

Rodriguez et al. (2015)	Women farmers in developing countries	Inclusive of gender equality objectives [civic performance]
Aker et al. (2016)	Small-scale farmers in developing countries	Technical performance
Deichmann et al. (2016)	Small-scale farmers in developing countries	Civic performance
Nakasone & Torero (2016)	Small-scale farmers in developing countries	Civic performance
Conceptual papers (4)		
Steins & Edwards (1999b)	Rural communities in developing countries	Collective dimension of platforms [relational performance]
Steins & Edwards (1999a)	Rural communities in developing countries	Collective dimension of platforms [relational performance]
Roling & Maarleveld (1999)	Rural communities in developing countries	Collective dimension of platforms [relational performance]
Mukhebi & Kundu (2014)	Based on the case of a platform in Kenya	Technical performance
Reports by development agencies (2)		
George et al. (2011)	Small scale farmers in developing countries	Technical and civic performance; and financial sustainability [financial performance]
The Food and Agriculture Organisation (2014)	Small scale farmers in developing countries	Technical and civic performance; and financial sustainability [financial performance]

The following sub-section presents an analysis of the different performance dimensions of knowledge-based platforms in agriculture in the identified articles presented in Table 1.1.

1.3.2.1. The organisational features of knowledge-based platforms

Analysis of the literature review shows that there is a gradual progression around the conceptualisation of knowledge-based platforms. The special issue in *Agriculture and Human Values* from 1999 introduces the notion of platforms in agriculture as organisational tools in processes of collective action around natural resources management (Maarleveld & Dangbegnon 1999; Ravnborg & del Pilar Guerrero 1999; Steins & Edwards 1999b; Steins & Edwards 1999a; Roling & Maarleveld 1999). While still indistinctly defined in this special issue, recent articles present examples of more concrete platform models and of their organisational forms (Mukhebi & Kundu 2014; Rodenburg et al. 2016).

Furthermore, the institutional dimension of knowledge-based platforms appears in the report published by the World Bank (George et al. 2011) and in the one by the the Food and Agriculture Organisation (2014). The authors from these reports are of the opinion that platforms should be based on models that are economically sustainable in the long-term. The question of financial sustainability is discussed in the literature review by Nakasone et al. (2014). PPPs for platform development are encouraged by Karippacheril et al. (2013). These authors are of the view that such partnerships can ensure financial sustainability of the platforms. Furthermore, development agencies such as the World Bank encourage governments and other stakeholders to develop knowledge-based platforms through PPPs (George et al. 2011). This is based on the assumption that PPPs can address monitoring issues for governments seeking to achieve public policy objectives (George et al. 2011).

There are however controversies in the literature around the development of PPPs (Sclar 2015). At best, such partnerships could help address societal issues of sustainability, equity and efficiency (Miraftab 2004). It is also expected that investors will benefit from such arrangements and serve the strategic objectives of foundations (McGoey 2016), concerned development actors and private investors (Blowfield & Dolan 2014). In this regard, these authors show that this model addresses market efficiency and investor profitability rather than societal issues (Sclar 2015; Miraftab 2004).

1.3.2.2. Platforms' capacity to deliver effective services to farmers

In the agricultural sector, many of the identified papers in economic literature from 2007 onwards focus on different platform performance registers in developing countries. These analyses provide evidence of or discuss by which mechanisms ICT platforms could effectively supply services to farmers.

Jensen (2007) investigates the positive impacts of mobile-based platform services on fishermen in India. Results show that the expansion of mobile phone coverage leads to a reduction in the scattering of fish prices across markets and a decline in fish waste. Findings from Goyal's (2010) study show that the introduction of internet kiosks in India had a positive effect on soybean prices and farm productivity, leading to an overall increase of 33% in farmers' net profits. Jensen (2010) concludes from this review of the literature that mobile-based platforms have positive impacts on efficiency gains and welfare transfers in developing countries (e.g. ICTs can be used to access commodity price quotes in distant markets, resulting in reduced intermarket price differentials). Based on a review of the literature, Aker (2011) examines the likely mechanisms by which ICTs may facilitate agricultural adoption and the provision of extension services in sub-Saharan Africa. The importance of information sharing via ICTs is stressed as key mechanism to contribute to agricultural productivity.

Fafchamps & Minten (2012) analyse the impact of a mobile-based platform services called the Reuters Market Light services (RML). It is an SMS-based price and weather information system provided via the mobile phone, connected to an internet-based database service. The authors find no differences in average benefits for farmers with RML subscriptions as compared to those without. Karippacheril et al. (2013) show that mobile-based platforms have the largest potential to reach the most remote population in developing countries. In their review of the literature, Nakasone et al. (2014) conclude that farmers in developing countries have experienced an improved access to market information services via mobile phones. They find little evidence of the positive effects of market information services on farm prices. Ogutu et al. (2014) examine the ability of an ICT-based market information services project to reduce information asymmetries for farmers in Kenya. Their results show that farmers' participation in the project enhances their participation in agricultural markets and strengthens their bargaining position as a result of reduced information asymmetries. Okello et al. (2014) study the conditions for small-scale farmers' awareness and use of ICT-based market information services. Their findings show that the farmers using this advisory service face smaller transactions costs.

The literature review by Aker et al. (2016) includes examples of ICT platforms developing in sub-Saharan Africa and India are presented and discussed[19]. Analysis from the papers reviewed

[19] For instance, the ESOKO platform in Ghana, the Digital Green platform in India, the National Farmer's Information Services in Kenya, Avaaj Otalo platform in India or the LifeLines Agriculture platform in India.

by these authors recommend that questions relating to trust, quality of information, usability of technology, and heterogeneity of impacts across populations could be integrated on a routine basis into economic studies on platforms. The authors conclude that accessing ICTs, such as platforms, could improve women and men farmers livelihoods. The authors are however of the opinion more effort should be put into adjusting ICTs more to farmers' demands (based on needs assessments). In this review however, there is a large volume of grey literature[20], and the sample sizes of the empirically-based scientific papers cited in the review are not mentioned. These recommendations therefore remain under scrutiny.

Some studies analyse the performance of a particular platform: Tata & McNamara (2016) analyse the 'Farmbook' platform in the Southern Africa region; Rodenburg et al. (2016) assess the 'AFROweeds' service and 'Weedsbook' platform in the rice value chain in sub-Saharan Africa; Courtois & Subervie (2015) examine the 'ESOKO' platform in Northern Ghana; and Wawire et al. (2017) base their case study on the 'KACE' platform in Kenya.

Overall, these authors make the hypothesis that platforms have a key role in effectively disseminating technical knowledge to farmers, at a reduced cost for governments in developing economies.

1.3.2.3. The gender dimension of platforms

Female farmers' access to ICTs, such as platforms, is a topic under debate. Scientific studies makes the hypothesis that platforms have a higher potential compared to traditional advisory services in reaching the most vulnerable strata of the population (Aker 2011), in particular women farmers (Kadiyala et al. 2016). Per the report published by the World Bank, platforms have the potential to address current gaps in access to knowledge, especially for disadvantaged groups, such as female farmers (George et al. 2011). In that sense, some authors make the assumption that platforms can be inclusive tools, based on certain conditions, giving female farmers better access to available technical knowledge.

In the empirically-based paper by Munyua et al. (2009), the authors examine the potential of platforms to provide knowledge to farmers and to increase farm yields. 66 interviews were carried out with technical staff working with ICT development in agriculture in Botswana, Ghana, Kenya and Uganda. The authors show that these tools support small-scale farmers, especially women, to enhance their livelihoods. In this regard, Karippacheril et al. (2013) are of the point of that mobile-based platforms may have the largest potential to reach the most marginalised part of the population. The main reasons put forward by the authors are the low cost of mobile phones, ease of usability and accessibility, and increasingly expanded network coverage in developing countries. It is also highlighted in this study that policy makers will need to revise strategic frameworks to stimulate mobile-based platforms, for instance by basing them on PPP models, and promoting openness, collaboration and competition[21].

Hudson et al. (2017) present a framework that equates internet-based platform services with radio programming for the purpose of enhancing interactivity and farmer participation (for instance via follow-up SMS services). The technology is presented as a type of ICT platform

[20] Aker et al. (2016) report that, of the total number of cited papers from the literature (i.e. 109 papers dealing not only with platforms but, more broadly, also with other types of ICTs), 38 are grey literature, 60 are scientific papers, 10 are books or book chapters, and 1 is a reference from a statistics database.

[21] Such statements should however be interpreted with caution as their empirical study is based on a limited number of interviews with individuals (n=31) working with platform development in the agricultural sector.

according to the definition presented in this research. Ethiopia, Malawi, Tanzania and Uganda are studied in the paper and 2,313 households' listeners of a particular radio programme were surveyed. Slightly more than 50% of the respondents were women farmers. The authors discuss the potential of this approach to enhance women's participation and access to information via platforms through the use of radio programmes (as additional communication mean). Findings show that combining platform services with interactive types of agricultural radio programmes have a large potential to reach women farmers, but it does not guarantee adoption.

Against this background, part of the research community is in the opinion that the question of content in technology and innovation policy is important to avoid an increasing gender gap. In their review of the literature, Nakasone & Torero (2016) conclude that developing ICT-based services for farmers is a complex task because of the high level of heterogeneity (i.e. among different groups of farmers, and each with dissimilar demands). Wawire et al. (2017) and Hudson et al. (2017) share a similar view when they put forward criteria that should be considered in platforms to ensure that they are socially inclusive. These include socio-economic characteristics (marital status) and ICT services and approaches that interest female agricultural workers (interaction with peers[22]).

Based on a review of the literature, Rodriguez et al. (2015) examine the information-seeking behaviours of rural women in Africa, Asia and South America. Their findings show how emerging ICTs are promoted by development agencies and various donors as solutions for providing services to women farmers. This is particularly true of web-based platforms, given their multi-functional features. The authors however question this agenda, and ask why platforms are promoted as a universal solution capable of addressing rural women's needs, compared to other types of service providers and methods.

Conclusively, this literature review shows a limited number of empirically based scientific articles that provide evidence in the ability of platforms to supply knowledge to farmers. The scientific review moreover provides evidence that there is still little empirically-based data to validate the hypotheses made by scientific research and development agencies. Furthermore, it appears that the scientific papers are still based on fragmented approaches of platform performance. Papers that articulate the different dimensions of platform performance in agriculture could not be identified. It thus becomes difficult to determine general rules as to how different groups can make the most of internet-based ICTs, such as platforms.

The review shows, however, that high expectations are placed upon these devices from both the scientific community and development agencies. As a result, several governments in sub-Saharan Africa are venturing into these technological innovations to provide female farmers with adequate advisory services more effectively.

Conversely, certain authors maintain that internet-based ICTs could increase the existing inequality gap between women and men, possibly leading to a new gender divide. Others make the hypothesis that these technologies have the potential to supply marginalised and remote rural groups, especially women farmers, with agricultural knowledge.

[22] With regard to the latter, Mekonnen et al. (2017) show the importance of informal networks to Ethiopian women farmers in their empirically-based paper on a survey of individual farmers (n=680). They find evidence for a statistically significant and positive relationship between female farmer networks and (a) the adoption of farm technologies, and (b) productivity yields.

1.3.3. Emerging issues with the introduction of ICTs in agriculture

Alongside the literature on platforms, there is research on ICTs and their contribution to a gender divide. Findings from this part of the scientific literature has been used to get a better understanding of platforms possible contribution to this divide. In this context, analyses based on the economic literature review show that assumptions regarding the potential of internet-based ICTs to supply services to farmers are supported by limited empirical evidence. The literature also presents emerging stakes around the development of ICTs and their ability to be socially inclusive. The subjects under discussion especially relate to accessibility and technical content of ICTs in agriculture.

1.3.3.1. The question of access to and technical content of ICTs

Women's and men's unequal access to material and immaterial resources for using ICTs is a topic under debate. Hafkin & Huyer (2008) stress that the cost of computers or the literacy levels required for internet use could be insurmountable obstacles. Women farmers may additionally experience greater difficulty in overcoming such impediments, and amplified use of ICTs will increase gender inequalities (Hilbert 2011). Authors below discuss such factors or provide evidence supporting them.

In a literature review by Antonio & Tuffley (2014), the term 'ICT access' is discussed. The authors mention that the term has evolved from 'haves' and 'have-nots' to a multi-faceted phenomenon. It consists of four factors regulating access, namely: (1) psychological, (2) material, (3) skills, and (4) usage[23]. In this regard, the fourth factor, 'access-use', particularly emphasises on socio-economic factors such a gender and income, influencing a person's ability to access an ICT service. Moreover, the authors announce that women's relative disadvantage in ICT access is related to different obstacles (material, cognitive) of internet use.

In their review of existing ICT statistics, Hafkin & Huyer (2008) attribute this unequal access to the fact that ICTs are not gender neutral, for they affect women and men differently. The authors make the assumption that women's disadvantaged situation (regarding education, gender roles, employment), particularly in developing countries, reduces their ability to access emerging technologies. The policy implication of this gap in ICT access between women and men is that they will not benefit from the information society to the same extent that men do.

Ensuring that technical content in internet-based ICTs is adjusted to women farmers needs is also emphasised by certain authors. In the literature review by Olatokun (2008), the author concludes that ICTs have created unintended and undesired effects such as deepening the socio-economic divide between developed and developing countries, and between social groups in developing countries, particularly amid women and men. In certain cases, the lack of consideration of women's needs in policy work causes the divide. The author highlights the need for African governments to incorporate female farmers in public policy work, so that they can benefit from ICTs and the opportunities they could generate.

Through an empirically based study, Somolu (2007) explores the way African women have embraced the blogging phenomenon. This author also analyses how blogs are used to promote

[23] *"Psychological access is where the user has little interest in gaining access, or has negative attitudes towards computers. Material access relates to not having the physical infrastructure. Skills access is where a person does not have the digital literacy skills to be effective on-line and usage access is where a person does not have the time or opportunity to access digital information, regardless of their skill level."* (Antonio & Tuffley 2014, p.674).

gender equality and women's empowerment. She stresses that the success of blogging among this group of women relates to the fact that the services and content have been co-produced with women. As a result, blogs have become a virtual forum for knowledge creation and dissemination. Findings show that women respondents (n=21) felt that they could easily communicate and share knowledge via these blogs on various subjects of relevance to them.

In sum, accessibility and technical content are two factors that seem to determine women farmers possibility to make use of internet-based ICTs and the services they may offer. Thus, if these dimensions are not given sufficient consideration in policy intervention, these emerging technologies could contribute to an increasing digital gender divide.

1.3.3.2. Potential gender divide produced by internet-based ICTs

Political and economic development may be hampered by a digital divide that seems to emerge with ICTs, as stressed by Gray et al. (2017). The gendered digital divide[24] can be defined as: *"the differential access and use of ICTs by gender as indicated by lower numbers of women who access and utilize ICTs compared to men."* (Alozie & Akpan-Obong 2017, p.3).

Scheerder et al. (2017) discuss factors leading to a digital divide through a review of current literature. They emphasise that there is a shift from a focus on binary internet access[25] (first-level digital divide) and internet skills and use (second-level digital divide) to a third-level digital divide. The tangible outcomes of internet use are highlighted at the third level. Material (devices) and immaterial (education) access patterns are key determinants to access and use the internet. These authors posit that unequal socio-economic status with respect to gender determine skills and use of the internet. In an empirically-based study covering 15,029 youth (10 to 29 years of age), Badran (2014) shows that there is a significant and negative relationship between Egyptian women and their access to and use of ICTs. The author stresses that internet-based ICTs can produce a divide between non-marginalised and marginalised populations.

Hilbert (2011) questions assumptions put forward in the literature on women's relationship to technological innovations. This author emphasises the dual debate in the literature, arguing on the one hand that technology is not built for women's needs and intuition, and that men are much better users of digital tools (Joiner et al. 1996; Lohan & Faulkner 2004), and on the other hand that women unreservedly embrace digital communication (Davis 2007; Brodman & Berazneva 2007). Hilbert (2011) analysed data sets from 13 African countries and 12 Latin American countries between 2005 and 2008. The findings show that a lower proportion of women access ICTs because of unequal employment, education opportunities and income. The author conclude that the digital divide can be turned into an opportunity. He also makes the assumption that, given women's affinity for ICTs and their potential in improving living conditions, ICTs represent an opportunity to tackle huge challenges of gender inequalities in developing countries.

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[24] Two interrelated aspects of the digital gender gap have been identified: (1) the 'first order gap', associated with access and use of ICTs and; (2) the 'second order gap', relating to the sociological gap of ICTs. The 'first-order gap' refers to differences in access to and use of ICT technologies. As previously observed, the lack of access and inadequate usability are two key dimensions likely to create a digital gender divide. The 'sociological gap' is based on the fact that ICTs are not gender neutral (Alozie & Akpan-Obong 2017).

[25] *"…a binary distinction between those connected to the Internet and those who were not"* (Scheerder et al. 2017, p.1608).

Drawing on sampled data at national level from six sub-Saharan African countries, Alozie & Akpan-Obong (2017) consider the specific constraints to women's active engagement in ICTs. These constrains especially concerns access, use and affordability patterns related to the sociology of ICTs. According to the research report by Deen-Swarray et al. (2012), particular constraints to women's participation in ICTs include: (1) low literacy levels and access to education; (2) time impediments due to their role in agriculture; and (3) geographical location since a higher proportion of women tend to live in rural areas, where ICTs are not widely available. However, the report is based on a number of statistical analyses from a sampled part of the population and qualitative case studies, with small sample sizes from various African countries. As such, it was not possible to draw any general conclusions from this report.

In the literature review by Gillard et al. (2008), the authors conclude that the digital divide can be caused by misrepresentations of women in public policy intervention. Another result, by Hafkin & Taggart (2001), is that stakeholders involved in technology innovation via policy intervention assume that ICTs are gender neutral. The empirically-based research (n=30)[26] of Mumporeze & Prieler (2017) on the case of Rwanda, shows that that a gender digital divide exists in this country in spite of extensive government efforts to eradicate such gaps. The authors assume that it is as a result of women's unequal access to education and ICTs, as well as socio-economic barriers (responsibility of care, lack of self-confidence and computer-use anxiety). Other results by Gilberds & Myers (2012) in their evaluation of an ICT research programme in sub-Saharan Africa, is that misplaced priorities in multi-actor intervention exacerbates this divide. Conflicts of interest among stakeholders is cited as one example.

Fuchs & Horak (2008) stress that different layers of inequalities (social, economic, political and cultural) are contributing to the digital divide. These authors base their analysis on the case of Ghana and South Africa, analysing ICT-related macro-data. They show that certain types of individuals benefit from ICT services more than others, depending on social hierarchies (age, family status, gender, ethnicity, language, geography). The authors are in the view that this unequal system results in various types of social divide, and that rural women are the most negatively affected.

The digital gender divide is on the agenda worldwide. Empirical research points towards the fact that ICTs could contribute to this divide. The analysis of the literature review reveals three contributing mechanisms, and relates to (1) the assumption that ICTs are gender neutral, (2) maladjusted priorities in multi-actor partnerships, and (3) an implicit [mis]representation of the different needs of women and men. There is hence enough evidence to question the potential contribution of internet-based platforms to the digital gender divide[27], and the underlying mechanisms.

In general, findings from this section show that there is a lack of scientific research demonstrating the potential of ICT platforms to replace traditional advisory services. Results from the literature raise questions about platforms' ability to be inclusive of women farmers, but there are large gaps in the literature, and therefore insufficient evidence in this regard. As a

[26] Mumporeze & Prieler's (2017) findings are based on a sample size with 30 individuals (15 households, 2 interviewees per household).

[27] In the economic literature, no records are found specifically analysing the contribution of ICT platforms (in farm advisory services) to the digital gender divide. Using the research query [platform*] AND [farm* OR agric*] AND [extension* OR advis*] AND [digital divide*] appearing in the paper abstract in the EconLit research engine. The same results appear in the pluridisciplinary database Web of Science when using this research query, using the 'in topic' research field.

result, it appeared relevant to focus on the study of a country which takes seriously the assumption that knowledge-based platforms in extension services will work to include women farmers and their demands. Kenya is emblematic in this regard. It is also a country that prioritises gender equality.

1.4. Kenya is an emblematic country in this context

1.4.1. Kenya: A hub for ICTs in agriculture

Kenya is often cited as an example in reports from various development agencies as a developing country with a high rate of internet use and development of various ICTs across sectors (Asenso-Okyere & Davis 2009; George et al. 2011; GSMA 2015). Box 1.2 presents examples of knowledge-based platforms in Kenya.

George et al. (2011) and GSMA (2015) highlight Kenya is a country particularly prominent in this area, especially known for the mobile money application 'M-Pesa': *"Tech innovations have gained momentum in Sub-Saharan Africa over the last five years. Nairobi in Kenya – referred to as Silicon Savannah – has been the epicentre of this development and has been leading innovations in areas such as mobile money (M-Pesa) and crowdsourcing (Ushahidi)."* (GSMA 2015, p.24), or *"In Kenya, access to financial services more than doubled over seven years to reach two-thirds of the population in 2013, helped by mobile financial services."* (2015, p.32).

In the agricultural sector, Kenya is also cited as a noteworthy example for developing e-services to connect farmers to markets and for accessing farm knowledge[28] (George et al. 2011). Moreover, in the policy brief on knowledge and innovation for agricultural development by Asenso-Okyere & Davis (2009), the case of Kenya is presented as a country promoting innovation in agriculture via public policy intervention and ICTs. Different examples in the area of agricultural extension services from Kenya are cited, namely the ICT KACE platform model. In this context, one device that is increasingly emerging in Kenya in the agricultural sector is ICT knowledge-based platforms.

Box 1.2: Examples of different ICTs that are being developed in Kenya

M-Pesa mobile phone application

'M-Pesa' (*M* for mobile, *Pesa* is Swahili for money) is a mobile phone-based money transfer, financing and micro-financing service via the use of unstructured supplementary service data (USSD) (Deichmann et al. 2016). The Kenyan telecommunications company, Safaricom launched the technology in 2007. M-Pesa allows users to deposit, withdraw, and transfer money, and to pay for goods and services easily with a mobile device. The phone subscription thus acts as a bank account and debit card (Munyua et al. 2009). M-Pesa is applied in the agricultural sector to, for instance, pay farm workers and purchase farm inputs in Kenya. The ICT solution is used by millions of farmers in Kenya and thus shows their acquaintance with internet services.

M-Farm mobile phone application

The M-Farm application is an SMS-based agricultural market information service, sending crop pricing information via SMS to small-scale farmers in Kenya (George et al. 2011). It is an application

[28] *"Kenya is a country of 5 million farmers, ranging from the smallest subsistence growers to large industrial agriculturalists. It is also increasingly a hotbed of technological innovations such as M-Farm, a mobile service that aims to improve Kenya's agricultural sector by connecting farmers with one another, because peer-to-peer collaboration can improve market information and enhance learning opportunities."* (George et al. 2011, p.58).

that aims at improving farm productivity in Kenya by connecting small-scale farmers with one another (based on the argument that peer-to-peer collaboration can improve market information and enhance learning opportunities). The M-Farm application was developed by a private enterprise based in Nairobi, with financial support from foreign financiers and donors (e.g. the World Bank).

The ICT 'KACE model' – a type of ICT knowledge-based platform
The ICT Kenya Agricultural Commodity Exchange (KACE) model is an ICT-based market information service project initiated by the Kenyan Government, with foreign-based financial support. This platform consists of different e-services (SMS, interactive voice response, radio programmes and internet based services) that aim at helping farmers to get rapid and reliable access to crop market prices (Asenso-Okyere & Davis 2009)., Since its foundation in 1992, the KACE model has gone through a number of stages (Mukhebi & Kundu 2014). In the late 1990s / early 2000s, the KACE started using ICTs for the transmission of market prices to Kenyan farmers. Initially established as a PPP (with financing from the Rockefeller Foundation), certain physical KACE centres in Kenyan counties are presently self-sustaining small enterprises (since the farmer pays a fee for most services). Some centres have nevertheless gone bankrupt due to lack of financial support and have as a result not re-opened.

1.4.2. Knowledge-based platforms in farm advisory intervention gain importance

ICT knowledge-based platforms in agriculture (accessible via the internet) are considered as emerging innovative solutions, providing rapid and affordable services to farmers, even to the most remote and marginalised. Administrative documents of the Kenyan Government show high expectations from these new technologies to increase farm yields and ensure food security (Ministry of Agriculture of Kenya 2012). The ICT Master Plan of the Government of Kenya states that ICTs in agriculture can organise the sector and its small-scale farmers more effectively, thus increasing productivity levels at the farm: *"The [agriculture] sector has a significant contribution to the GDP of 24% […], but the sector is largely informal and inefficient. The indicators of the sector are based on major commodities such as tea, coffee, etc. that are handled with some level of formality. There is an opportunity for using ICT to formalise the sector by collecting data of all farmers on all commodities and to provide a platform to learn about better farming practises to increase production quality and quantity."* (Ministry of Information and Communications of Kenya 2014, p.80).

This specific position of Kenya is also apparent in the scientific literature. Nine of the papers on knowledge-based platform development written from an economic point of view (i.e. from the EconLit scholarly database, cf. Appendix 1) either cover or include Kenya (Mukhebi & Kundu 2014; Wawire et al. 2017; George et al. 2011; The Food and Agriculture Organisation 2014; Deichmann et al. 2016; Aker 2011; Karippacheril et al. 2013; Ogutu et al. 2014; Okello et al. 2014). All of these nine papers deal with platforms in agriculture.

As previously emphasised in Sections 1.3.2.1 and 1.3.2.2, these papers concentrate either on: (a) platform performance in Kenya (Ogutu et al. 2014; Okello et al. 2014; Wyche & Steinfield 2016; Karippacheril et al. 2013; Aker 2011), or (b) the institutional dimension of platforms (George et al. 2011; The Food and Agriculture Organisation 2014; Deichmann et al. 2016), or (c) the development of an existing platform, i.e. the KACE platform (Wawire et al. 2017;

Mukhebi & Kundu 2014). Moreover, Awuor et al. (2013) and Awuor et al. (2016) focus on the conceptualization of a new platform[29].

Results from the literature show that there are high expectations upon platforms' capacity to supply services and technical content to farmers. These expectations relate to the ability in platforms to provide rapid market access to farmers, without having to pass through middlemen (Okello et al. 2014; Mukhebi & Kundu 2014; Karippacheril et al. 2013; George et al. 2011). It is also assumed that ICT platforms reduce information asymmetries and transaction costs (Ogutu et al. 2014). These devices are considered as possible tools to increase the productivity levels for small-scale farmers in Kenya (Aker 2011).

Some authors (and at times the same ones) raise questions regarding the limitations of knowledge-based platforms. Aker (2011) highlights that ICTs in farm extension can become unsustainable (particularly due to their inaccessibility for target groups). Mukhebi & Kundu (2014) present some challenges related to the financial perennity of ICT platforms, which limits the technical capacity of the devices to supply farmers with the services they require. How to address different stakeholder concerns is highlighted as a difficulty by Awuor et al. (2013) and Awuor et al. (2016), when designing and developing a platform in Kenya.

Despite the questions that these ICT devices raise, the opportunities that they may generate for farmers and the agricultural sector as a whole should not be neglected.

1.4.3. Women farmers are targeted with ICT-based farm advisory methods by the Kenyan Government

ICTs, such as knowledge-based platforms in farm advisory services are increasingly being used by the Government of Kenya to disseminate knowledge to their farming population (The Government of Kenya 2010). Women farmers are particularly targeted with this type of emerging agricultural extension method, given their important role in the agricultural sector in this country (The Government of Kenya 2010; Ministry of Agriculture of Kenya 2012).

The agricultural sector is of vital importance due to the large demographic growth the country has experienced over the last 55 years, going from 8 million individuals in 1960 to 46 million in 2015. In 2015, the value added of the sector to the gross domestic product of Kenya was 33% (The World Bank 2016).

Statistics from the International Labor Organization (2016a) confirm women's important role in agriculture. 75% of women were employed in the agricultural sector in 2016, compared to 52% of men. To strengthen this statement, the statistics from the International Labor Organization can be completed with results from the Kenyan population and housing census (PHC) data from 2009. According to the PHC data, a majority of females residing in rural areas[30] in Kenya worked on a farm in 2009. As shown in Figure 1.4, out of the active rural

[29] These two articles do not exist in the EconLit nor the Web of Science scholarly databases and thus are not part of the literature review presented in Appendix 1. They come from the Google Scholar database, discovered through the 'Publish or Perish' software program (that retrieves and analyses academic citations). They are nonetheless considered important, given that the authors demonstrate how to construct a platform (from an engineering point of view).

[30] It is noteworthy that 86% of the Kenyan population resided in rural areas in 2009.

population in Kenya, 55% of women and 47% of men worked at the family agricultural holding[31].

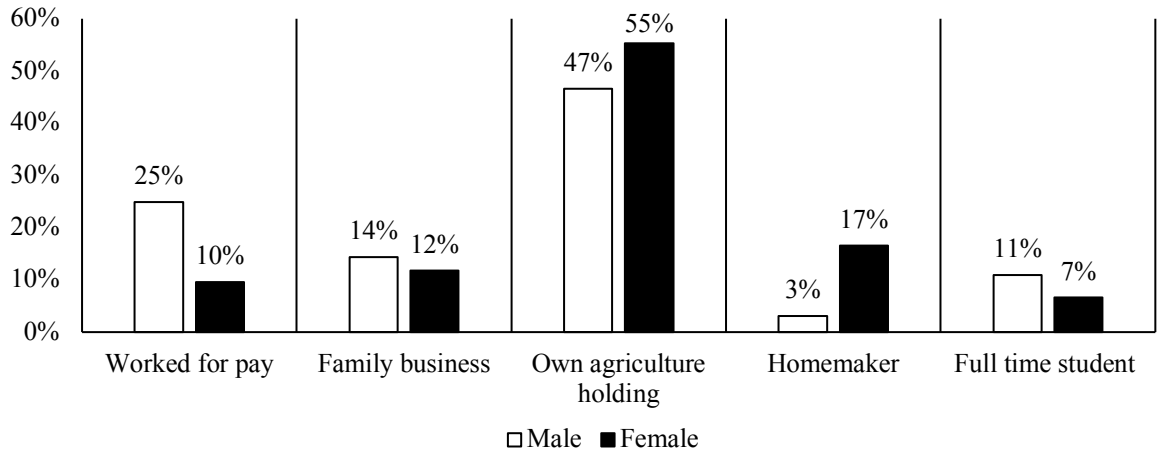

Figure 1.4: Proportion of women and men above or equal to 18 years of age per main economic activities in rural Kenya (n_{women}=6,077,467; n_{men}=5,365,586). (Source: Population and Housing Census Data of the Kenyan Government, 2009, special data processing by the author).

The action guidelines, affirmative action and gender mainstreaming, are used by the Government as an attempt to decrease inequalities between women and men farmers, and exclusion from various resources (e.g. knowledge) and rights (Ministry of Gender of Kenya 2011; The Government of Kenya 2010). *"In principle, existing laws provide for equal rights and privileges for both men and women. However, it is difficult to interpret existing laws through common law and social conventions and ultimately, the equality enshrined in these laws is compromised. Women contribute 60–80 per cent of labour in household and reproductive activities and in agricultural production. Generally, women work longer hours than men. This contributes to their poorer health and nutritional status and high maternal mortality. Traditionally considered heads of households, men have greater access to land, credit and extension services. In schools, girl dropouts make them proportionally less educated than boys. Traditional interventions in agricultural development are likely to affect men and women differently. An effective gender approach to designing and implementing interventions in agriculture would take these differences into consideration, focusing on equality and equity of the outcomes rather than just equal treatment. The Government will develop a gender policy for the agricultural sector to ensure women's empowerment and mainstream the needs and concerns of women, men, girls and boys in all sectors so that they can participate and benefit equally from development initiatives."* (The Government of Kenya 2010, p.81). Here, the Government of Kenya recognises existing gender inequalities in the agricultural sector, where female farmers are especially disadvantaged. A need for specifically targeting female farmers in policy intervention is acknowledged.

Per the ICT Master Plan (Ministry of Information and Communications of Kenya 2014) and the ICT policy of the Kenyan Government (Ministry of Information and Communications 2006), remote and marginalised populations in Kenya, such as women farmers, are especially targeted with ICTs. The aim is for this part of the population to rapidly access knowledge and information. *"The broad-objectives of the IT policy include: a) Ensuring that IT plays a key role as an empowerment tool, addressing gaps relating to gender, youth, people with special*

[31] A higher proportion of women declare working as farmers, homemakers or in charge of a family business. A higher proportion of men declare working for pay or studying.

needs, rural and urban and disadvantaged groups, and as a literacy tool for the population and potential." (Ministry of Information and Communications 2006, p.9). *"Gender issues touch on all aspects of ICTs in development. There is, therefore, need to: a) Ensure the participation of women in ICT policy formulation and implementation at all levels. b) Ensure that ICT policies at all levels are engendered and geared towards meeting specific developmental needs of women."* (2006, p.8). In this respect, it is also recognised that ICT policy objectives must adhere to the needs of the Kenyan female population.

With regard to advisory services, one of the objectives is to integrate gender equality activities into ICT devices (e.g. knowledge-based platforms). Gender equality objectives in advisory services and new approaches (via ICTs) can be found in the National Agricultural Sector Extension Policy of the Kenyan Government (Ministry of Agriculture of Kenya 2012). Moreover, the administrative report, *"A guide for mainstreaming gender in the agricultural sector"*, contains a specifically developed gender mainstreaming 'toolkit' for the agricultural sector (Ministry of Agriculture and Ministry of Livestock Development of Kenya 2010). In the report, it is suggested to put in place verification indicators based on gender norms in new technologies. Hence, the Kenyan Government uses gender mainstreaming and affirmative action for an effective gender equality integration in public policy intervention in agriculture and in ICTs.

1.4.4. Factors excluding for women farmers to adopt ICT devices

The Government of Kenya prioritises female farmers and their demands in public policy intervention via the extensive use of gender action guidelines. Yet this does not necessarily mean that women farmers are included in policies and knowledge-based platforms. Conclusions from this chapter question female farmers' access and use of different types of ICT devices to acquire new knowledge. Thus, inaccessibility to ICT devices and inadequate services, and thus content within them, are presented in the literature as possible factors contributing to a new digital divide. The causes generating such a divide could be related to Kenyan female farmer's unequal access to resources from the outset, which puts them at a disadvantage. It may also relate to overlooked factors in policy intervention, for instance that fact that female farmers prioritise knowledge acquisition through informal structures and/or at collective points. It could also be linked to other mechanisms specific to platforms' operations. Such causes may also be interlinked.

1.5. *To conclude:* ICT platforms ability to include women farmers?

Empirical evidence suggests that the use of ICT knowledge-based platforms in farm advisory service intervention is steadily increasing. However, analyses allowing one to compare their role and capacity as substitutes for traditional agricultural extension services and as socially inclusive devices are lacking. Kenya is used as a case study in this regard and is particularly relevant since this Government targets women farmers with emerging ICTs in advisory services. The literature analysis moreover highlights that ICT platforms in agriculture can spawn a new gender divide and induce new forms of inequality between women and men. These statements are however supported with very limited empirically-based evidence. In some cases, there are entire gaps in the literature, especially regarding platforms' contribution to the digital gender divide. This research aims at filling this gap, based on the following research question: Are knowledge-based platforms in agriculture inclusive of women farmers?

CHAPTER 2 - State of the Art: Information and communication technologies in agriculture and the gender dimension in economic literature

This chapter presents different theoretical frameworks that provide insights into the factors that must be taken into consideration in an analysis of women farmers' inclusion in ICT knowledge-based platforms, in line with public policy goals.

2.1. Theories underlying the models of structural adjustment policy reforms of the 1990s lead to gender inequalities

2.1.1. From state-led to market-led policy interventions in developing countries

Due to difficulties attributed to failures in state-led interventions in several sub-Saharan African countries, a first shift in development thinking to macro-economic reforms occurred in the 1980s (Mellor 1998).

In 1981, the World Bank adopted an 'Agenda for Action', published by the Berg Report (The World Bank 1981). In this report, the organisation stressed that the main causes of the African economic underdevelopment were: (1) poor economic management; (2) bloated and inefficient parastatals; (3) a neglect of agriculture; (4) repressive pricing policies; and (5) failure to exploit Africa's competitive advantage, namely export in the agricultural sector. In this regard, the World Bank suggested major policy reforms through structural adjustment programmes, going from state-led to market-led interventions.

In preparation for the structural adjustments, the Berg Report made the case to: (1) adjust foreign exchange rates; (2) liberalise trade; (3) clarify the role of the state in agricultural production, marketing and grain storage; and (4) decrease the level of taxation on agricultural exports (Hugon 2013). During this period, national policies in various developing countries underwent major structural reforms, with a shift to the market as the main regulating body (Rivera 2008; Van Crowder & Anderson 2002).

In the agriculture sector, the World Bank led the charge to tackle these reforms through various short-term structural adjustments and balancing of payment loans (Eicher 2003). It thus implemented various projects based on liberalisation and trade. The reforms resulted in large-scale restructuring of the agricultural extension services system and the approaches used to supply services and knowledge to farmers.

The second shift was in the 1990s, with a focus on agricultural trade and subsidies, decentralization and privatisation of public services (Eicher 2003). In this context, the agricultural extension service system went through two main restructuring phases from the early 1980s to the beginning of the 2000s in the sub-Saharan Africa region (Anderson & Feder 2004; Faure & Compagnone 2011). These phrases are marked by the establishment of bilateral cooperation between governments in this region and the involvement of international bodies, particularly the World Bank and the FAO (Faure & Compagnone 2011). A diversification of farm advisory services could be observed during these phases. The first period (during the 1980s/early 90s) consisted in the restructuring of the public advisory services system and approaches, implemented by respective governments of the sub-Saharan African countries and

financed by the World Bank. The 'Training and Visit' (T&V)[32] farm extension programmes supported by the World Bank spread across countries in this region. The T&V programmes involved a normative and top-down approach with the aim of improving agricultural productivity (Birkhaeuser et al. 1991). Yet when the World Bank withdrew its finances, it became difficult for governments in sub-Saharan Africa to sustain the T&V system (Davis 2008).

As a result, privatisation of the farm advisory services system was introduced in the 1990s (Carney 1995), epitomised by the Washington Consensus (Rivera 2008). Hence, in this second phase, governments started trying out different types of farm advisory approaches in partnership with private actors (Eicher 2003). They encompassed decentralisation, privatisation, cost sharing, pluralistic advisory services, commercialisation, contracting (in and out) and enhanced participatory processes (Davis 2008). Arguments for the privatisation effect relates to the high costs of sustaining traditional farm advisory systems (Baxter 1987), the difficulty in meeting the demands of a growing population, and unequal access for different social groups (Dinar 1996; Dinar & Keynan 2001).

The policy recommendations during the structural adjustments that encouraged the privatisation of public services (Hugon 2013), and particularly of farm advisory services, were based almost singularly on neo-classical economic theory (Laurent et al. 2006). Advisory services can nevertheless be assessed from different theoretical perspectives, each theory providing fractional and often complementary representations of reality (Laurent et al. 2006; Laurent 2012). This means that there is a need to include in policy design knowledge from different disciplines and plurality of theories within those disciplines. Otherwise, there is a risk of omitting key mechanisms able to structure current economic trends. Yet this is precisely what happened during the restructuring of the agricultural extension services system in the context of the structural adjustments.

2.1.2. The reorganisation of the farm advisory system was based on a number of assumptions

Assumptions partly founded on neo-classic economic theory were the basis of the restructuring of the agricultural extension services system (Laurent et al. 2006).

The work of Dinar (1989) and of Umali-Deininger & Schwartz (1994) was considered as seminal research to use in designing these reforms. These authors compared the performance between public and private extension services, and concluded that they should be complementary to optimise yield output. They however focused on micro-economics, and therefore let limited room in the analysis for coordination mechanisms, institutional compromises, farm types and a variety of technological paths. Dinar (1996) and Carney (1995) moreover, considered institutional coordination to be redundant.

It was assumed that supply could be assessed independently of demand to achieve objectives in farm advisory policies during the structural adjustments, and thus to change to a demand-driven model. Such arguments were based on the hypothesis that the market is the most effective solution for securing the optimal supply of these services, and that individuals make rational choices for decision optimisation (i.e. the farmer knows the service and type of knowledge she or he needs to optimise farm yields) (Dinar 1996; Holloway & Ehui 2001). In

[32] Training and Visit (T&V) extension system, which was promoted by the World Bank in the period 1975-1998 in over 50 developing countries, as a national public extension system (Feder et al. 1986).

this regard, unequal access to extension services is ascribed to market distortions or explained as farmers incapacity to invest in capital or time (Carney 1995).

The technical functioning of farms was considered to be 'non-scale dependent' (Dinar et al. 2007). The size of the farm was studied to model the effect of extension services on one aspect of agricultural production. It was set as a continuous variable, to ascertain the levels of investment in extension services. Presumably, the size of the farm was not considered to have a threshold effect in accessing agricultural advisory services or in producing different types of technical problems. Whether it was a large-scale or small-scale farm, the same type of extension advice was considered equally relevant and inclusive.

Within neo-classical economics, the notion of 'information' or 'information exchange' in national farm advisory policies started to be used in parallel (and at times as synonymous) with 'knowledge' (Holloway & Ehui 2001; Holloway et al. 2000). In this case, knowledge was considered a substitutable good that could be assessed with the same economic categories as other production factors (Holloway & Ehui 2001). Accordingly, microeconomic models were constructed, describing how such commodities were allocated, assuming that the role of extension was limited (especially public extension), and thus reducing coordination costs.

In line with these analyses, the organisations in charge of restructuring public policy in farm advisory interventions decided to give more importance to standardised instruments for extension (Davis 2008; Faure & Compagnone 2011). Davis (2008) gives an overview of agricultural extension services' experience in sub-Saharan Africa since the 1980s, providing a typology of extension models used in this region. Findings from Davis' study confirm that extension services became increasingly standardised in the context of the structural adjustments. The number of actors have also multiplied since the 1990s, as shown by Faure & Compagnone (2011) in their review of the literature. The forms of farm advice oscillate between rationales of accompanying them and rationales of managing them. These interventions are developed by different actors and at times with conflicting agendas. Faure & Compagnone (2011; Davis (2008) maintain that by combining a multi-actor approach (with conflicting interests) and a standardisation of advisory services, there are increased risks and ambiguities weighing on agricultural productivity.

During this period, empirical research has shown that these reforms led to increased gender inequalities across sectors in several developing countries (Elson 1995; Beneria 1995; Verma 2001; Kanji 1995; Lugalla 1995; Barker & Feiner 2004; Whitehead & Tsikata 2003).

2.1.3. Economic models of the policy reforms in the agricultural sector increased gender inequalities

In the agricultural sector, the implemented reforms led to a number of difficulties considered as 'market failures', and increased gender inequalities between women and men farmers. First, it pushed a greater number of women into informal employment. Second, and as a consequence of the first, it led to an increased difficulty in accessing different types of resources. A hypothesis is that it reduced female farmers' access to farm advisory services and technical knowledge.

Evaluations of reformed macro-economic policies and their instruments generated various exclusion mechanisms, in particular for women farmers (Verma 2001). In her conceptual article, Elson (1995) revealed that the theories underlying the models upon which the reforms

rested, created gender discriminations in the labour market. She thus showed how structural adjustment policies contributed to social exclusion[33] for women, stressing that the models were discriminating because they were not conceptualised as a gendered structure[34]. Such issues had already been put forward in Elson's theoretical work from 1993 and the conceptual paper by Whitehead (1979). They implied that the economic instruments of the structural adjustment policies would have to recognise that gender relations were present in all types of economic activities (Elson 1995), since all economic institutions were carriers of gender relations. The author demonstrated that the economic models of the structural policies did not integrate gendered employment patters and, as a result, contributed to this gender equality gap.

In her conceptual paper, Beneria (1995) highlighted the fact that the structural policies of the 1980s/1990s contributed to the sexual division of labour. She discussed a blind spot of the theoretical models upon which the structural adjustment programmes were based that increased gender inequalities. The author shows that the macroeconomic models of the reforms did not consider social relations and women's social integration across sectors. As a result, the visibility of women's work (in the formal and informal sector) and their inclusion in the labour force was unaccounted for.

Barker & Feiner (2004) have completed the findings from Elson's (1995, 1999) and Beneria's (1995) earlier research. The authors show that macroeconomic models treating labour as non-produced inputs are misleading. Their studies indicate that the implicit assumption in such models is that the work required to uphold and reproduce a labour force is independent of its valuation and compensation. When such approaches were applied to the structural adjustments, the full economic costs of such alterations remained heavily underestimated. Most importantly, a majority of the costs fell upon women since they had to increase the number of paid and unpaid working hours. Government spending on social services was moreover reduced with the structural adjustments, forcing families to provide for these services themselves. Costs were thus transferred from the monetised public sector to the non-monetised household sector.

In sum, because social relations where unaccounted for in the economic models of structural policies, the economic value of household labour was not officially taken into consideration. The increased hidden costs and decreased purchasing power of women farmers were consequently overlooked. One posit is that these costs may have reduced in the models the level of opportunities for female farmers to pay for advisory services.

The assumptions of the economic models underpinning the adjustment policies, overlooked the invisible yet fundamental part of women's work, and therefore led to discriminatory gender

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[33] Elson (1995) examines the strategies for introducing gender analysis into macroeconomic models of the structural adjustment programmes. She evaluates the strengths and weaknesses of these models from a gender perspective. The structural adjustments comprised of two major components; (1) aid packages financed by the World Bank, multilateral and bilateral donors and; (2) a bundle of economic reforms. A prerequisite to get financial support from these institutes was to adopt the economic instruments. The processes and implementation of the structural adjustment programmes implied a reconfiguration in political, social and economic powers. It particularly favoured owners of large money capital from international financial institutions in Washington to merchants in recently liberalised markets in developing countries. However, in less favourable areas, this lead to a decrease in public investments, followed by a non-compensation from private-sector investment. Hence, the restructuration stagnated and consequently increased the burden on women via the intensification and extension of their work load.

[34] *"This entails recognizing that the matrix of gender relations is an intervening variable in all economic activities: economic institutions which are not themselves intrinsically gendered, are nevertheless bearers of gender."* (Elson 1995, p.1852).

patterns, including in women's access to and use of agricultural extension services. As Beneria (1995) emphasised, such patterns emerged because social relations are not studied in mainstream economics. In parallel, heterodox economic approaches studied the economic analyses of this period and criticised the policy reforms that took place as part of these structural adjustments (Boyer 2001; Stiglitz 1999). Hence, these alternative economic approaches suggested different approaches to address the gender inequalities in farm advisory services intervention.

2.2. Alternative theoretical proposals to study gender relations in technological innovations

Faced with these market failures in policy intervention, alternative theoretical proposals suggest that the political, economic and social dimensions should be considered in policy design. Recognising these dimensions is also fundamental to a better understanding of the articulation of gender relations in public policy.

2.2.1. Gender and gender relations in public policy

To analyse how innovations through policy intervention can be socially inclusive, we first need to have an understanding of the meaning and profound implications of gender relations. The conception of gender relations is inherently based on a set of values peculiar to a culture (Ferber & Nelson 1993; Nelson 2006; Jennings 1993). Gender can be defined as the social organisation of sexual difference, and relates to cultural constructs in a given society, as opposed to sole biological differences (Ferber & Nelson 2003).

In this regard, Barker & Feiner (2004) define gender as *"…the social organization of sexual difference. Social roles, responsibilities, privileges, and opportunities are allocated according to gender…Feminist scholarship has, however, demonstrated the enormous variation in how societies have organized sexual difference. Recognizing this, gender analysis always need to be historically grounded. As we show, this masculine-feminine coding also varies by class, race, ethnicity, and nation so that what is appropriate for women or men in one group may not be appropriate for women and men in other groups."* (2004, pp.7–8). Here, the authors stress that gender is a social construct, based on power relations between women and men, non-static, valued differently based on cultures and norms within a country.

In *'Histoire du travail des femmes'* ('A history of women's labour'), Françoise Battagliola (2008) highlights that gender is a social construction: *"Historical, sociological, anthropological sciences have mutually informed one another to see 'gender relations' as a product of social construction. Beyond the diverse conceptualisations of these relations, it is a matter of rewriting the history not of women or what is considered as feminine, but of the social relations of gender"* (personal translation from Battagliola, 2008, p. 4)[35].

In this context, in her conceptual paper, Agarwal (1997) defines gender relations from a feminist economist point of view[36]. The author provide evidence that the nature of gender

[35] *« Histoire, sociologie, anthropologie se sont nourries mutuellement pour voir les « rapports de sexe » comme le produit d'une construction sociale. Au-delà des conceptualisations diverses de ces rapports, il ne s'agit pas de faire l'histoire des femmes ou du féminin, mais des rapports sociaux entre sexes. »* (Battagliola 2008, p.4).

[36] *"The nature of gender relations – relations of power between women and men – is not easy to grasp in its full complexity. But these relations impinge on economic outcomes in multiple ways. The complexity arises not least from the fact that gender relations (like all social relations) embody both the material and the ideological. They*

relations is based upon complex power relations between women and men, which are difficult to grasp and impinge on economic outcomes in various ways. Such complexity stems from the fact that gender relations embrace both the ideological and the material.

The ideological and material dimensions appear not only in the division of resources and labour between women and men, but equally in representations and ideas: *"the ascribing to women and men of different abilities, attitudes, desires, personality traits, behavior patterns, and so on"* (Agarwal 1997, p.1). Hence, gender relations are comprised of and help to constitute practices and ideologies, via the interaction with other structures of social hierarchy (race and socio-economic class). These relations are not uniform within a given society, and are socially constructed rather than biologically determined as Ferber & Nelson (2003) have emphasised. These authors consider moreover that 'gender relations' are based on power relations between women and men, which are non-static and non-transposable.

Thus, the understanding of the concept varies between and within countries, based on different values, evolving through cultural interactions and social relations (Ferber & Nelson 1993). It is hence these pre-existing values setting the foundation for deciding whether or not current gender relations are 'honourable' and if a change is needed via policy intervention (Ferber & Nelson 2003).

In sum, there are two key arguments stressed by feminist economists that are fundamental to this research. First, this area of research provides evidence of the invisible part of women's work, which leads to discriminatory gender patterns. It indicates that there is an implicit gender dimension in public policy intervention. Second, feminist economic research has demonstrated that gender relations are context bound, varying within a country and its communities.

Indeed, gender values differ depending on context (Harcourt 2016), and also as reflected in political documents, such as the Constitution of a country. One way of verifying whether gender equality is considered as a human right is for instance to check which countries have ratified Conventions developed by the bodies of the United Nations. One such body is the International Labour Organization's (ILO) and its international labour standards on equality of opportunity and treatment, e.g. Article 1 of the Equal Remuneration Convention (Box 2.1) (International Labor Organization 2017).

Box 2.1: Article 1, the Equal Remuneration Convention from 1951 developed by the International Labour Organization.

The Equal Remuneration Convention (from 1951, No. 100), states in Article 1 that: *"For the purpose of this Convention -- (a) the term remuneration includes the ordinary, basic or minimum wage or salary and any additional emoluments whatsoever payable directly or indirectly, whether in cash or in kind, by the employer to the worker and arising out of the worker's employment; (b) the term equal remuneration for men and women workers for work of equal value refers to rates of remuneration established without discrimination based on sex."*

Source: (International Labor Organization 2016b).

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are revealed not only in the division of labor and resources between women and men, but also in ideas and representations […]. Gender relations are both constituted by and help constitute these practices and ideologies, in interaction with other structures of social hierarchy such as class, caste and race. Neither uniform across societies nor historically static […], they may be seen as largely socially constructed […]. The process of this social construction, however, is inadequately understood, as also how particular forms of gender inequalities are maintained, and by what means they might change over time." (Agarwal 1997, pp.1–2).

As of June 2017, the Convention had been ratified by 173 out of 187 ILO member states. ILO member states that have not ratified the convention are Bahrain, Brunei, Cook Islands, Kuwait, Liberia, Marshall Islands, Myanmar, Oman, Palau, Qatar, Somalia, Tonga, Tuvalu and the United States.

Gender values and norms set via international Conventions can then be ratified by a country, depending on the value granted to gender equality. They are further reflected within national policies. Policy instruments are developed and put into practice to achieve the set policy goals. Depending on the perception of gender in a country, some types of policy areas, such as employment, are subsequently considered to be either feminine or masculine (Barker & Feiner 2004). According to these authors, social responsibilities, roles, opportunities and privileges are allocated based on gender relations. As a consequence, certain types of employment and labour are labelled masculine and others feminine. Hence, gender and gender [in]equality relate to how it is perceived and defined in policy intervention. It could in turn generate certain exclusions for women.

To take the analysis further, gender equality also depends upon the value given to women versus men in a society, reflected in public policy. Barker & Feiner (2004) affirm that women and men are individual human actors socially determined by gender traits and social constructs. Deductions show that to analyse the extent to which policies are inclusive of dimensions of gender, it is important to discuss possible perceptions of 'women in developing countries'. In this regard, Esther Boserup was one of the first researchers to influence the debate on women in economic policy in developing countries. Her view of a woman is criticised by contemporary feminist economists (for instance, Lourdes Beneria, Cecile Jackson, Julie Nelson, and Nancy Fraser). Esther Boserup portrays women, and in particular the 'African woman', as the poorest of the poor, deprived of productive functions and values (Boserup 1989). In the well-known book, *'Woman's Role in Economic Development'*, this author describes this pattern of female deprivation as a significant obstacle to the success of development policies. According to feminist economists, Boserup's work is characterised by a negative focus, for she treats the 'problems of women' in Africa as though they had inherent flaws (Beneria & Sen 1981; McCune 2006).

In addition, in their conceptual paper, Beneria & Sen (1981) stress that Boserup ignored the exploitation of women in global capitalism. Boserup perceived the spread of capitalism as a liberating force for women, arguing that it would free women from domestic subordination. Barker & Feiner (2004) illustrate the contrary, based on an analysis from Beneria & Sen's (1981) critical analysis of Boserup's work. *"Benería and Sen point out the flaws in this view, arguing that even as capitalism spreads, women continue to be economically marginalized, not because they are less productive but because their subordinate gender status is reinforced as they are drawn into female occupations. Moreover, Benería and Sen point out that Boserup overlooks the social significance of unpaid labor performance in households and communities that is necessary to maintain and reproduce labor force"* (Barker & Feiner 2004, pp.102–103).

Contrary to Boserup, contemporary feminist economists stress the necessity of considering social relations in policy intervention. The above-cited feminist economists thus have a different view of a 'woman in developing countries' compared to Boserup. The empirical research by Verma (2001) shows that sub-Saharan African women are considered the most vulnerable strata of local communities, often unprivileged in terms of authority and power. She nevertheless insists on the fact that these women are a dynamic and diverse group of actors,

with heterogeneous objectives and extensive knowledge of their environments and own abilities.

Feminist economist research shows the heuristic value of analysing gender as a social relation. They show indeed that in-built representations of gender relations can discriminate against women in the labour market in policy intervention (Elson 1999). Institutional economics theory may provide methodological tools to fully integrate this dimension in the economic analyses of information and communication technology (ICT) development.

2.2.2. Gender relations a as fundamental social relation

Departing from the beginning of the structural adjustment programmes, it is possible to observe the evolution of gender relations in society. The economic models upon which the adjustment policies were based led to structural crises (Boyer 2001). This included an increased gender equality gap (Elson 1995). As previously emphasised, implicit representations of what is considered gender equal in the political economy, resulted in specific gender discrimination patterns. Empirical evidence from feminist economic research shows such patterns to have negative repercussions on the livelihoods of different socio-economic groups and, as a result, upon the economic growth of a country. It is therefore assumed that 'gender relations' is a type of institution.

'Institutions'[37] remains a relatively extensive term, ranging from habitus and conventions to fundamental constitutional orders, including through laws (Petit 2008). The difficulty is thus how to navigate through this entanglement of institutions in order to understand how fundamental social relations shape economic structures. The French regulation theory[38] may provide a relevant analytical framework for this purpose.

The regulationist approach examines a wide range of institutional forms and social forces directly and indirectly involved in capital accumulation (Jessop & Sum 2006). Regulationists especially stress the complementary functions of mechanisms other than market forces (or exchange relations) in capitalist reproductions, in structuring, facilitating and guiding capital accumulation. These include institutions, collective identities, shared vision, common values, norms, conventions, networks, procedures and modes of calculation. Thus, social relations structure economic activities.

The regulationist research programme developed a variety of intermediary notions describing the processes of capital accumulation and the associated social configurations. Boyer (1986, p. 46) defined the notion of accumulation (or growth) regime as: *"a set of regularities ensuring general growth, which is relatively coherent with the accumulation of capital, i.e. allowing for*

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[37] *« Par ailleurs, ce que l'on entend par « institution » reste souvent assez vaste, allant des habitus et conventions aux ordres constitutionnels fondamentaux en passant par les lois et règlements. La notion renvoie ainsi à tout ce que l'homme met en place pour « régler » la conduite des agents, qu'il s'agisse de contraindre leurs marges d'action ou au contraire d'en élargir le champ (pour faciliter coordination et coopération) »* (Petit 2008, p.219).

[38] In the French regulation theory, the notion of regulation has been used since the 1980s in order to understand how a set of combined adjustment mechanisms over a defined period of time can ensure a certain stability (Laurent 1992), thus, constituting a 'mode of regulation' of the economy. Hence, for this approach, 'regulation' does not only emanate from the market or the State; it also stems from a conjunction of mechanisms contributing to the reproduction of the whole of society (Boyer 1986). In terms of epistemology, the notion of 'regulation' that falls under 'regulation theories' differ from systemic approaches using the notion of regulation (e.g. in biology) (Di Ruzza 1981). This theory is also used to analyse the agricultural sector (analyses of agricultural holdings, land-use planning, institutional compromises in agriculture, etc.) (Laurent 1992; Berriet-Solliec et al. 2008).

the possibility to resorb or spread-out over time distortions or imbalances resulting from the continuity of the process itself." For an accumulation regime to sustainably reproduce, a set of institutional types, procedures and habits are required (Boyer 1986). The mode of regulation is a set of interdependent structural forms. These ensure the compatibility of behaviours in a growth regime, in accordance with the state of social relations, across the contradictions and conflicts emerging in relations between agents and social groups.

In this regard, the economic regulationist research programme proposes five structural (or institutional) forms that underpin the organisation of economic activities in a growth regime (Petit 1998). The five forms are (1) the State; (2) the money form; (3) the labour-wage nexus; (4) international regimes; and (5) organisational forms of economic competition. A structural form can be defined as any codification of one or more fundamental social relations (Boyer 1986, p.48).

The definition of a 'structural form' in regulation theory and of 'gender relations' put forward by feminist economists allows us to analyse how gender relations are considered in economic analysis. I have thus been inspired by these earlier scientific elaborations to classify gender relations as a fundamental social relation in economic development. I hereby argue that 'gender relations' should be considered as a fundamental social relation, and I want to explore how this methodological step will allow to decipher a complex reality. Moreover, by using this type of approach to the research question of this thesis, I expect to be able to reveal the implicit gender dimensions in public policy intervention, thus making them explicit.

Based on previous research by feminist economists, and according to the description of a structural form proposed by the regulation approach, I will analyse 'gender relations' as a social construction, which is perceived and inherently defined within a society based on a set of values specific to a culture. The notion is context bound and not comparable between countries. Thereupon, to understand how gender relations, as a fundamental social relation, interfere with technological innovations in public policy intervention, the research analysis is based on four conceptual foundations.

(1) The way gender relations are articulated in information and communication technologies (ICTs) in the public policy sphere through gender mainstreaming and/or affirmative action (Section 2.2.2.1).
(2) The integration of gender equality dimensions in knowledge-based platforms supported by public policies (Section 2.2.2.2).
(3) The consideration of women in the services and technical content of knowledge-based platforms (Section 2.2.2.3).
(4) The social integration of women defining their ability to access knowledge-based platform services (Section 2.2.2.4).

2.2.2.1. Contemporary gender principles for implementing objectives of equity in public policy and ICTs

It is proposed in gender studies to specifically target women and their needs in policy intervention in any sector (Waal 2010). The same applies to emerging technologies that serve as tools to achieve policy objectives set by a government (Lascoumes & Le Gales 2007; Borrás & Edquist 2013). Some authors suggest that this can be done through the use of gender action guidelines / measures: affirmative action and gender mainstreaming (Lombardo & Meier 2006; Verloo 2005; Stratigaki 2005). It is relevant to get acquainted with these gender principles since

they are used in some of the analysed ICT platforms studied in this thesis to implement gender equality objectives.

Gender studies are not homogenous and have different positions with regard to the ability of these action guidelines to reduce gender inequalities (Box 2.2). A large number of these studies are however critical of affirmative action and gender mainstreaming in their capacity to adequately ensure gender equality in policy work (Dauphin 2010; Stratigaki 2005). Some authors are particularly critical of gender mainstreaming (Walby 2005; Dauphin 2010; Jackson 1996; Bock 2015), and others of affirmative action (Edigheji 2007; King 2007). Some suggest profound ameliorations to these frameworks, especially concerning gender mainstreaming (Stratigaki 2005; Lombardo 2005; Shortall 2015). It is still emphasised nevertheless that the guidelines are necessary to avoid total exclusion of women from the economic and political scene (Davids et al. 2014; Moser & Moser 2005), and that gender mainstreaming is necessary for gender equality integration in public policy development (Waal 2010). Waal does nonetheless mention that certain gender mainstreaming evaluation criteria must be revisited, explicitly targeting women's needs.

In sum, on the one hand, there is a general consensus among the cited authors (cf. Box 2.2) that women and their demands must be targeted explicitly in policy intervention. On the other, a large part of the literature focusing on the effectiveness of these guidelines still remains critical, in particular in ensuring that institutional mechanisms for the inclusion of women are established within policies and their tools. It shows that gender relations and how they are conceived by national public policy is not only a matter of applying certain 'general strategic concepts'; on the contrary, as Woodford-Berger (2004) emphasised in her conceptual paper, they must be adjusted to the social, political and economic context of a country in order to fulfil their expected function. They must take into account that gender values cannot easily be transposed from one cultural context to another.

Box 2.2: Assessment issues of affirmative action and gender mainstreaming

Affirmative action, also known as positive action, has in certain cases proven adequate when it comes to the integration of women in public policy intervention. For instance, the elimination of certain discriminatory factors present in the labour market, such as the principle of having one third women in Government at high level positions (Selanec & Senden 2011). Moreover, in the 1960s, affirmative action enabled women and people of colour to access jobs that had previously been an exclusive white male prerogative (Barker & Feiner 2004).

Affirmative action measures have nevertheless not been implemented without challenges. Even though obstacles to women's employment in traditionally male-dominated occupations have been reduced since the 1960s, men's employment in traditionally female occupations have not risen respectively. In addition to this, wages remain low in occupations considered as 'female jobs'. Edigheji's (2007) research report, based on a South African case study, shows challenges in the integration of women in the labour market with the introduction of affirmative action measures. The report states that to properly implement the measure in public administration processes, a government must perceive the necessity of implementing the guideline. This encompasses building capacity and employing administrative staff working exclusively with affirmative action.

King's (2007) conceptual paper provides evidence of both intended and unintended effects of affirmative action through the use of a policy instrument. The author analyses the way in which certain means to implement affirmative action through the use of quotas as a policy instrument unintentionally reengineered divisions between key groups in American society. The policy

instrument was in this case preferential treatment. On the one hand, the measures decreased the discriminatory gaps in education and certain types of economic activities previously classified as 'white male jobs'. On the other, as a result of not considering the history of the US before the 1960s, the effects of the instrument created divides between and among targeted socio-economic groups, that is, between different groups of women.

Political and economic analysts used quantitative methods to measure the effectiveness of the quota system and ultimately of affirmative action. These analyses failed however to consider the intra socio-economic class divides created by the policy instrument (King 2007), and it was only years later that the discriminatory and unintended outcomes were noticed (in the 1990s). Thus, even with the specific use of strategic gender equality interventions within public policy, discriminatory norms and values remained intact (simply shifted to other minority groups within a larger group, e.g. African American women).

Gender mainstreaming gained in popularity in public policy from 1995 in the context of the Beijing Women's Conference. The approach is analysed by authors such as Dauphin (2010); Debusscher (2011); Stratigaki (2005); Giraud & Lucas (2009); Jenson & Saint-Martin (2003); Walby (2002); Fraisse et al. (2008); Szirka & Szelewa (2009); Shortall & Bock (2015).

According to Lewis (2006), Stratigaki (2005) and Dauphin (2010), affirmative action is increasingly being replaced by gender mainstreaming, although not without criticism. Stratigaki (2005) for instance, stresses that gender mainstreaming should not and does not have the ability to replace positive action measures. She also notes that gender mainstreaming could downplay the importance of gender equality integration in policy matters, due to its weak institutional framework.

In the same line of work, Lewis (2006), pp.426–427 states that *"...mainstream social and economic policy is dominated by a 'sound money, sound finance' paradigm of the neo-liberal project, which means, in an area such as work/family reconciliation, that 'the business case' rather than gender equality likely becomes the dominant frame into which arguments for gender quality must 'fit'...Hence, implicitly (issue of mainstreaming) it depends on what extent it relies on equal treatment, on positive action on behalf of women, and/or measures to promote change in the behaviour and position of both men and women."* Accordingly, policy designers have not focused on the approach to ensure gender equality integration and the different ways of securing it. The author also stresses that limited attention is given to the meaning of gender equality and related policy outcomes.

Verloo (2005) assesses the status of the evaluation processes of gender mainstreaming in the European Union (EU). The major outcomes from different evaluations show that: (1) there is no common understanding of the concept of gender mainstreaming across member States in the EU and (2) most 'gender mainstreamed' policies implemented in member States are simply a continuation of previous policies. The author concludes that gender mainstreaming cannot be used as a common gender equality framework, having the potential to lead to increased improvement, development and evaluation of gender equality integration in policies. Similar conclusions are drawn from the empirically-based paper of Shortall & Bock (2015), in their analysis of the performance of gender mainstreaming in the EU rural development programme. In this regard, based on a review of the literature, (Bock 2015) studies the integration of gender equality objectives via gender mainstreaming in the EU rural development programme. Her study reveals that behind the congruent clothing of gender mainstreaming, unequal gender patterns in rural areas in the EU still remain.

Debusscher (2011) empirically shows that even though gender mainstreaming is largely promoted in the public sphere in the EU as able to include women's demands, women are still considered to be the solution holders (i.e. they need to act upon inequality issues as they arise and lobby for a change). The author considers that the face of not involving civil society organisations increases an inadequate representation of women. Hence, strong external lobbying for gender mainstreaming enables the EU to position itself as a normative power on the political agenda and in the global arena, thus also enhancing the EU's internal legitimacy. It could be argued that much of this lobbying is used for the strategic positioning of the EU, drawing the attention away from internal gender equality integration problems. This is consistent with findings from Shortall's (2015) review of the literature, examining the position of women in the agricultural sector in the EU through the extensive use of gender mainstreaming in the Common Agricultural Policy. It is highlighted that the gender principle focuses primarily on the symptoms of gender inequality in agriculture as opposed to the actual causes.

Still, the action guideline assumes that policies are not neutral devices and could cause inequality effects (Fraisse et al. 2008). However, since it has a flexible and undefined structure, and given that it is 'integrated' into other policy tools, it becomes subject to a number of assumptions. Stratigaki (2005) highlights the fact that such a guideline could have been developed to mask present inequalities, increasing the risk of doing 'gender washing' by integrating gender as a concept into projects and programmes simply for the 'purpose of' (for example, when gender equality integration in national action programmes is required by donors).

Presently, gender mainstreaming is used by a variety of actors (private, NGOs, foundations, not for profit organisations) (Dauphin 2010; Stratigaki 2005; Walby 2005). Dauphin (2010) shows that gender mainstreaming was developed for the public sector, and questions the ability of this action guideline to ensure that gender equality is properly integrated into organisations other than public authorities[39] (given bias, implicit representations, mandate and objectives of the organisations and investors). Actually, towards the end of her paper, Dauphin (2010) questions whether this principle is appropriate for any sector and/or any type of intervention at all.

Walby (2011) has furthermore criticised the mediocre role of gender mainstreaming in the service economy, highlighting that gender mainstreaming does not have the institutional power to alter gender-unequal norms in the services sector. The author makes the hypothesis that the role of government organisations and the institutional procedures in place are highly important in regulating and shaping the knowledge society and economy, and thus the development of gender equality.

This Section presented two theoretical concepts (i.e. gender mainstreaming and affirmative action) that allow to examine how public policy and knowledge-based platforms view and consider gender relations. Even if specific strategies are used for gender equality inclusion however, this does not imply that policies and the tools used to achieve policy objectives are gender inclusive, nor that there are processes in place for gender equal policy actions. Parallels can be drawn to the studies of Cécile Blatrix, who has analysed how policy work could involve civil society through participatory processes, to avoid that policies and policy instruments become source of exclusion. In her empirically based paper, Blatrix (2009) analyses the effects for a government when putting in place 'participatory democratic processes'[40]. The author

[39] Also, as shown in certain gender studies, given the limitations of gender mainstreaming to properly integrate women's priorities, expectations and needs into public policy.

[40] The author defines it as *"The enhancement of the idea of the participation of ordinary citizens in public decision-making and the multiplication of participatory detours, i.e. procedures or practices designed to involve citizens in*

presents a reconstruction of a diversity of configurations in which elected representatives find themselves when confronted with participatory democracy. The results stresses that the representative system has a certain capacity to absorb participatory instruments in its own logic. In the case of this research, it implies that participatory policy instrument types used to attain gender equality objectives may be tweaked to only represent parts of the population.

This can be connected to the issue of institutional compromises[41] among actors in policy intervention, which can have unintended socio-economic effects (for instance, by increasing gender inequalities). This is likewise the case of knowledge-based platforms. The services provided through platforms and the knowledge content therein, and how gender relations are considered, are based upon power relations between actors. It will also depend upon how the different stakeholders value gender equality. It is most likely that the degree to which gender relations will be considered in platforms depends on the most influential actor (with regard to type of services and technical content, and type of target groups). It is therefore necessary to analyse who the actors involved in the different types of platforms are, and what principles and representations that guide their actions.

2.2.2.2. The integration of the gender equality dimensions in knowledge-based platforms supported by public policies

In order to analyse how gender equality objectives are considered in ICT platforms, it is necessary to have a precise idea of how they are organised and how their performance is designed.

Evolutionary economists have studied how technology and innovation relate to organisational innovation for economic development[42] (David 1994; Arthur 1989; Freeman 1995; Freeman 2002). This framework does not however examine the aspect of social relations and social inclusion in technological innovation. I have therefore turned to institutional economics of services studies to look at it more closely.

Institutional economics of services highlight that technological innovation (and technological choice) combined with organisational innovation is important for social inclusion in policy intervention in the services sector (Gadrey & Gallouj 1998). This includes the farm advisory services sector (Labarthe 2006; Sutherland et al. 2013). Technological innovations in this sector also apply to knowledge-based platforms, as observed in the literature review[43].

Hence, given that platforms are information- and communication-based tools inserted into the farm advisory services sector, institutional economics of services approaches allow us to analyse: (1) gender in farm advisory service relations; and (2) the ability of platforms in providing technical knowledge to women farmers.

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decision-making, characterize a context that can be described as 'participationist'." (personal translation from French to English, Blatrix 2009, p.97).

[41] Institutional compromises result from a situation where tensions and conflicts arise between different socio-economic groups over a longer period, taking the form of an organisational type, and thus defining regulations, rights and legal obligations for the stakeholders involved (Delorme & André 1983). Institutional compromises thus become 'self-imposed' frameworks for which concerned populations and groups adjust their behaviour and strategies, and the fundamental principles remain unchanged in the long-term, that is, the nature of institutional compromises in the balance of power concerning the distribution of economic resources and profits (André 2002). See Appendix 3 for further information.

[42] See Appendix 4 for a more detailed presentation of institutional evolutionary economics theory.

[43] See Appendix 1.

Women's access to platforms in farm advisory services intervention depends on the power relations between involved actors in the development of these devices. As emphasised by Granovetter (1985), the relations, interactions and compromises taking place within political, social, and economic institutions lead to a set of technological choices. Institutional economics of services studies provide methods for analysing such power relations and compromises within social relations of services.

In his reassessment of the services economy, Gadrey (1990) makes the connection between interactionist approaches (Goffman 1963)[44] and the regulation approach (Boyer 1986). He shows how different agents within the services sector are collectively associated to services through both suppliers and clients. The case under scrutiny here concerns the stakeholders involved in platform services development and dissemination, as well as the farmers. Hence, how farmers can access knowledge-based platform services depend upon the social relations that are established between service suppliers. These are based on a number of institutional compromises and implicit representations of farmers' needs at policy level.

Gadrey (1990) presents two levels of service relations: the 'lower level' and the 'upper level'. In several cases, the service providers are in direct contact with the clients: this is the front-office dimension. An example would be public and private agricultural advisory services providers offering their services to farmers via group advice, face-to-face, or virtual modes of interaction. These different client groups enter into two levels of service relations.

(1) The 'lower level' corresponds to 'co-production of knowledge' and thus the level of direct interaction between extension officer and farmer. It is also referred to as the level of 'emotional work' and will be elaborated on in Section 2.2.2.3.
(2) Co-production of knowledge is governed by social relations and this is the 'upper level'. It concerns the institutional and overall regulation of services, with a focus on the supply of services[45]. It thus relates to the ways in which public policy integrates farm advisory services, in a specific regulatory space[46].

In regards to the 'upper level' of service relations, for platform services to be effective and inclusive of gender equality objectives, a regulatory space and institutional coordination mechanisms[47] via public policy guidelines is required. This is to ensure that various clients' demands / requests are considered. Clients in this case can correspond to the farmers but also to the donors or investors of platforms. In this regard, institutional coordination (Labarthe &

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[44] Goffman (1961) defined interactions as service relationships between services provider and beneficiary. *"This service relationship is source of co-produced knowledge (a new type of knowledge combining scientific proof, technical information, knowledge gained through experience, information on the objectives of the farm household, the farmer's tacit knowledge, etc.). It is a prerequisite to developing solutions that are relevant for each kind of farms and consistent with farmers' objectives."* (Labarthe & Laurent 2013a, p.244).

[45] It corresponds to clients' indirect relation with the management of the service provider (Gadrey 1990). For instance, it is towards the management that clients should turn in case the service does not provide the expected effect. It is through the management that new compromises will be reached, for instance because of a vehement complaint from the client.

[46] Moreover, Gadrey (1990) stresses the importance of having a regulatory space for the services sector, particularly since the dissemination of knowledge is not necessarily controlled by respective governments. Both he and Petit (2008) maintain that having a regulatory space is important for two main reasons: the services sector is not negligible is economic terms and has significant socio-economic impacts on employment; and there are political power struggles emerging, given the levels of investment in the services sector, due to increased private-sector interference.

[47] See Appendix 3 for a more detailed elaboration of institutional coordination mechanisms.

Laurent 2011) can be seen as social interactions taking place within political, social, and economic institutions (Granovetter 1985; Gadrey 1990). These institutions shape the content (e.g. which agricultural model?) (Prager et al. 2016) and modalities (e.g. which types of farmers?) (Laurent et al. 2006) of social interactions.

Gadrey (1990) demonstrates that it is however complex to capture 'upper level' processes in policy work because services multiply social relations and these are not always perceptible, for two reasons: first, the tangible evidence of the execution of a service (i.e. the product) is rarely as clear as the delivery and the functionality of a good, and the extent to which services comply with norms is consequently difficult to measure; second, the client participates throughout the procurement process, where the final result is the first source of ambiguities (especially as regards to the rights and duties of respective parties), mainly because advisory services and the technical content therein are based on social constructs. Similarly, in the case of knowledge-based platforms, their organisational configuration is grounded on the social constructs that involved parties have of the demands of different groups of farmers. This is reflected in both the types of services and the technical content of platforms in agriculture.

In this regard, Gadrey (1990) stresses that co-participation of the 'upper level' and the 'lower level' actors, with special involvement of the end user, should be a key element in policy work. He shows that co-participation is a crucial dimension for the development of service relations, in the following respects: (1) co-evaluation of the outcomes; and (2) co-responsibility for their procurement. It serves the purpose of making explicit the different social relations that are established during decision-making processes, and ensuring that services do not become a source of exclusion. It furthermore helps ensure that the outcomes of services and technical content do not have harmful effects (for instance, on the environment, or on farmers' health).

The degree to which service relations are integrated in knowledge-based platforms via public policy objectives will determine the social inclusiveness of these devices (services and technical content). For instance, agricultural extension services policies could provide for: (1) facilitation procedures for knowledge exchange in platforms; (2) an ethical standards framework guiding platforms on gender inclusion; and (3) a monitoring system to evaluate (i) the type of technical content in platforms, and (ii) the outcomes of knowledge dissemination and services from platforms.

Gadrey's (1990) analysis of service relations show that there are connections between the technological innovations and the social relations of activities. It is indeed necessary both to reinvest in analyses of knowledge and technological regulation and coordination procedures, and to clarify the social relations of activities with respect to gender relations.

In this regard, the conceptual study by Walby (2011) complements existing research on how the gender dimension can be considered in the 'upper level' of services supply. The author presents three institutional perspectives. The first is the gendering of labour, which can happen in different ways. Education and training for instance are themselves gendered, as women are less likely to acquire the specialised skills required for employment in science and technology. Walby (2011) stresses that the devaluation of women's abilities in performing a type of labour labelled as masculine, allows for a masculinist discourse to become dominant. One may well wonder by what means gender principles in platforms could shift such masculinist discourse and allow for an increased number of women farmers to access the knowledge economy.

The second institutional perspective is the gendering of networks, which most often are not neutral and are made up of people from the same sex, religion, or ethnicity (Walby 2011). Networks can be centred around occupational groups, professions, trade unions and professional associations, using their resources in order to maintain/keep and enhance their positions. Hence, it may or may not be informal practices in networks that contribute to the conception of technical content in platforms to enhance social inclusion.

The third perspective is the extent to which definitions are 'gendered' in the knowledge society, and their potential in creating gendered digital exclusion (Walby 2011). The author reveals that emerging types of internet provision have the potential in creating, enhancing or reproducing traditional gender imagery. An example is the image of the male farmer as being the household head and in charge of decision making (Ragasa 2012). In this context, governmental institutions are important in regulating and shaping the knowledge society and economy, particularly with regards to social constructs of gender. Walby (2011; 2005) emphasise however that there has been a softening in this respect over the last decade, partly due to the extensive use of gender mainstreaming. Thus, it appears as if platforms with a technological focus produce a more masculinist image than one that includes a wider range. It might therefore be that the knowledge content and the institutions regulating the technical content must be explicit and formalised via farm advisory policies to avoid any types of discrimination against women.

2.2.2.3. The consideration of women in the services and technical content of knowledge-based platforms

With reference to Gadrey's (1990) two levels of service relations, this section focuses mainly on the 'lower level', namely where the supply of agricultural advisory services meets the demands of farmers.

From the farmer's perspective, agricultural extension services must generate reliable knowledge to solve problems as they arise. Since the seminal work of Goffman (1961), many studies have shown the numerous requirements that must be taken into consideration for advisory services to be effective – in particular the need for interaction between service providers and clients (Gadrey & Gallouj 1998; Ostrom 1996). The service economics theory emphasises the importance of two main services modalities to achieve such objectives.

The first modality is the efficiency of the service, where the advisor and the client develop interaction to foster co-production regarding the problem or issue at stake (i.e. a technical problem on a specific farm) and the solution (i.e. a response adapted to the features of the farm), called 'front-office activities' (Labarthe & Laurent 2013b). Front-office work *"is performed in the beneficiary's presence and allows for the co-construction of the demand and / or the co-production of the response."* (Labarthe & Laurent 2013b, p.21). Here, the service quality is dependent on the level of trust in the social relations established between advisor and farmer (Prager et al. 2016). It is undeniably a service where the farmer is active in defining the problem and in producing the solution. In this regard, certain knowledge processes are near impossible to codify (e.g. in the case of tacit-to-tacit knowledge exchange), as they frequently require face-to-face contact to provide adequate advice (Nonaka et al. 1996). The provision of agricultural advice can involve different levels of interaction between advisors and clients, giving rise to disparate levels of standardisation of the service (Laurent et al. 2006). The higher the degree of interaction, the more the advice will be personalised and adjusted to the specific conditions of the farm.

The second modality stems from the fact that the analysis does not limit itself to individual interactions (Labarthe & Laurent 2011). The conditions of success in co-constructing knowledge includes front- and back-office activities, and depends on both the beneficiary's and the service supplier's sense of belonging to society at large (Gadrey & Gallouj 1998; Gadrey & De Bandt 1994). Hence, the advice must be based on robust knowledge, relevant to the question at hand and accessible for advisers (on technology, risk assessment, etc.) (Labarthe & Laurent 2013b). Back-office work *"takes place outside the beneficiaries' presence and allows for the standardisation of the service offer and for capitalising on existing knowledge. It consists of activities such as technology monitoring, training advisors, accumulating technical references (building and using databases, etc.) and even the production of original knowledge (through experimentation and R&D)"* (2013a, p.21).

These two interrelated dimensions go hand-in-hand with an increased intensity in the co-production of knowledge (Labarthe & Laurent 2011). This implies that the co-production of knowledge is not only created during direct interaction between the extension officer and the farmer, but also for activities taking place during non-interactive activities with the farmers. Thus, knowledge is used to implement a solution and needs to be adjusted when transferred to the farmer (Labarthe & Laurent 2013a).

The characteristics of farmer-service provider interactions are therefore considered to be a major component in the effectiveness of advisory services. However, this pattern is called into question for knowledge-based platforms. To what extent do they guarantee a certain level of interaction? How is the technical content tailored to female farmers' needs? Is there still a need for interaction with an advisor if available knowledge is directly accessible? These questions call for an in-depth analysis of the conditions of interaction between women farmers and platform service providers.

In this context, institutional economics of services has developed an innovations performance analysis framework to analyse the effectiveness of farm advisory services. Additionally, criteria from gender studies are required to complete the advisory service performance framework, to analyse whether platforms can be inclusive of women farmers. Gadrey & Gallouj (1998), Gallouj et al. (1999) and later Labarthe (2006) developed this framework for analysing the performance of advisory services[48] (cf. Table 2.1 in Box 2.3).

The innovations performance framework will thus be used to analyse the performance rationales of ICT platforms in agriculture in respect to the consideration of gender equality objectives.

The institutional economics of services emphasises the importance of interactions and different dimensions of service performance. It also provides methods to evaluate the potential of platforms with regard to: (i) the levels of co-production of knowledge and supply of information to female farmers; and (ii) the potential inclusion or exclusion factors for women farmers in farm advisory services intervention.

[48] The framework is part of intensive knowledge-based services (KIBS). Knowledge-based platforms can be seen as one form of KIBS, i.e. services where knowledge is seen as inputs and outputs (Gallouj 2010; Muller & Doloreux 2007).

Box 2.3: The innovation performance framework for analysing the ability of knowledge-based platforms to be socially inclusive

It is difficult to quantify the performance of a service (Gadrey & Jany-Catrice 2005), including farm advisory services (Labarthe & Laurent 2011). Since the service 'product' is the transformation of the service relationship between farmer and supplier, the innovation performance framework provides a method for quantifying the performance of a service. This framework is especially useful for emerging innovation technologies, such as platforms, given that the steps required for farmers to enter into direct contact with the service supplier become more complex (e.g. face-to-face interaction or virtual interaction).

The five dimensions of the framework are presented below (Gadrey & Gallouj 1998; Gallouj et al. 1999; Labarthe 2006) (cf. Table 2.2). It has been complemented with indicators developed by Labarthe & Laurent (2011) for assessing the performance of farm advisory services. Furthermore, to be able to analyse the implicit gender dimension within knowledge-based platforms, Walby (2011), Debusscher (2011) and Hafkin & Huyer (2008) provide different indicators for an effective gender integration in the performance analysis framework.

The financial dimension includes the financial sustainability and profitability of the advisory service, looking at the annual turnover sheet, budget, and in-kind contribution. In the case of gender equality integration, there is a set of gender-bound financial indicators: gender disaggregated budgeting and balance sheet; gender-bound financial reporting procedures; and type of in kind contributions to ensure that the needs of social groups are considered in the development of knowledge content.

The technical dimension includes: the productivity of the advisory service (i.e. the ratio farmer to unit of advisory activity); the degree of standardisation; the rates of dysfunctioning of the service; access to the service; the terms and conditions of the service; and performance rationales of service suppliers. To analyse the integration of gender equality in this dimension, an analysis of the type of farm advisory methods used to reach female farmers, and the results based on their priorities, should be evaluated.

The relational dimension includes the degree of personalisation (interactions, frequency of visits, duration of visits); client loyalty (annual or monthly turnover of agricultural producers); and the nature of the contract between farmers and advisors. If gender equality is adequately integrated into this dimension, different services and knowledge content should be adjusted to women's priorities, expectations and needs. A gender-bound monitoring system should be in place to assess the personalisation and clients' loyalty (e.g. number of female farmers visiting and using the service).

The innovation dimension relates to the back-office work of developing adequate services and technical content, i.e. share of the total budget devoted to back-office activities; the number of back-office staff; types of back-office activities (experiments, databases, scientific monitoring, training and capacity building) innovation trajectories specific to the service provider; and institutional coordination procedures. When considering gender equality in this dimension, each of the above-mentioned indicators needs to be gender specific (e.g. back-office staff responsible for gender equality), budget dedicated to the integration of women's demands in back-office activities, gender-bound innovation trajectories specific to the service provider.

The impacts upon different social groups as a result of farm advisory interventions are evaluated in the civic dimension. Here the focus is on the different controversies that are generated because of the dissemination of certain types of knowledge, for instance over the use of harmful agricultural inputs.

The use, implementation, monitoring and evaluation of the performance of gender mainstreaming and/or affirmative action are considered.

Table 2.1: Analysis framework for advisory service performance

Dimensions	Theoretical performance indicators	ICT platforms performance indicators for gender equality analysis

Financial	- Profitability of the advisory service
	  - Annual turnover
	  - Annual budget
	  - In-kind contribution
		- Financial sustainability of platforms
		- Gender disaggregated budgeting
		- In kind contributions
		- Financial reporting procedures integrating women's demands

Technical	- Productivity of the advisory service
	  - Ratio of farmers to advisor
	  - Ratio of surface areas under crops to advisor
	  - Quantity of agricultural produce sold per advisor
	- Level of standardisation
	  - Is there a standardisation of advisory services?
	  - Evaluation of dysfunction rates of services
	  - Are there indicators of the advisory services' success?
	- Direct impact
	  - Access to the service
	  - Terms and conditions of the service
		- Procedures in place facilitating knowledge exchange between platform staff and farmers
		- Monitoring tools to evaluate if female farmers access and use the services provided by the platform, and also if services are used differently
		- Level of standardisation
		  - Is there a standardisation of advisory services?
		- Direct impact
		  - Access to the service
		  - Terms and conditions of the service

Relational	- Degree of personalisation
	  - Frequency of visits
	  - Duration of visits
	- Client loyalty
	  - Turnover of producers
	  - Turnover of advisors
	- Nature of the contract
		- Gender-bound monitoring system assessing the degree of personalisation (the frequency of visits and the duration of visits)
		- System measuring farmers' loyalty to the platform
		- Gender-bound activities that relate to service relations

Innovation	- Share of the total budget devoted to back-office activities
	- Number of back-office staff
	- Back-office activities
	  - Experiments
	  - Databases
	  - Scientific monitoring
	  - Training
	- Innovation trajectories specific to the service provider
		- Gender equality bound monitoring and evaluation system in place
		- R&D policy and activities that are inclusive of objectives of gender equality
		- Gender disaggregated data
		- Staff conducting gender back-office activities evaluating the performance of platform services
		- Gender equality inclusive coordination system

Civic	- Considering controversies over the use of harmful agricultural inputs - Health - Equity - Equality	- Equal right to economic resources and institutions - The use, implementation, monitoring and evaluation of gender mainstreaming and affirmative action used by platforms - Adequate representation of farmers' demands to adjust services accordingly in platform design

Source: Based on Gadrey & Gallouj (1998); Gallouj et al. (1999); Labarthe (2006); Labarthe & Laurent (2011).

2.2.2.4. The social integration of women defining their ability to access knowledge-based platform services

Empirical evidence from Chapter 1 shows that female farmers have different demands with regard to advisory service approaches and technical knowledge. Knowledge exchange in collective spaces[49] is particularly important to women farmers (McCarthy & Kilic 2015; Fischer & Qaim 2012; Harcourt et al. 2002). Findings from this Chapter also reveal that female farmers have multiple professional statuses (as agricultural producers, community leaders, business women, etc.). A framework is thus required for analysing how the social inclusion of women farmers in public policy will determine/orient how they access resources, including knowledge[50].

Laurent & Mouriaux (2008) developed 'the six modalities of social relations of activities' framework. This framework becomes relevant in a context where gender is considered a construct based on social relations. It allows us to analyse the capability of female farmers to access ICTs in farm advisory services, depending on their social inclusion through public policy intervention.

The first modality concerns material and immaterial production means. These are key when it comes to the consolidation of qualifications and the construction of competencies in the professional development cycle of female farmers. Knowledge-based platforms in farm advisory policy intervention can be seen as mobilised means of production. We shall examine whether platforms are configured according to policy objectives that are supposed to ensure women farmers' access to and use of platforms to carry out their professional projects.

The second modality concerns different forms of activities. It incites us to enquire about how forms of occupational work structure differing demands. Status types and carrier paths are examples. There are two levels in this modality: the demand level, and the institutional level.

[49] Networking and alliance-building among women in developing economies is stressed as fundamental in the literature review by Harcourt et al. (2002). The authors are of the point of view that such collective spaces/forums, interlinked with place-based politics, are vital to the inclusion of gender relations and the demands of women in policy making.

[50] In this regard, knowledge simultaneously provides: instruments of power and building blocks for new norms; and economic resources to produce various types of goods (e.g. agricultural products, foodstuffs) for a variety of actors (different industries, farmers, etc.) (Laurent & Landel 2017). This is especially so in terms of the role of knowledge (production and dissemination of knowledge, through ICT knowledge-based platforms, for example) within the social relations of activities (Laurent & Mouriaux 2008).

The first concerns the ways in which women farmers organise themselves through their multiple activities as farm workers, business women and care workers, to structure the demand and access knowledge. The second pertains to the ways in which their activities are taken into consideration in platforms, through the use of gender action principles. Hence the need to analyse the degree of the disparity between female farmers' demands and service supply.

The third modality concerns women farmers' institutional affiliations and their access to resources based on norms and behavioural patterns. First, it relates to female farmers' membership at various institutes, and whether they access technical knowledge and knowledge-based platforms indirectly (e.g. via husbands) or directly (themselves). Second, it relates to the standards and procedures in place to guarantee the inclusion of female farmers and their demands into platforms and within organisations providing farm advisory services.

The fourth modality concerns the sources of income of female farmers, including the determinants of work time associated with income generated from professional activities, social time and care giving. The access to and use of technical knowledge in platforms should generate income as it supports women farmers in sustaining and increasing farm yields, thus generating profits. Here, the types of policy means put in place to ensure how female farmers can access platforms and farm advice are key.

The types of lifestyles of women farmers that enable them to access knowledge for supporting the productive systems is the fifth modality. The main aspect is the importance attributed to collective spaces, shared identities, and networks (women's groups), in policy objectives. Connected to the latter is the sixth modality: the topologies of the families of women farmers and their most often multifaceted connections to the agricultural sector. In other words, the attachment of household members to sectors other than the agricultural sector (for instance, if certain household members work in urban areas). This means that through women farmers' household networks, they can access certain resources more easily (a computer enabling internet access to enter into use with platforms).

This framework may allow us to examine how women farmers are integrated into various institutions, which determines how they can access platforms and knowledge.

2.3. *To conclude:* The articulation of gender relations in ICT platforms can be explored based on three interlinked theoretical frameworks

The state of the art show that platforms are devices that raise questions at the intersection of: (1) Feminist economics and gender studies (consideration and interpretation of gender relations within policy intervention and knowledge-based platforms); (2) Institutional economics (public policy analysis, development of PPPs, exclusion/inclusion criteria of social groups); and (3) Economics of services (supply analysis of services, how actors organise themselves to enable the access to innovations in advisory services).

The integration of gender equality objectives into ICT knowledge-based platforms in agriculture is studied based on four conceptual foundations. One, the way gender relations are articulated into information and communication technologies (ICTs) in the public policy sphere through gender mainstreaming and/or affirmative action. Two, the integration of gender equality in knowledge-based platforms supported by public policies. Three, the consideration of women in the services and technical content of knowledge-based platforms. Four, the social integration of women defining their ability to access knowledge-based platform services.

Hence, these four foundations of the 'gender relations analytical framework' allows to analyse how this fundamental social relation is articulated in policy intervention and in ICT platforms, used to achieve policy objectives. Through these foundations, it is expected to reveal the mechanisms that are contributing to gender exclusion effects in technological innovations, and more precisely ICT platforms. These four critical steps will enable me to answer to the research question of this thesis: Are technological innovations used in policy intervention (ICT platforms in agriculture) inclusive of gender equality, and women farmers and their demands?

In this context, the results from the literature review (cf. Chapter 1) provide evidence in the heuristic value of the research question. Findings from the review show how various authors explore different performance registers of ICT platforms in agriculture (i.e. most often either the technical, the financial, or the civic dimension). There is also substantial scientific literature revealing that ICTs could contribute to the digital gender divide. Different types of mechanisms behind this gender gap have also been discussed. Any scientific literature explicitly treating of ICT platforms possible contribution to a digital gender divide could however not be identified. Hence, departing from such scientific evidence and gaps therein, this thesis aims at providing a more integrated analysis of the different performance registers of platforms. Also, this research intends to reveal the mechanisms behind knowledge-based platforms contribution to a digital gender divide, which can be turned into levers of action. To analyse this issue, the theoretical frameworks presented through the gender relations analytical framework demonstrate that it is not enough to confine the study to the demand level. Analyses in earlier sections[51] reveal that, in theoretical models, either the gender equality dimension is not integrated or there are implicit representations of what is considered gender equal. Because the political and economic system is based on these models, they lead to gender inequalities. However, since gender relations have significant social implications in economic development, it becomes fundamental to analyse: (i) how gender relations are considered in economic analysis; and (ii) how new developments at policy level can be inclusive of gender equality objectives in platforms. An analysis at the institutional level is therefore required.

[51] Section 2.1.3 and 2.2.2.1 of this chapter.

CHAPTER 3 - Materials and methods

Five main objects of study to respond to the overall objective of this research have been established, namely: (1) the integration of gender equality objectives into public policy intervention [macro level] ; (2) the integration of women farmers in the diversity of ICT platforms in Kenya [meso level]; (3) the ability of ICT platforms in farm advisory services to provide knowledge to female farmers [meso level]; (4) the means through which female farmers access knowledge based on their priorities [micro level]; and (5) the type of innovations practised by women farmers to overcome the digital divide [micro level]. To analyse these five objects of study, a multilevel analysis methodology was used.

3.1. Methodological framework: three levels of investigation

The multilevel analysis was designed to connect the institutional analysis of public policy and of knowledge-based platforms to the supply of services and the demands of farmers:

- Public policy and strategic frameworks with regard to gender equality, farm extension and ICT policy goals (national/macro level)
- Supply of agricultural extension services by a selection of knowledge-based platforms (enterprise/meso level)
- Demand for extension services from female farmers (regional level, Machakos county in Kenya eastern province – micro level).

Qualitative and quantitative data were obtained from various sources:

(i) A review of the scientific literature and administrative reports, internet research for (a) platform identification, (b) getting an understanding of the objectives of the Kenyan Government regarding the role of women in agriculture and the short- and long-term vision of the agricultural extension services support system in Kenya, and (c) the historical analysis of the development of ICTs in this system.

(ii) Special data processing of the statistical data from the Kenyan Population and Housing Census (PHC) data 2009 (data processing at national, regional and district levels, 37,919,647 number of individuals).

(iii) In-depth institutional interviews of employees from: (a) the Ministry of Agriculture; (b) the Extension Unit at National and Machakos county level; (c) one University; (e) Machakos Coffee Cooperative Union; and (f) NGOs[52,53,54,55,56,57].

(iv) Interviews with persons responsible for the design and implementation of two knowledge-based platforms: The National Farmers Information Services (Nafis) platform and the AgriProFocus (APF) platform (n=13)[58]. To complete the performance analysis of these platforms, I conducted individual surveys with small-

[52] See Appendix 5A and 5B for survey questions with staff working at the Ministry of Agriculture at National level.

[53] See Appendix 5C for survey questions with staff working at the Ministry of Agriculture at Machakos county head offices.

[54] See Appendix 5D for survey questions with staff working at the University.

[55] See Appendix 5E for survey questions with staff from Machakos Cooperative Union.

[56] See Appendix 5F for survey questions for local context analysis with extension workers in Machakos county area.

[57] See Appendix 5G for survey questions with extension workers from the Ministry of Agriculture in rural Machakos county offices.

[58] See Appendix 6A for survey questions with Nafis staff and appendix 6B for follow-up questions with Nafis manager. See appendix 7A and 7B for survey questions with APF staff.

scale farmers on their use of the internet and these platforms (n=1,179) at a local level (in Machakos county[59]). Moreover, an online survey was carried out in 2016 with APF users in Kenya to assess the use and satisfaction levels of the APF platform services (n=33).

(v) Extensive individual interviews with female small-scale farmers on access and content of farm advisory services in Machakos county (n=26). Two different surveys at different points in time were conducted, with different women farmers. A first survey was conducted with 10 individuals and a second survey with 16 individuals[60]. I was able to draw similar conclusions from both questionnaires.

Table 3.1 connects the type of data / materials based on the four objectives, tied to respective results chapter. Each source of qualitative or quantitative data is presented more extensively in the following sections.

[59] See Appendix 8 for survey questionnaire with small-scale farmers in Machakos county.

[60] See Appendix 9A and 9B for survey questionnaires with small-scale female farmers in Machakos county.

Table 3.1: Multilevel analysis methodology used for the five results chapters.

Results Chapter / **Material or method**	**Ch. 4:** How are gender relations articulated in ICTs in public policy in Kenya?	**Ch. 5:** Which gender dimension in ICT platforms?	**Ch. 6:** Can platforms supply Kenyan women farmers with advisory services?	**Ch. 7:** How do and can female farmers access platforms?	**Ch. 8:** What innovative practices are women farmers using to overcome a digital divide?
Administrative documents review (policies, regulatory frameworks)	X	X	X	X	X
Review of scientific literature and internet research as sources of primary data	X	X	X	X	X
2009 Population and Housing Census data	X	X		X	X
Interviews at national public level (n=5)	X	X	X		X
Individual interviews with public extension officers (n=11)	X	X	X		X
Platform interviews (n=13)	X	X	X		
Individual interviews Cooperatives and NGOs (n=7)	X	X	X		
Individual surveys with small-scale farmers (n=1,179)				X	
Individual online surveys with APF platform members (n=33)			X		
Individual interviews with female farmers (n=26)			X	X	X

3.2. Local and national scale

In order to analyse the relationship between supply of platform services and the demands of individual women farmers, it was necessary to select one specific geographical zone in Kenya. Machakos country in Kenya's Eastern province is especially relevant to the purpose of this research.

According to the Kenyan News Agency[61], Machakos county is an area where the Kenyan Government aims at constructing an ICT hub to decrease poverty levels and increase employment (Kipkoech 2017). In 2013, the Government of Kenya launched the ICT hub, 'Konza Techno City[62]' (labelled 'Africa's Silicon Savannah Valley'), located between Machakos and Makueni county (Ventures Africa 2013; The East African 2013). This hub is currently under construction (Konza Techopolis 2018). The town of Machakos has moreover been considered as one of the main technology hubs in Kenya since the Kenyan Government launched the ICT project 'iHub' in 2010 (Dahir 2017). Optic fibre has been present in the area since 2009 (Ministry of Information and Communications of Kenya 2014). One can therefore expect to find various types of ICT initiatives and e-services in farm advisory intervention in this area.

Against this background, analysis of the PHC data was used to assess the average demographic and internet connectivity characteristics of Machakos county. The analysis is presented here because it is used as site for the qualitative analysis of: (1) the profiles of the women farmers [demand level]; (2) the platform performance assessment [supply level]; and (3) the relationship between supply and demand.

3.2.1. Geographical location

Machakos county is based in the Eastern province of Kenya, with a total area of 6,051 km^2 (Figure 3.1) (Ngugi et al. 2011; Wambugu et al. 2011). The county borders on Makueni county, as shown on the map. Per the 2009 census data, 1,084,631 individuals resided in Machakos county in 2009, representing 3% of the total Kenyan population. The headquarters of Machakos county is Machakos town. In this region, the dominant ethnic group is the Akamba people and the main spoken language is Kikamba (Wambugu et al. 2011). The Kikuyu and the Maasai ethnic groups also reside in the area. The majority of the population is Christian (Orodho 2006) and predominantly monogamous. A total of 58% out of the population is above or equal to 18 years of age (PHC special data processing, 2009).

[61] The government-run national news agency

[62] *"In 2008, the Government of Kenya approved the creation of Konza Technology City as a flagship Kenya Vision 2030 project. Vision 2030 aims to create a globally competitive and prosperous nation with a high quality of life by 2030. As part of this vision, Konza will be a sustainable, world class technology hub and major economic driver for Kenya. Konza was initially conceived to capture the growing global Business Processing Outsourcing and Information Technology Enabled Services (BPO/ITES) sectors in Kenya."* (Konza Techopolis 2018).

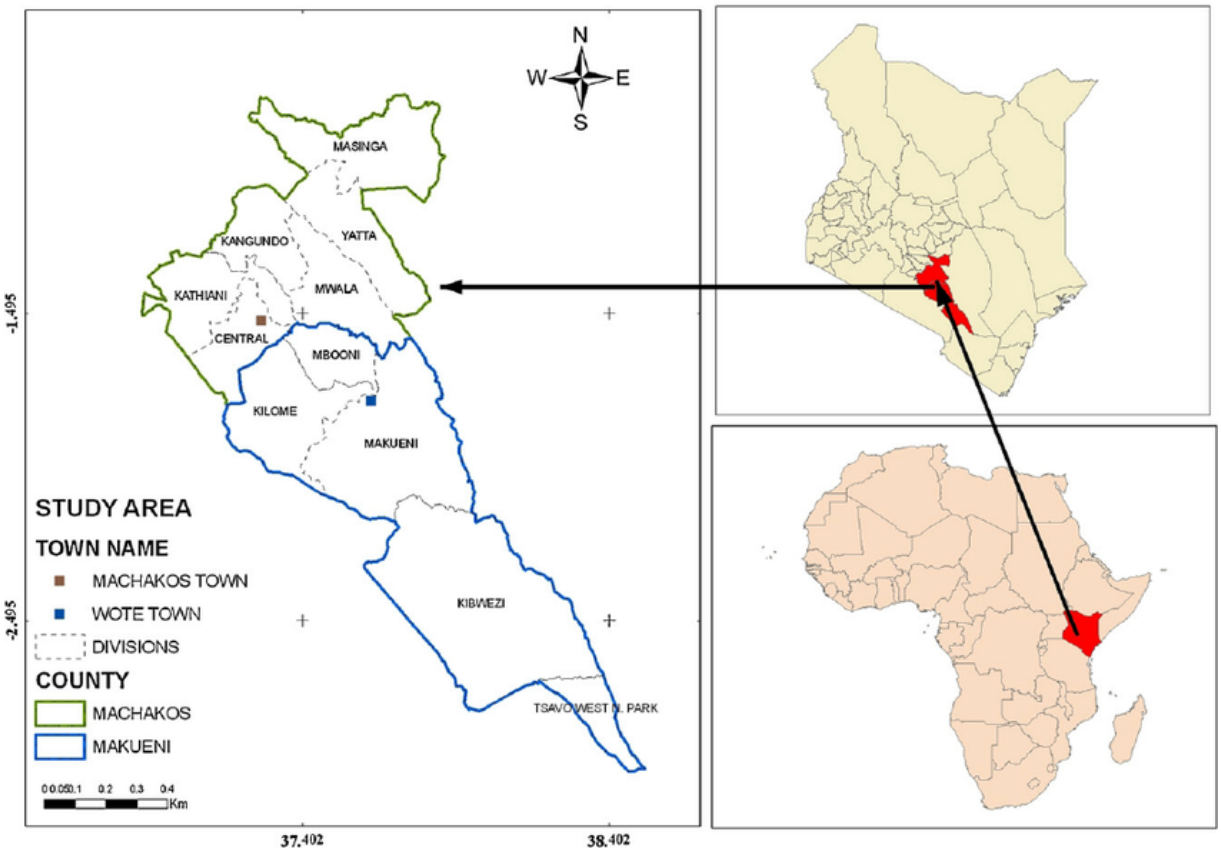

Figure 3.1: Machakos county study site, Kenya (Wambugu et al. 2011, p.946).

The county has six constituencies, as indicated in the 2009 census: (1) Kathiani; (2) Kangundo; (3) Machakos town; (4) Mwala; (5) Yatta; and (6) Masinga. Table 3.2 shows that there is a higher number of females in the county (50.6%). Such figures cohere with average national statistics (50.4% females). There are on average four individuals per household, composed of two children and two adults.

Table 3.2: Population per gender and constituency, Machakos county.

Constituency	**Number of males**	**Number of females**
Kathiani	60,643	64,579
Kangundo	69,960	75,199
Machakos town	107,473	109,903
Mwala	123,727	116,322
Yatta	95,359	99,670
Masinga	78,242	83,554
Total / gender	**535,404**	**549,227**
Total number of individuals		**1,084,631**

Source: PHC special data processing, 2009.

The individual interviews (n=26) and surveys (n=1,179) were conducted in rural areas in all six constituencies. The institutional surveys with agricultural extension officers were conducted in Machakos town and the Yatta constituencies (n=11).

The characteristics of agricultural production systems in Machakos county are presented in Appendix 11. The agricultural system in Machakos county is essentially composed of small-scale farms, with a standard farm size varying from 0.5 to 2 acres per household (Orodho 2006). Each household generally farms on one smaller plot in the highlands (where they grow coffee

and bananas, with some maize, and vegetables), and a medium plot in the lower lands (where they grow maize, with leguminous crops and fruit trees) (Orodho 2006; Ngugi et al. 2011), in addition to livestock. There are two types of agricultural system, with a majority of subsistence agriculture and a minority of irrigated agriculture.

The land system in the area is composed of public government land, trust land, community land, and private land (Ministry of Lands of Kenya 2009). The land tenure systems are based on two types: freehold land (private land) and trust land. According to the Constitution of Kenya, any individual in Kenya (women and men) have an equal right to purchase and own land.

3.2.2. Demographic characteristics

Data from the 2009 census show that there is proportionately a higher number of women residing in rural areas compared to men, i.e. 73% to 66% in Machakos county. On the other hand, 34% of men stated that they were living in urban areas, compared to 27% women. The numbers at national level, and thus for the entire Kenya, for the population residing in urban and rural areas, show similar results (Figure 3.2).

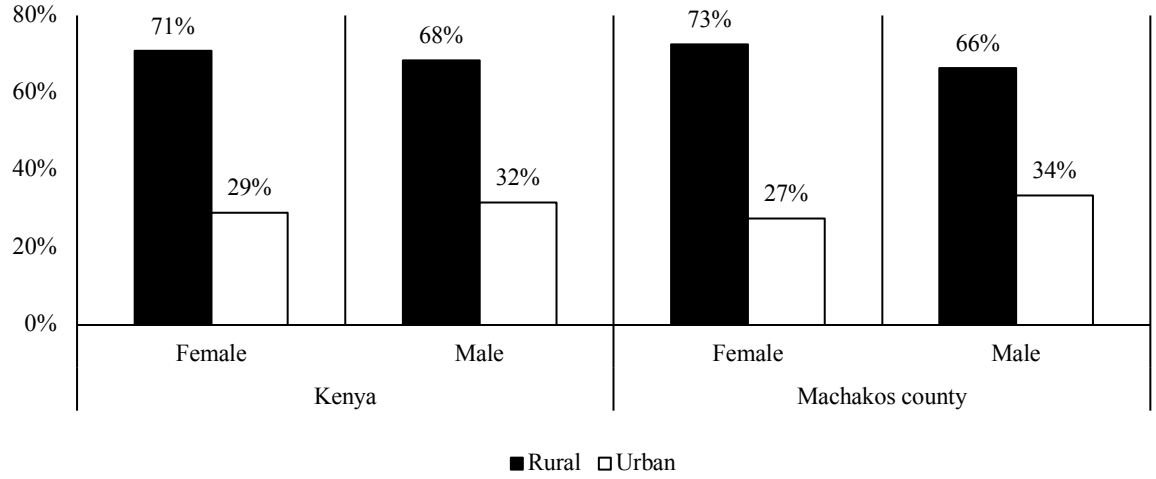

Figure 3.2: The proportionate number of women and men above or equal to 18 years of age residing in rural and urban areas in rural Kenya (n_{women}=9,439,382, n_{men}=8,896,818) and Machakos county (n_{women}=205,845, n_{men}=186,814). (Source: primary PHC data, 2009).

Figure 3.3 shows the proportion of women and men per main economic activities in rural Kenya and rural Machakos county. A higher proportion of women declare themselves as farmers, residing on the own family agricultural holding, compared to men, whether in rural Kenya or rural Machakos county. Out of the rural population above or equal to 18 years of age in Machakos, 38% of women and 29% of men worked at the family agricultural holding, compared to for instance the 'work for pay' category: 11% women compared to 37% men.

Results show that the figures are similar irrespective of the scale of observation (with a slightly higher proportion of female and male farmers in rural Kenya and a higher proportion of women declaring themselves as 'homemakers[63]' in rural Machakos). A higher proportion of women say they work as farmers or homemakers, or are in charge of a family business in rural Kenya and in rural Machakos (Figure 3.3). On the other hand, a higher proportion of men declare that they work for pay or study (i.e. 'full time student' category) at the two scales of scrutiny.

[63] Working at the homestead.

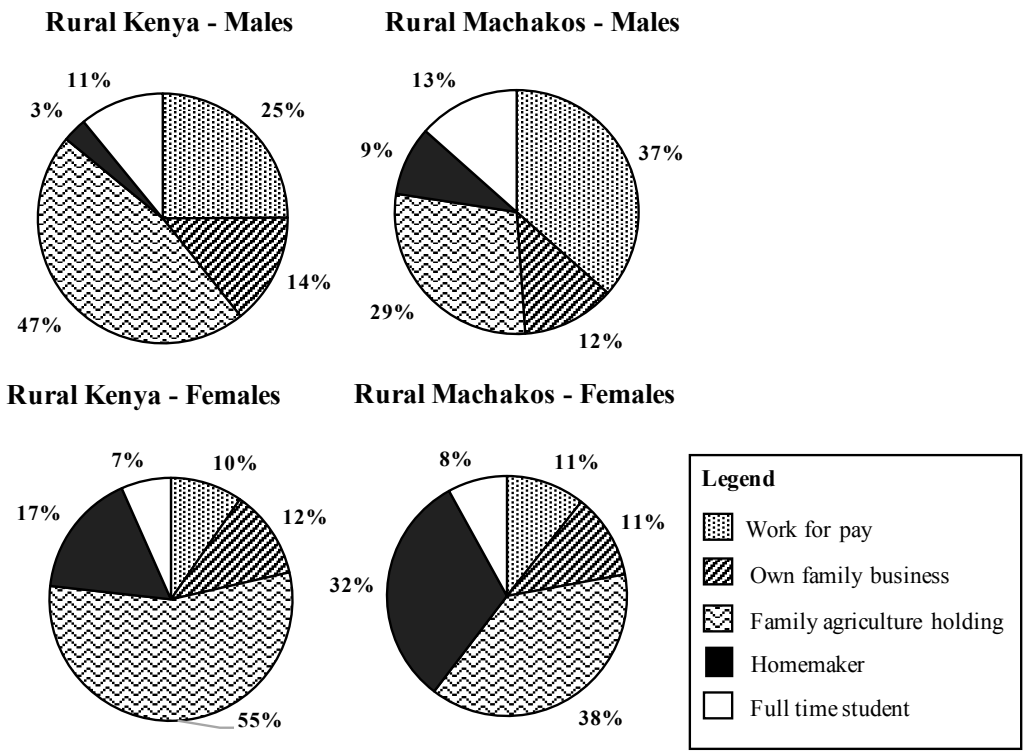

Figure 3.3: Proportion of women per main economic activities and geographical areas in rural Kenya ($n_{Kenya\ females}$=6,077,467; $n_{=Machakos\ county\ females}$=135,680; $n_{Kenya\ males}$=; $n_{=Machakos\ county\ males}$=). (Source: Primary PHC data, 2009).

3.2.3. Rate of internet use by the rural population

The 2009 census data shows that accessibility to internet services in Kenya is still limited, particularly in rural areas where most of the population is based (Figure 3.4). According to the last national census, 9% of individuals over or equal to 18 years of age used internet services in 2009 in Kenya. Less than 2.5% used internet services in rural areas. In all provinces, with the exception of Nairobi Province[64], individuals who had never used internet services accounted for more that 86% of the total population. The levels of internet use in rural areas is on average 2%, irrespective of the scale of observation (at national level, regional level in the Eastern Province, and in Machakos county).

[64] Nairobi Province is classified as an urban province only.

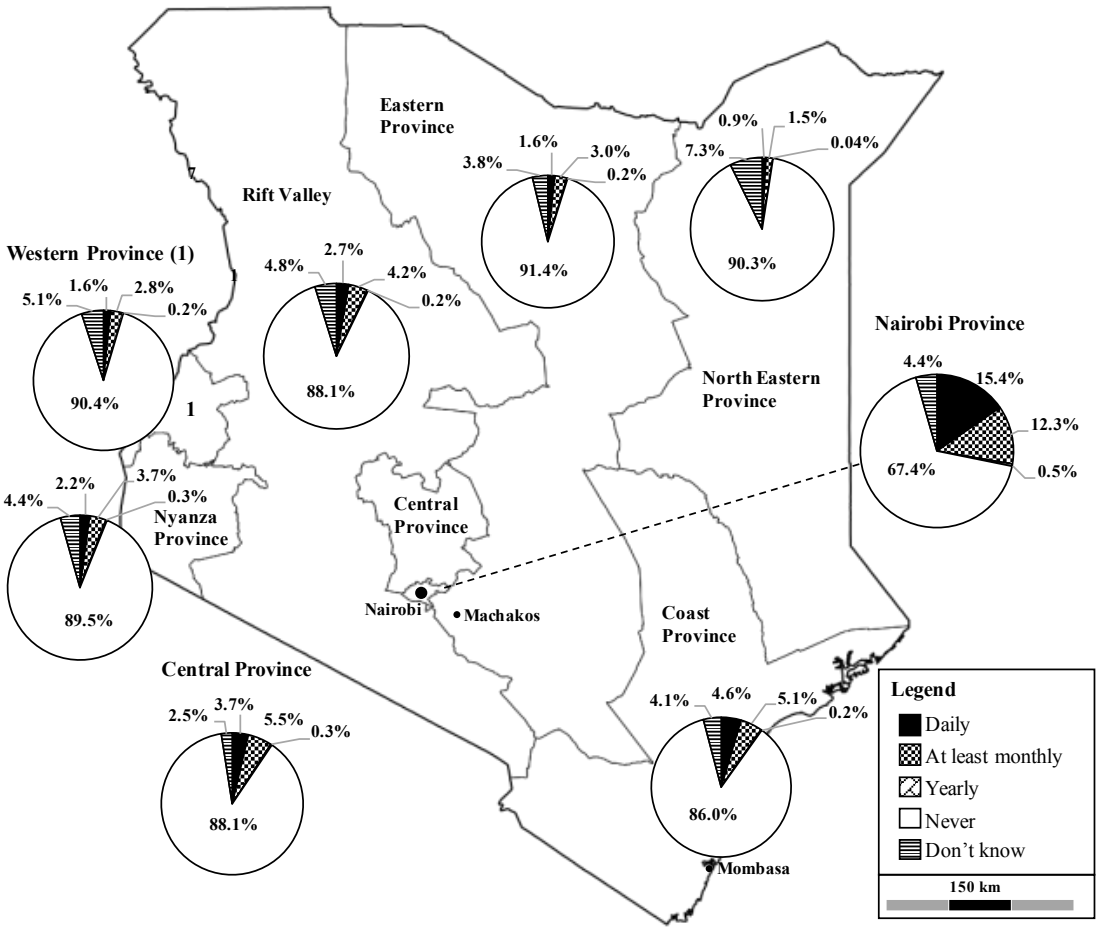

Figure 3.4: Individual internet use per province in Kenya in 2009, total population over or equal to 18 years of age, n=19,885,290 (Source: PHC special data processing).

Machakos county is considered as one of the major ICT hubs in Kenya. It is a geographical location in Kenya where government officials and development agencies believe in the assumptions that ICTs will be inclusive. This confirms the relevance of using Machakos county to analyse the relation between the ICT platform services supply and female farmer's demands for specific farm advisory services and technical knowledge.

3.3. Presentation of the material and survey collection processes

3.3.1. Ethical standards

The study was designed in order to meet international ethical standards. The study protocol was not submitted to an ethics panel because there was no ethical issue that required specific assessment (no experiment, no intervention [no treatment, no advice on farm management, etc.], no behavioural studies). It is consistent with the recommendations of international ethical standards (e.g. Ethics for Researchers of the European Commission, recommendations on ethical requirements of the Kenyan Government) and good practices in social sciences. Official agreement to collect data in Kenya was part of the research clearance provided to the author (research fellowship, ICRAF, Nairobi, Kenya). As regards the individual surveys, before being interviewed all informants were provided with information regarding the goals of the study and the organisations funding it. Consent of each selected interviewee was obtained orally. All informants were given the possibility to refuse to participate. The interviewee names were never reported in the questionnaire, data bases or on data processing sheets. Anonymity was secured in the presentation of the results. The census data processing was completed under the control of the national bureau of statistics of the Kenyan Government. Statistical secrecy rules were respected.

3.3.2. Review of the literature and policy documents of the Kenyan Government

I conducted a review of scientific literature[65] and administrative reports by the Kenyan Government (public policies, legislative documents, strategic frameworks) as well as internet research. I used platform annual reports and other documents obtained during interviews with platform staff (activity reports, manuals, guidelines, etc.) to complete the analysis. These different documentations allowed to: (1) identify and analyse knowledge-based platforms; (2) as such, understand the perceived role of women in agriculture by different actors; and (3) get an understanding of the objectives of the Kenyan Government with regard to (i) the short- and long-term vision of the agricultural extension services support system; and (ii) the inclusion of women farmers and the development of ICTs in farm advisory services intervention.

3.3.3. Internet use for different population groups: statistical data from the Kenyan population and housing census

Obtaining accessible and reliable data on internet access and use is a worldwide issue. Cross-checking of different sources of statistical data, institutional interviews and field surveys shows that there are discrepancies in the estimation of the internet penetration rate in Kenya. Some specialists in the field consider that data from the International Telecommunication Union (ITU) from the World Bank Database is the most reliable source, although primary data from the PHC shows a lower figure of internet users in Kenya in 2009. These discrepancies may result from a biased sample from the ITU.

I chose to rely on the PHC data since it is a complete count of all individuals in Kenya at a stated time (not only a sample of the Kenyan population). I was able to access the census data based on a formal agreement with the Kenya National Bureau of Statistics (KNBS). In this respect, the PHC is a surveying process repeated every tenth year in Kenya since 1948 (Kenya National Bureau of Statistics 2009b). The most recent census was conducted in 2009 and was

[65] See Appendix 1 for the systematic review on knowledge-based platform development.

the seventh one. The PHC is the primary source of benchmark statistics on the size, distribution, composition and other social and economic characteristics of the population.

The 2009 PHC questionnaire was the first to contain questions and hence data on individual access to and ownership of ICT devices, such as: radio, TV, mobile phone, landline and computer (Kenya National Bureau of Statistics 2009a). In addition, there was one question on the frequency of access to internet services[66] (i.e. daily, weekly, monthly, yearly, or never) and another asking where each individual in the household used the internet (i.e. own house, a friend's house, office/workplace, cyber café, community centre, educational centre, other or mobile phone). With regard to the research question, the data was analysed based on two variables from the PHC:

(1) Frequency of access to internet services. This variable has been used in two-fold because it describes how frequently members of the household (a) access; and (b) use the internet and its services, according to the variable definition from the enumeration manual from the KNBS (Kenya National Bureau of Statistics 2009b). Thus, it has been used to analyse:
    a. Internet accessibility
    b. The frequency of internet use
(2) Internet use location.

I used the statistical software R/RStudio and Stata to analyse the PHC data[67], and conducted different types of analyses with the PHC data:

(a) Exploratory analyses for demographic purposes, in particular to get an understanding of the profiles of Kenyan women farmers, their differences compared to men farmers, and if and from where they accessed and used the internet (using R/RStudio).
(b) Descriptive statistics regarding population types accessing and using the internet and from where they choose to do so (using R/RStudio).
(c) Extraction of subgroups of the Kenyan population, performing regression analyses (Probit regression, reporting on the marginal effects using Stata 13)[68].

The used variables are presented in Table 3.3.

Table 3.3: Variables of the Kenyan PHC Database 2009 providing information on household typologies and use of the internet (information collected for each household member).

Name of the variables	**Modalities**
Province	Eight provinces: Eastern Province / North-Eastern Province / Rift Valley / Nairobi Province / Coast Province / Nyanza Province / Central Province / Western Province
Type of enumeration area	Rural / urban / peri-urban
Household type	Ordinary/conventional households, institutional households / refugees
County	47 counties: Nairobi / Nyandura / Nyeri / Kirinyaga / Murang'a / Kiambu / Mombasa / Kwale / Kilifi / Tanariver / Lamu / Taitataveta / Marsabit / Isiolo / Meru / Tharaka / Embu / Kitui / Machakos / Makueni / Garissa / Wajir / Mandera / Siaya / Kisumu / Migori /

[66] In the PHC enumerator's instructions manual (Kenya National Bureau of Statistics 2009b, p.44), the frequency of access to internet services is defined as: *"how frequently eligible members of the household access and use internet services. Frequency of access could either be daily, weekly, monthly or yearly. Record the response given by the respondent by entering the appropriate code: 1 to 4. If a member of the household has NEVER used internet enter code 5."*

[67] The different scripts are available on request.

[68] Cf. Appendix 10 on the regression analyses.

	Homabay / Kisii / Nyamira / Turkana / Westpokot / Samburu / Transnzoia / Baringo / Uasingishu / Elgeyo-marakwet / Nandi / Laikipia / Nakuru / Narok / Kajiado / Kericho / Bomet / Kakamega / Vihiga / Bungoma / Busia.
Relationship to household head	Head / spouse / son or daughter / grandchild / brother or sister / father or mother / nephew or niece / in law / grandparent / other relative / non-relative / don't know
Sex	Male / female
Age	Continuous variable
Marital status	Never married / married monogamous / married polygamous / widowed / divorced / separated / don't know
School/learning institution attendance	At school or learning institution / left school or learning institution / never went to school or learning institution
The highest educational level completed	Not attended / never attended / pre-primary / primary standard 1 incomplete / primary standard 1 to 8 / secondary form 1 to 6 / not completed or attending post-secondary education (tertiary-middle level college) / completed post-secondary education (tertiary-middle level college) / not completed/attending undergraduate (university) / completed undergraduate (university) / not completed or attending Masters or PhD degree (university) / completed Masters or PhD degree (university) / not completed or attending basic or post literacy (non-formal education) / completed basic or post literacy (non-formal education) / not completed or attending youth polytechnic / completed youth polytechnic, attending Madrassa or Duksis / completed Madrassa or Duksis
Economic activity	Worked for pay / on leave / sick leave / own – Family business/ own – family agricultural holding / intern, apprentice / volunteer / seeking work (action taken) / seeking work (no action taken) / no work available / retired / homemaker / full time student / incapacitated / other / not applicable
Main employer	Private sector enterprise / local authorities / central government, teachers' assistance commission / stated owned enterprise / international NGO's / local NGO's or CBO's / faith based organisation / self-modern, informal sector 'Jua Kali' (employed) / self-employed – informal / small scale agriculture (employed) / self-small scale agriculture / pastoralist activities (employed) / self-pastoralist activities / individual or private household / other
Access to a service from the radio in the last one month	Yes / No / Don't know
Access to a service from the TV set in the last one month	Yes / No / Don't know
Access to a service from the mobile phone in the last one month	Yes / No / Don't know
Access to a service from the landline in the last one month	Yes / No / Don't know
Access to a service from the computer in the last one month	Yes / No / Don't know
Frequency of access to internet services	Daily / At least monthly / Yearly / Never / Don't know
Location of use of Internet	Own house / A friend's house / Office, workplace / Cyber café / Community centre / Educational centre / Other / Mobile phones / Don't know

Ownership of livestock	Number of exotic cattle / number of indigenous cattle / number of sheep / number of goat / number of camels / number of donkeys / number of pigs / number of indigenous chicken / number of commercial chicken / number of bee hives / number of fish ponds
Ownership of radio	Yes / No
Ownership of TV	Yes / No
Ownership of mobile	Yes / No
Ownership of computer	Yes / No

Source: (Kenya National Bureau of Statistics 2009b).

3.3.4. Qualitative interviews at three levels of investigation

In order to understand what to expect from the qualitative data, I developed counter-factual hypotheses at policy and platform level. These are presented in the following results chapters:

- Chapter 4: Table 4.2 [policy level]
- Chapter 6: Table 6.2 [platform level]

The reason for not presenting the counter-factual hypotheses in this Chapter is to avoid repetition.

For their development, I was inspired by dimensions put forward in feminist research (Ferber & Nelson 1993; Jennings 1993; Barker & Feiner 2004), gender studies (Walby 2011; Webb et al. 2006; Dauphin 2010), and institutional economics approaches (Petit 2008; Jessop & Sum 2006). Moreover, I used an analysis framework for advisory service performance (Labarthe 2006; Gadrey & Gallouj 1998; Gallouj et al. 1999) based on economics of services to understand whether platform services and knowledge content are in line with women farmers' demands. On this basis, the results from the interviews have been analysed. The subsequent sections present the data collection at institutional (3.2.4.1), platform (3.2.4.2) and female farmer level (3.2.4.3).

3.3.4.1. Assessment of policy goals in the development of knowledge platforms and gender integration based on institutional interviews

The interviewees at institutional level were asked questions regarding historical changes in agricultural extension services in Kenya, related to the goals of the support system, i.e. target groups for public policies, gender issues, and expectations regarding the development of ICTs for farm extension, especially knowledge-based platforms.

In total, I carried out 23 interviews during different periods in time (between end 2013 and 2016), based on semi-open questionnaires[69], with: (1) individuals at national level from the University and the Ministry of Agriculture (n=5); (2) staff from two NGOs (n=3); (3) agricultural extension officers working at the Ministry of Agriculture responsible for the implementation of agricultural extension services in Machakos county (n=11); and (4) individuals from Machakos Cooperative Union (n=4). Cf. Table 3.4 for interview details. The level of saturation was reached at 18 interviews. The last five interviews were conducted to verify any nonconformities. Each interview took between 1 and 3 hours. 19 interviews were recorded and transcribed in full. Performance rationales could then be withdrawn from the

[69] See appendix 5A to 5G for the questionnaires at institutional level.

surveys based on the developed counter-factual hypothesis and respective indicators (cf. Chapter 4 –Table 4.2).

Table 3.4: Presentation of institutional interviews

No.	Function of interviewee	Organisation	Duration
National level in Kenya			
1	Professor	University	3 hours
2	Senior officer	Ministry of Agriculture	30 mins (introductory meeting)
3	Senior officer	Ministry of Agriculture	2h30 hours
4	Senior officer	Ministry of Gender	1 hours
5	Senior lecturer	School of Business, University	1h40 mins
6	Senior programme manager	NGO1	1 hours
7	Senior programme manager	NGO1	1 hours
8	Senior programme manager	NGO2	1 hours
Machakos county level			
9	Agricultural extension officer	Ministry of Agriculture	2 hours
10	Agricultural extension officer	Ministry of Agriculture	3 hours
11	Agricultural extension officer	Ministry of Agriculture	3 hours
12	Agricultural extension officer	Ministry of Agriculture	1 hours
13	Agricultural extension officer	Ministry of Agriculture	1 hours
14	Agricultural extension officer	Ministry of Agriculture	1 hours
15	Agricultural extension officer	Ministry of Agriculture	1 hours
16	Agricultural extension officer	Ministry of Agriculture	1 hours
17	Agricultural extension officer	Ministry of Agriculture	1 hours
18	Agricultural extension officer	Ministry of Agriculture	1 hours
19	Agricultural extension officer	Ministry of Agriculture	1 hours
20	Project officer	Machakos Cooperative Union	2h30 hours
21	Project officer	Machakos Cooperative Union	2h30 hours
22	Project officer	Machakos Cooperative Union	3 hours
23	Project officer	Machakos Cooperative Union	3 hours

Source: Author's data collection, 2013 – 2016.

3.3.4.2. Interviews at knowledge-based platform level for an assessment of the supply of services to farmers

Agriculture extension is identified as a critical area requiring immediate action in Kenya's agricultural sector development strategy (ASDS) (The Government of Kenya 2010). Various extension methods and tools have been developed based on the advancement of technology and innovation, including knowledge-based platforms. These new types of e-services in agricultural extension can be via public initiatives, such as the National Farmers Information Service (Nafis) platform or PPP initiatives, e.g. AgriProFocus or iCow.

In this regard, the first interviews and analyses of the farm extension system in Kenya resulted in the identification of nine major knowledge-based platforms active in farm extension (Table 3.5). This identification process allowed me to build a typology of these platforms (cf. Chapter

5). I contacted three platforms for in-depth interviews (Nafis, APF and iCow). Only two of them agreed to interviews: the Nafis platform and the AgriProFocus (APF) platform. Nafis is a state-owned public platform implemented by the Kenyan Ministry of Agriculture. AgriProFocus is an international platform, with the governing body and authority based in the Netherlands.

Table 3.5: Identified knowledge-based platforms in Kenya

No.	Name of platform	Geographical coverage
1	The National farmers' information services (Nafis)[1]	Kenya
2	AgriProFocus (APF)[2]	Developing countries
3	iShamba[3]	East Africa
4	Infonet-Biovision[4]	East Africa
5	iCow[5]	Kenya
6	Seed Sector Platform Kenya (SSPK)[6]	Kenya
7	Forum for Agricultural Research in Africa (FARA)[7]	Pan-African
8	Pan-African Farmers Organization (PAFO)[8]	Pan-African
9	Pan-African Agribusiness Agroindustry Consortium (PanAAC)[9]	Pan-African

Sources: [1]National Agricultural Farmers Information Service 2009; [2]AgriProFocus 2015; [3]Mediae 2016; [4]Infonet Biovision 2016; [5]GreenDreamsTech 2014; [6]Agri Experience 2016; [7]Forum for Agricultural Research in Africa 2014; [8]Pan African Farmers' Organization 2016; [9]Pan-African Agribusiness and Agroindustry Consortium 2016)

I asked the platform managers different questions based on an open questionnaire[70] about the performance of the platforms, the economic model and organisational structure of the platform, the strategic objectives (both long- and short term), how the platform works with gender equality and more specifically gender mainstreaming, who the target group is, what types of contracts that are established between the target groups and the platform, interaction modes, use of back- and front-office resources, and what they think the priorities of rural women are.

For in-depth investigations, I selected Nafis and APF because they are two knowledge-based platforms targeting the small-scale farmer. Nafis was selected since it is a public platform operating in Kenya, freely accessible, and uses both gender mainstreaming and affirmative action as action guidelines. APF was selected because it is a PPP agricultural ICT platform operating in Kenya, it uses gender mainstreaming as a gender principle, and it has a specific knowledge base on 'gender in value chains'. Moreover, the platform conducts both online and offline activities with both members and non-members, including in the case of gender-related activities. The APF has moreover published several gender-related materials (books and training materials).

The two platforms have a different core performance motive. As Nafis is a public platform it prioritises the civic dimension, whilst APF, as a PPP platform, prioritises the financial dimension (cf. Chapter 2 and Chapter 5). This makes it interesting to compare them.

In total, 13 interviews were conducted during different periods in time, over Skype (n=6) and in person (n=7). Regarding the interviews with Nafis staff (n=4), the saturation level was reached at three interviews. I conducted a second interview[71] with the overall Nafis platform manager to cross-verify the findings. I furthermore conducted another nine interviews with APF staff, reaching a level of saturation at six interviews. The last three interviews were conducted

[70] See Appendix 6A, 6B and 7A and 7B for the questionnaires with Nafis and APF platform staff respectively.

[71] See Appendix 6B for the second questionnaire with the Nafis platform manager.

to counter check the platform's performance objectives, such as its long-term strategic objectives.

All interviews were conducted with semi-open questionnaires and took on average 1 hour and 30 minutes. Nine interviews have been recorded and transcribed in full. Based on the counter-factual hypotheses, I could then withdraw performance rationales from the surveys (cf. Chapter 6 – Table 6.2).

To complement the performance assessment of these platforms, individual surveys[72] on small-scale farmers regarding their internet use and use of these platforms (n=1,179) were conducted in March 2016 in Machakos and Makueni county (two neighbouring counties in Kenya Eastern Province). The survey process was administered by Machakos Coffee Cooperative Union. Farmers were randomly selected from the Union's members list. The sample is representative of 24% of the farmers producing coffee in the two counties.

At the end of the survey, each respondent was asked to fill in her or his name and contact details if they were interested in participating in an in-depth interview. The criteria for an interview were that the respondent was using the internet and knew of, had used, or was using either of the two platforms (i.e. Nafis and/or APF). Only 3 individuals were selected based on these criteria, i.e. mentioned that they knew about or had used / were using one of the platforms. A fourth person, the spouse of one of the three interviewees, was also interviewed.

I also carried out an online survey[73] in 2016, targeting the users of the APF platform. The APF platform staff in Kenya administrated the process. The survey assessed, in particular, the use of the platform services, and levels of satisfaction. Some background indicators showed the profiles of the users. 33 individuals responded to the survey. The results from the survey have been used to assess the performance of the APF platform. In addition, one individual matched the profile criteria for the research (i.e. small-scale female farmer in Machakos county, using internet and the platforms services) and was contacted for further details concerning the answers provided in the online survey. The interview was conducted via Skype and took approximately 1 hour and 30 minutes. It was recorded and transcribed in full.

3.3.4.3. Demand for advisory services

I conducted surveys with small-scale female farmers from Machakos county. The survey process was carried out during two different periods. Based on an open-questionnaire, I interviewed 10 women farmers[74] in 2014. The purpose was to get an initial understanding of the context. In 2015, I held 16 interviews with different small-scale female farmers, based on a semi-open questionnaire[75] (Table 3.6 gives an overview of the survey process). I thus conducted in total 26 interviews.

I was able to extract similar data from both questionnaires and therefore combine the answers. The aim of these interviews was to understand the needs, priorities and expectations of these women, especially with regard to knowledge processes (and how knowledge is transmitted and exchanged, and the relative importance given to institutions).

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[72] See Appendix 8 for the closed survey for small-scale farmers in Machakos county.

[73] See Appendix 7C for the online survey by APF users.

[74] See Appendix 9A for the first questionnaire for the survey on female small-scale farmers.

[75] See Appendix 9B for the second questionnaire for the survey on female small-scale farmers.

Table 3.6: Survey process with small-scale female farmers in Machakos county

Survey process	**Data collection 1**	**Data collection 2**
Year of interviews	2014	2015
Total number of interviews	10	16
Saturation level	8	13
Number of recordings	3	16

Each interview took on average two hours per individual and all interviews were conducted in person by the author, accompanied by a translator. The interviewer asked the women farmers on questions related to their access to, control over, and demand for different resources, such as knowledge and information, and how they applied agricultural knowledge and information. The different responses from the female farmers were compiled into different sets of patterns and rationales and then analysed.

I chose the line transect method for the selection of the Kenyan women farmers (Thomas et al. 2006). I was inspired by the gross national happiness index (GNH) methodology (Section 3.2.5.2) to design the two questionnaires to assess women farmers' priorities, needs and expectations (Ura et al. 2013).

The line transect method

The line transect method is a technique mainly used in biological and ecological studies[76] but has also been applied in development studies and in sociological and economic sciences for random sampling purposes. It has been used, for instance, in the case of the selection of pig farms in Madagascar (Costard et al. 2009) or the random sampling of rice farmers in Bangladesh (in order to assess their potential shift to freshwater prawn farming) (Ahmed et al. 2010). This method allowed me to select female small-scale farmers in Machakos county. Each woman farmer on the line transect was asked to select a person as different as possible from herself. In all cases, the difference related to socio-economic characteristics (e.g. economically wealthier, a mother/not a mother, a widower/not a widower, etc.).

The gross national happiness index methodology

[76] The line transect sampling methodology is part of a large group of methods called *distance sampling* (Thomas et al. 2006). Distance sampling is a widely-set group of associated methods for estimating the density and/or abundance of biological populations. The major methods are line transects and point transects, which have been successfully used in a varied array of data, e.g. shrubs, trees, reptiles, birds and land mammals. The idea is similar in both cases. The observer performs a standardised survey alongside a series of lines or points, examining the objects of interest. The survey design is an algorithm for laying out samplers, which in this case is the line transect within the area of study (Thomas et al. 2006). There are two requirements for a good design: (1) randomisation; and (2) replication. Randomisation implies that the design algorithm should use some form of random probability sampling in laying out the line transects inside the study area. This means that each time the algorithm is executed, an altered random realisation is acquired. It is assumed with standard analysis methods that, on average, over numerous realisations, each point within the study area has the same probability of being sampled (uniform coverage probability). If the coverage is not uniform in the case of randomisation, the design-based estimation and standards methods must be extended to avoid bias, thus involving replication, i.e. the placement of multiple lines (Thomas et al. 2006). By increasing the number of lines, the reliability of variance estimates that are equal increases, e.g. the total line length and evenness of coverage. In case of an uneven landscape, it is recommended to do a minimum of 10-20 replicates. Generally, several short parallel lines are preferred, compared to fewer long lines. The lines should be oriented perpendicularly to the longer axis of the study area.

A methodology was required for adequately considering women's demands. The expectations of women are multidimensional, as repeated and synthesized in gender index reports (The Economic Commission for Africa 2011; Ura et al. 2013; World Economic Forum 2004; The United Nations Development Programme 2013; The United Nations Development Programme 2004). Several indexes[77] aim at capturing gender inequalities at international and national scale. Some of these indexes could be relevant to measure the priorities, expectations and needs of rural women in Kenya, in the form of indicators and corresponding variables. Major limitations of different gender indexes are however that they do not always comprehend non-economic and non-substitutable indicators.

The gross national happiness (GNH) index methodology was therefore used to develop the individual surveys for the small-scale female farmers. It allows us to understand the multidimensional priorities, needs and expectations of women farmers. This is because it is a multidimensional and non-substitutable index, combining economic as well as non-economic indicators (Ura et al. 2013). The GNH index is supposed to guide Bhutan and its people towards happiness, mainly by improving the status and conditions of the not-yet-happy people (Ura et al. 2013). The index serves to assess where unhappiness is arising from and for whom. Regarding policy action, the index supports the Government of Bhutan and other institutes to increase the GNH in two ways: (1) increase the percentage of people considered as happy; or (2) decrease the unsatisfactory conditions for those that are not-yet-happy. The index is developed so that there is greater incentive for the government (and other institutions) to reduce the deficiencies of not-yet-happy people, which is done by reducing the various domains of deficiencies the not-yet-happy people are facing[78].

The index provides performances across nine domains of GNH (Ura et al. 2013). The domains are: (1) health; (2) education; (3) time use; (4) psychological well-being; (5) community vitality; (6) ecological diversity and resilience; (7) good governance; (8) living standards; and (9) cultural diversity and resilience. Each domain has its representative indicators (in total 33 clustered indicators). Each grouped/clustered indicator is composed of multiple variables[79].

I investigated these nine standard domains to analyse the qualitative interviews of the small-scale female farmers and to get an adequate understanding of their multidimensional demands.

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[77] These indexes are; (i) the Inequality-adjusted Human Development Index (Inequality-adjusted HDI) from the UNDP Human Development Report 2013 (The United Nations Development Programme 2013); (ii) the Gender Inequality Index (GII) from the UNDP Human Development Report 2013 (The United Nations Development Programme 2013); (iii) the Gender Development Index (GDI) and the Gender Empowerment Measure (GEM) from the UNDP Human Development Report 2004 (The United Nations Development Programme 2004); (iv) the Global Gender Gap Index (GGGI) from the Global Gender Gap Report 2013 (World Economic Forum 2004) and; (iv) the African Gender Development Index 2011 (The Economic Commission for Africa 2011). Major limitations of the different gender indexes are that they do not always comprise non-economic (and non-substitutable) indicators for e.g. informal work, unpaid and reproductive work, time-use (also non-economic), psychological and physical health, access to information and knowledge, child care, etc. These are critical to understand women's participation in the economy as a large amount of women's work falls outside the formal sector. Nevertheless, the choice of an indicator is generally a 'simplified' or 'simplistic' option, since they do not cover all dimensions of interest to this research. The Gross National Happiness (GNH) index of Bhutan has a broader dimensional scope, making it highly relevant in the context of this research (Ura et al. 2013).

[78] Appendix 16 presents the nine dimensions of Gross National Happiness index of Bhutan.

[79] When disaggregated, the 33 grouped indicators contain 124 sets of variables (each domain has four indicators except for time use, that has two, and living standards, that has three). Hence, each clustered indicator is composed of different variables. The variables have different weights attached to the respective indicators. The subjective variables are subject to lighter weights and a threshold is applied to the respective variable. At the domain level, all nine domains are weighted equally, i.e. are non-substitutable, since they are equally valid for happiness.

3.4. *Conclusions:* The multi-level analysis methodology enables the possibility to organise the qualitative and quantitative data into five main results

The multi-level analysis methodology has allowed to organise the quantitative and qualitative data into five large result chapters as presented in Table 3.1. The first results chapter, based at a macro level, focuses on the articulation of gender relations in ICTs in policy and their instruments (Chapter 4). The second results chapter presents an analysis of platform types (Chapter 5), followed by the third chapter, providing an in depth analysis of the gender equality dimension in the performance rationales of two ICT platforms (Chapter 6). Both these chapters are at a meso-level. The last two results chapters are going down at a micro-level, in first providing an analysis of how and can women farmers access platforms (Chapter 7). In second, the types of innovative practices that are undertaken by both women and men farmers to access the internet and consequently, ICT platforms (Chapter 8).

CHAPTER 4 - The gender dimension in policy intervention and knowledge-based platforms in agriculture

This first results chapter aims at providing evidence to confirm that gender equality is a fundamental concern to the Kenyan Government for agricultural development and ICT development.

4.1. Policies and strategic frameworks for analysing gender relations

To analyse how gender equality objectives are articulated in policy intervention in Kenya, I have selected eight policy documents or national action programmes of the Kenyan Government:

(a) The Constitution of Kenya
(b) The National Agricultural Sector Extension Policy (Nasep)
(c) The National ICT Policy
(d) The National Gender Policy
(e) The Agricultural Sector Development Strategy 2010-2020 (ASDS)
(f) The ICT Master Plan 2014-2017/18
(g) The Agricultural Sector Gender Mainstreaming Guideline (ASGMG)
(h) The National Population and Housing Census (PHC) surveying process of the Kenyan population.

These documents have been selected because they are key references and fundamental to an examination of the positioning of the Government of Kenya, via public policy and strategic frameworks, regarding gender equality, farm extension and ICT policy goals. They are presented in Table 4.1 per respective institutional status. Three main categories have been defined to identify the status of the policy frameworks and national action programmes:

- Level of implementation, implying that it is a framework that concerns either all sectors in Kenya – horizontal integration – or one particular sector (i.e. agricultural sector) or system (i.e. the farm advisory services system) – vertical integration.
- Time of implementation or entering into force of respective frameworks.
- Duration of administrative framework or process, and if and when a renewal of the framework is planned (if relevant); in other words, whether it is a long-term or permanent document, or else limited in time.

Table 4.1: Selection of eight administrative documents of the Government of Kenya for an analysis of gender relations articulation in farm advisory intervention and ICT platforms.

(I) Fundamental principles	
The Constitution of Kenya[a]	- Fundamental principles or established precedents according to which the state of Kenya is governed. Horizontal integration (document concerns any Kenyan citizen) - Latest version from 2010 - Stable long-term policy framework
(II) National policies	
The National Agricultural Sector Extension Policy (Nasep)[b]	- Vertical integration in the agricultural sector (main national level policy for the farm advisory services system in Kenya) - Published in 2012 - Stable long-term policy framework
The National ICT Policy[c]	- Horizontal integration (main national policy for ICT interventions across sectors and systems)

	- Published in 2006 - Stable long-term policy framework
The National Gender Policy[d]	- Horizontal integration (main national policy for gender equality interventions across sectors and systems in Kenya) - Published in 2011 - Stable long-term policy framework
(III) National action programmes	
The Agricultural Sector Development Strategy (ASDS)[e]	- Vertical action programme at national level (agricultural sector in Kenya) - Came into force in 2010 - Ends in 2020. Not able to identify if a second phase of the programme will be developed. In place to achieve the Kenya 2030 vision (The Ministry of Planning and Devolution 2007), so it can be expected to be renewed.
The ICT Master Plan[f]	- Horizontal action programme at national level (ICT services across sectors) - Entered into force in 2014 - Ends in 2018. Not able to identify if a second phase of the programme will be developed. In place to achieve the Kenya 2030 vision (The Ministry of Planning and Devolution 2007), so it can be expected to be renewed.
(IV) Gender guidelines	
The Agricultural Sector Gender Mainstreaming Guideline (ASGMG)[g]	- Vertical gender equality integration support tool for the agricultural sector. - Published in 2010 - No identified timeline for the evaluation (and renewal) of the guideline.
(V) Surveying processes at national level	
The National Population and Housing Census (PHC) of the Kenyan population[h]	- National surveying process and demographic tool. Complete enumeration count of all individuals of Kenya at a stated time. Gender disaggregated data. (Horizontal integration) - Repeated every tenth year in Kenya, led by the Kenyan Bureau of National Statistics (KNBS). Last census conducted in 2009. - All statistical data is uploaded into a national database detained by the KNBS. General data available to the public. The next PHC will be conducted in 2019.

Source: Cf. footnote no.[80].

The analysis of these policies and national action programmes have been based on four counter-factual hypotheses and respective indicators (Table 4.2). The hypotheses presented in this Table enable us to analyse how gender equality dimensions are reflected in policy intervention and more precisely in knowledge-based platforms in agriculture in Kenya. These have been developed based on research from institutional economics (feminist economics, economics of services, cf. Chapter 2, Section 2.2.2). The policy analysis has been complemented with:

(1) Findings from interviews with staff working at the Ministry of Agriculture of the Kenyan Government (working at national and county levels) (n=19)
(2) Results from interviews with Kenyan small-scale female farmers (n=26)

[80] [a]National Council for Law Reporting (2010); [b]Ministry of Agriculture of Kenya (2012); [c]Ministry of Information and Communications 2006; [d]Ministry of Gender of Kenya (2011); [e]The Government of Kenya 2010; [f]Ministry of Information and Communications of Kenya (2014); [g]Ministry of Agriculture and Ministry of Livestock Development of Kenya (2010); [h]Kenya National Bureau of Statistics (2009).

Table 4.2: Data analysis framework of national administrative documents of the Kenyan Government

Counter-factual hypotheses	Indicators for data analysis
A: If the 8 policy documents from Table 4.1 are inclusive of gender equality, then it is expected to find gender-specific objectives and means in these documents (Section 4.2).	A.1: Objectives and/or statements that are gender specific A.2: Gender equal frameworks applied (i.e. gender mainstreaming, affirmative action) A.3: Disaggregated statistical data based on repeated surveying processes (i.e. the population and housing census) A.4: Gender disaggregated budgeting
B: If a gender equality dimension is included in the farm advisory services system in Kenya, then it is expected to find the integration of gender equality objectives in:	
B.1: Front-office activities (Section 4.3.1)	B.1a: Financial system to reach women and men farmers with advisory services B.1b: Facilitation procedures for knowledge exchange with female and male farmers B.1c: Interaction modalities to address women and men farmers' demands
B.2: Back-office activities (Section 4.3.2)	B.2a: R&D gender equal framework for farm advisory services with a dedicated budget and evaluation measures B.2b: R&D instances responsible for gender equality integration in the farm advisory services system B.2c: Monitoring and evaluation system measuring if female and male farmers are accessing and actively using advisory services
B.3: Institutional coordination processes (Section 4.3.3)	B.3a: Institutional coordination strategy to ensure that services and technical content is gender inclusive B.3b: Institutional coordination instance responsible for the overall surveillance of gender equality integration in the farm advisory services system
C: If platforms are considered important tools for the Government to achieve gender equality objectives, then it can be expected to find evidence that platforms are used to reach female and male farmers with services and knowledge (Section 4.4.1).	C.1: Some objectives for using platforms in policy intervention should be gender specific C.2: Rationales found in administrative frameworks considering the use of platforms as gender inclusive tools
D: If gender equality objectives are integrated into platforms in farm advisory services through policy work, then it can be expected that different gender equality dimensions are included in the policy processes and work of the Kenyan Government (Section 4.4.2).	D.1: Facilitation procedures for knowledge exchange with female farmers in platforms (front-office) D.2: Ethical standards framework-guiding platforms on the inclusion of gender equality (back-office) D.3: Monitoring and evaluation system measuring if female farmers are accessing and actively using platform services (back-office) D.4: Institutional coordination strategy for platforms to ensure that services and technical content is gender inclusive D.5: Financial strategy by the Kenyan Government to ensure that female and male farmers are provided with ICT-based services and technical knowledge in the long-term

The following sections present the findings from the policy analysis with respect to the counter-factual hypotheses in Table 4.2.

4.2. The articulation of gender relations in public policy intervention

Gender equality is part of the fundamental principles of the Kenyan Government, as stipulated in the Constitution of Kenya (Chapter 4, the Bill of Rights Part 1 and Part 5 (Article 59) in the Constitution, National Council for Law Reporting (2010)). The Kenya National Human Rights and Equality Commission is responsible for the overall integration of gender equality and of gender mainstreaming in national development. This Commission has the mandate to promote gender equality and freedom from discrimination. It holds the Kenyan Government accountable by undertaking audits to establish levels of compliance with the principles of gender and inclusion.

The national gender policy, guided by the Constitution of Kenya, sets the general gender equality goal for the Kenyan Government (Ministry of Gender of Kenya 2011). *"The overall goal of this Policy Framework is to mainstream gender concerns in the national development process in order to improve the social, legal/civic, economic and cultural conditions of women, men, girls and boys in Kenya. Progress towards gender equality depends upon strategic and well-targeted interventions. The policy provides direction for setting priorities. An important priority is to ensure that all ministerial strategies and their performance frameworks integrate gender equality objectives and indicators and identify actions for tackling inequality. In addition, each program will develop integrated gender equality strategies at the initiative level in priority areas. Within selected interventions, the policy will also scale-up specific initiatives to advance gender equality."* (Ministry of Gender of Kenya 2011, p.15).

This is a horizontal integration document, implying that any public instance and therefore Ministry in Kenya must adhere to the gender equality principles stated in this framework. Applying gender mainstreaming as a gender guiding principle is mandatory for all Ministries and public authorities[81]. The gender principle is used in both national policies (the Nasep, the ICT policy) and national action programmes (the ASDS and the ICT Master Plan) (Ministry of Agriculture of Kenya 2012; Ministry of Information and Communications 2006; The Government of Kenya 2010; Ministry of Information and Communications of Kenya 2014). In addition to the use of gender mainstreaming as the main principle for the integration of gender equality, the Government of Kenya uses affirmative action measures and particularly the one-third quota. Per the Constitution of Kenya, at least one third of elected officials, in any sector, must be women (National Council for Law Reporting 2010). The one-third principle is applied via the national Gender Equality Policy (Ministry of Gender of Kenya 2011).

Hence, the Constitution of Kenya and the national Gender Equality Policy sets the gender equality agenda for all sectors, national policies and action programmes. Moreover, there are

[81] The Ministry of Gender, Children and Social Development was established by the Kenyan Government in 2008 (Ministry of Gender of Kenya 2011). This body is responsible for the overall coordination of the integration of gender equality across sectors (and their institutional frameworks) in Kenya. There are two main technical departments that constitute the Ministry: The Department of Gender and Social Development, and the Department of Children's Services. There are three semi-autonomous government agencies: the National Commission on Gender and Development (responsible for coordinating gender mainstreaming, establishing partnerships, monitoring and evaluation to achieve gender equality); the National Council for Children's Services (responsible for the formulation of policies on children's issues) and the National Council for Persons with Disabilities (accountable for the mainstreaming of individuals with disabilities in socio-cultural, economic and political development). The main guiding policy for gender equality is the gender policy of the Government of Kenya. Gender mainstreaming is the major guideline used for the integration of gender equality. Affirmative action is used as a tool for managing discrimination against any social groups at a given point in time. The policy emphasises women's and men's needs, and should be taken into consideration in policy intervention in all sectors.

gender equality objectives and/or statements present in the policy documents of the Kenyan Government, namely the Nasep[82] and the ICT policy. In regards to the integration of gender equality objectives in ICT development in Kenya, gender equality is present in the overall objective of the Kenyan ICT policy and there is a specific chapter on the matter in the document. *"Gender issues touch on all aspects of ICTs in development. There is, therefore, need to: a) Ensure the participation of women in ICT policy formulation and implementation at all levels. b) Ensure that ICT policies at all levels are engendered and geared towards meeting specific developmental needs of women."* (Ministry of Information and Communications 2006, p.8). The policy states that women have specific needs and that gender mainstreaming will be used to integrate these multiple needs into ICT-related activities. The Government notes that there is unequal access to ICT services and that there is a need for public investments in infrastructure and IT education, especially for women in rural areas. This is also the case for the national action programmes, i.e. the ASDS[83] and the ICT Master Plan[84]. It is also possible to observe that all four documents make use of gender equal frameworks[85].

The Government of Kenya allocates on average 0.3% of the annual budget to bodies that implement gender related actions[86] (The National Treasury of Kenya 2018). This part of the budget is divided into two main items: (1) the National Gender and Equality Commission (0.03% of the total annual budget), and (2) the State Department for Gender (0.3% of the total annual budget). The legal and policy framework for adopting and implementing gender responsive budgeting ensures that the annual budget in Kenya allocates funding to gender authorities and earmarked gender projects[87] (The National Gender and Equality Commission Kenya 2014). Its purpose is to pursue gender-equitable allocation of resources.

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[82] In the national agricultural sector extension policy (Nasep) the gender integration process is set, based on five goals (Ministry of Agriculture of Kenya 2012). Different types of extension service providers are responsible for achieving this process (public extension services, private firms, non-governmental organisations, agricultural supply chain services suppliers). Per the Nasep, it is expected of these actors to: (1) Disseminate gender-sensitive technologies and interventions; (2) Influence the development of gender-sensitive technologies; (3) Connect extension clientele to stakeholders in education and awareness creation of various rights, followed by a change in attitudes on gender relations in the community; (4) Influence gender mainstreaming in the curricula of schools and training institutions and; (5) Target the youth in becoming farmers and agri-business entrepreneurs. To attain these objectives, the Nasep proposes different farm advisory methods (farmer group trainings, farmer demonstration days and, ICT devices).

[83] Per the ASDS, female farmers are key economic agents in the Kenyan economy, which is why this group of workers are prioritised in policy intervention in agriculture in Kenya. As highlighted in the ASDS: *"Women contribute 60–80 per cent of labour in household and reproductive activities and in agricultural production. Generally, women work longer hours than men. [T]raditional interventions in agricultural development are likely to affect men and women differently. An effective gender approach to designing and implementing interventions in agriculture would take these differences into consideration, focusing on equality and equity of the outcomes rather than just equal treatment. The Government will develop a gender policy for the agricultural sector to ensure women's empowerment and mainstream the needs and concerns of women, men, girls and boys in all sectors so that they can participate and benefit equally from development initiatives."* (The Government of Kenya 2010, p.81).

[84] Equity and non-discrimination is one of the five principles for achieving the vision of the ICT master plan: *"Kenya as a regional ICT hub and a globally competitive digital economy"* (Ministry of Information and Communications of Kenya 2014, p.39). More explicitly, it highlights equal and adequate access for women to ICTs in Kenya and across county governments in rural and urban areas. A multi-actor approach, via the establishment of public-private partnerships, is suggested for the implementation of these five principles.

[85] Cf. Appendix 12 for a presentation of gender equality goals per national administrative frameworks.

[86] This year's annual budget (2017/2018) and future projections until 2021 (The National Treasury of Kenya 2018, pp.95–101).

[87] I was not able to obtain the national budget figures for the earmarked gender projects of the Kenyan Government.

Verification of regulatory aspects at national level show that the policy documents and national action programmes are inclusive of gender equality objectives. The results provide evidence that the Government of Kenya stands behind and values gender equality, as reflected in its national policies. Irrevocably, this fundamental social relation is affirmed as an objective of equity by the Kenyan Government. These results strongly indicate that it is expected of ICT platforms used in agriculture (and farm advisory services) intervention to integrate objectives of gender equality. We shall now verify how gender equality goals are articulated in different farm advisory services dimensions of policy work.

4.3. The gender equality dimension of the Kenyan farm advisory services system

This section presents an in-depth analysis of what can be expected in regards to the integration of gender equality objectives in ICT platforms used in farm advisory intervention in Kenya. The Nasep and the ASDS are the main administrative frameworks that are analysed here because they present the farm advisory services objectives of the Kenyan Government, and actions for their implementation.

The current farm advisory services system in Kenya mobilises multiple types of actors and service modalities to supply millions of small-scale farmers with services and technical knowledge. The importance of ICTs and knowledge-based platforms are growing in this system (Ministry of Agriculture of Kenya 2012). As shown in Chapter 1, the Kenyan Government takes seriously the assumption that ICT platforms have the ability to reach, more effectively compared to traditional types of advisory services, marginalised farmers, such as female farmers. Thus, knowledge-based platforms do not come into an empty space, there are already technological trajectories and institutional coordination structures in place. Hence, there are different services modalities to be considered by ICT platforms, if they are to replace traditional forms of farm advisory services and be inclusive of gender equality goals. In this respect, three key scopes of analysis have been identified based on economics of services studies (cf. Chapter 2, Section 2.2.2.2 and Section 2.2.2.3):

(1) Front-office activities: modalities of interaction, co-production of knowledge (Falzon & Cerf 2015; Berriet-Solliec et al. 2014; Labarthe & Laurent 2011).
(2) Back-office activities: knowledge capitalisation, R&D, regular keying in of data based field observations, scientific monitoring (Laurent et al. 2006; Labarthe & Laurent 2013b).
(3) Institutional coordination processes: coordinating structures and bodies in place to interlink supply and demand (Laurent et al. 2006; Poulton et al. 2010).

4.3.1. Gender equality objectives in front-office activities of the farm advisory system

There are three main front-office objectives presented in the Nasep, which are put in action through national programmes such as the ASDS. The first one concerns the financial mechanisms in place to reach women farmers with advisory services. To compensate for the decrease in the extension advisor to farmer ratio, and budget cuts, the Kenyan Government is willing to use a multi-actor approach to supply women and men farmers with services. Public services providers, private-sector suppliers, agricultural supply-chain services providers, NGOs and cooperatives are involved and given the mandate by the Kenyan Government to supply services to farmers. Female farmers are especially targeted.

This multi-sector approach consists in having two main financial mechanisms that are supposed to reach women farmers. The first one is where the Government of Kenya finances the farm

advisory system with public funding and with the support of foreign-based governments, international donors (the World Bank, the FAO), or PPPs (private investors) (Ministry of Agriculture of Kenya 2012). The second financial mechanism consists in the implementation of specific farm advisory programmes or projects. Such interventions can be implemented: (1) via the Ministry of Agriculture at national or county level, and the Government channels the funding to different advisory service suppliers; or (2) from different donors to extension service suppliers without going through the Kenyan Government. Gender relations in services and knowledge content will thus be addressed differently between these two mechanisms. The first mechanism must address gender equality aspects according to the definition and means set in national documents. By contrast, the stakeholders involved in the second financial mechanism process do not have to go via the Government, and could have their own vision of what is considered gender equal. They may therefore not develop services based on the Kenyan Governments' vision of gender relations.

Five major facilitation procedures are presented in the Nasep, where knowledge is disseminated via the use of ICTs: group interventions, farmer demonstration trainings, organised trainings at agricultural centres, and agricultural shows.

In this regard, findings from the individual interviews of small-scale women farmers (n=26) show that knowledge exchange in collective spaces is of particular interest to them (groups, demonstration days, organised trainings, although in confined spaces, maximum of 10 individuals). Therefore, some of these modes have been designed to address the demands of women farmers. The institutional interviews at national level with staff from the Ministry of Agriculture (n=3) confirm that the gender mainstreaming principle has supported them to integrate gender equality in farm advisory services. Likewise, it is stipulated in the Nasep that gender mainstreaming is used to integrate women farmers' demands in front-office activities.

Besides the importance to the interviewed small-scale female farmers (n=26) of collective spaces for knowledge exchange, receiving individual advice is also a priority to them. Results from the institutional interviews (n=19) confirm that this is a persistent demand from female farmers in Kenya. Individual advice is especially a demand from women farmers to co-construct the problem at hand, co-produce knowledge and enter into a service relation based on trust. Labarthe & Laurent (2011) show in another context that the highest likelihood for co-production of knowledge between the farmer and the service supplier is through face-to-face interaction or individual meetings at the farm. Per the Nasep, the face-to-face intervention method is being increasingly replaced by other more standardised extension approaches. Responses from the interviews with officers working for public entities in Kenya (n=19) confirm this. The interviewees also expressed concerns relating to the fact that the knowledge content disseminated via more standardised approaches (i.e. trainings in large groups, more than 20 participants) could not be adjusted to the individual demands of women farmers.

In sum, although not always explicit, there is evidence supporting the fact that gender relations is a dimension that structure the front-office activities in the farm advisory system of the Kenyan Government. It could thus be expected of ICT platforms used in farm advisory intervention in Kenya to work against gender equality objectives, and integrate women and men farmers specific (and different) demands for services (e.g. receiving interactive advice) and technical knowledge.

4.3.2. Gender equality objectives in back-office activities of the farm advisory system

If a gender equality dimension is included in the farm advisory services system in Kenya, then it can be expected to find the integration of women farmers in back-office activities. Based on analysis of the Nasep and the ASDS, as well as the institutional interviews (n=19), I was not able to identify: (1) a gender equality R&D framework in farm advisory services; (2) an R&D body responsible for gender equality integration in the farm advisory services system; and (2) a monitoring and evaluation system measuring if female farmers are accessing and using advisory services.

I thus found no evidence of the inclusion of gender equality dimensions in the back-office dimension of Kenyan farm advisory services intervention. If this is indeed the case, then there is a risk of certain aspects being absent from advisory services, causing them to be unable to effectively address women and men farmers' demands. Farmers may consequently be offered services that are not relevant to them, as regards the type of technical content they need, on the one hand, and the types of interaction modalities and facilitation procedures usually prioritised by female farmers, on the other. An emerging risk is also that ICT platforms do not consider gender equality objective in the back-office dimension of services.

4.3.3. The consideration of the gender equality dimension in institutional coordination processes

The overall consideration of gender equality objectives in the farm advisory services system should be ensured via institutional coordination processes.

Based on analyses from the Nasep and the ASDS, it is possible to develop a conceptual framework showing the integration of gender equality dimensions in the farm advisory services system of the Kenyan Government (Figure 4.1). Rationales from the interviews at institutional level (n=19) were also used in this regard. The institutional interviewees working at national level involved in gender mainstreaming activities (n=3), confirm that the Kenya National Human Rights and Equality Commission has an overall surveillance responsibility for gender equality integration across sectors and systems. The Ministry of Public Service, Youth and Gender Affairs has the mandate to coordinate gender equality integration across the public system in Kenya. This includes the agricultural extension services system.

Hence, Figure 4.1 demonstrates that the Government of Kenya is making a considerable effort to include objectives of gender equality in the institutional coordination system of agricultural extension services. I was not however able to identify processes for gender equality content assurance via research bodies. Moreover, enough supportive evidence was not found to show how gender equality goals are concretely integrated at meso level (enterprise level) in the farm advisory services system.

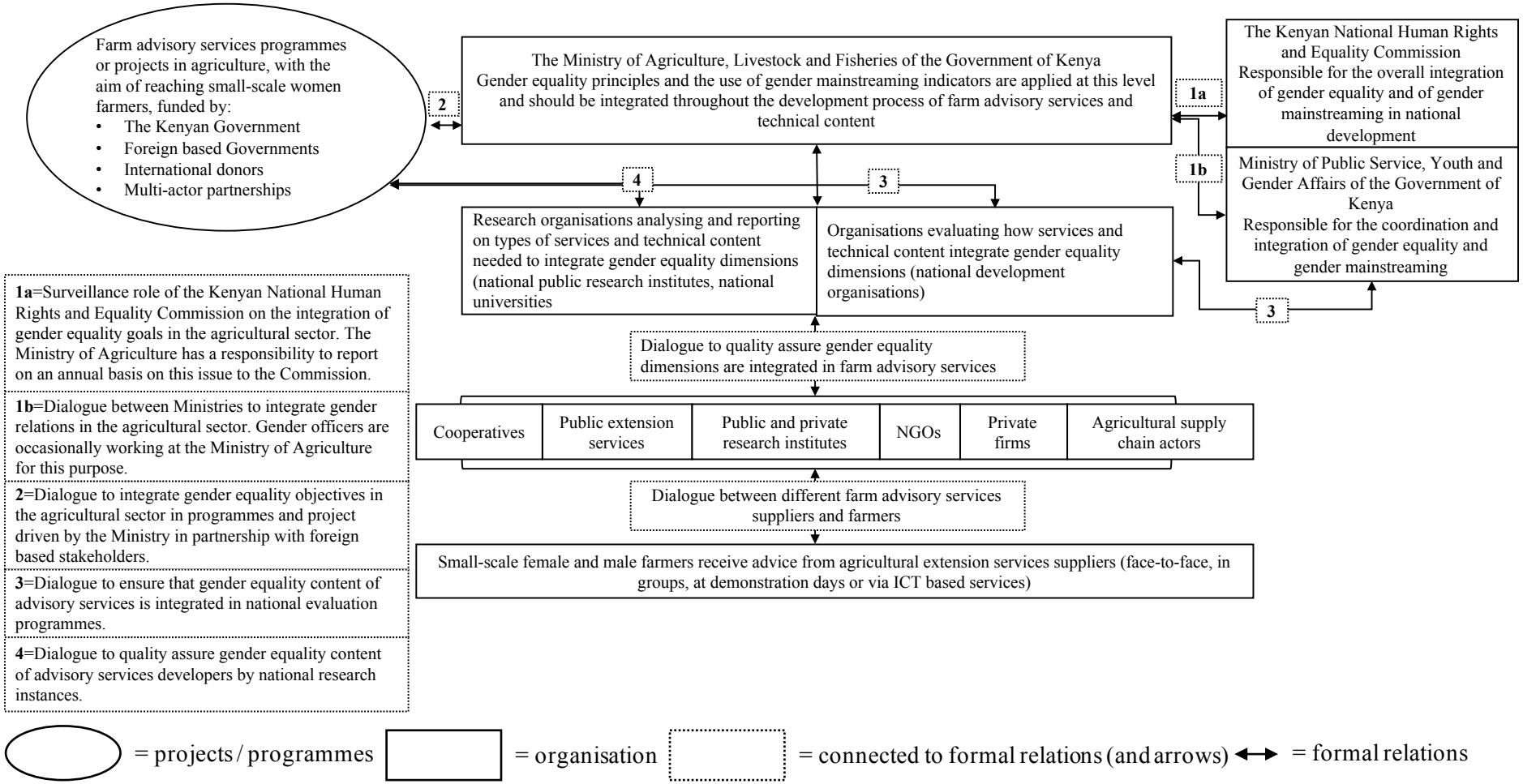

Figure 4.1: Institutional framework of the integration process of gender equality in the farm advisory services system of the Kenyan Government.

4.4. Gender equality objectives in ICT platforms used in advisory services

ICT knowledge-based platforms are one instrument used to achieve set policy goals in the farm advisory services system and thus to ensure that gender equality dimensions are integrated therein. The policy frameworks that are analysed in this section are the Nasep, the ICT Policy, the ASDS and the ICT Master Plan.

4.4.1. ICTs and platforms: tools in place to reach women farmers

In this dimension, if platforms are considered important means for the Government to achieve gender equality objectives, then it can be expected to find evidence that platforms are used to reach female farmers with services and knowledge adjusted to their specific demands (cf. Table 4.2 (C)).

Through the ASDS, the Government of Kenya aims at becoming a knowledge-led economy (The Government of Kenya 2010). It makes the assumption that to increase agricultural productivity levels, knowledge must especially reach women farmers. The national ICT policy and national action programmes (ASDS and the ICT Master Plan) bear witness to the fact that the Kenyan Government believes that ICTs have the ability to achieve this objective[88]. Farm advisory services are therefore being increasingly supplied via the use of ICTs in Kenya (Ministry of Agriculture of Kenya 2012). One such device is ICT knowledge-based platforms.

An objective in the Nasep is to use ICTs in farm advisory services to disseminate knowledge in remote areas and to vulnerable groups. Women farmers are identified as a particularly vulnerable group. Hence, the main rationale found throughout the national frameworks[89] is that ICTs, such as platforms, can reach female farmers with technical knowledge and information updates more rapidly compared to traditional advisory services. The foremost arguments are based upon the rapid spread of the internet and innovations in agriculture, and the assumption that most women farmers can at present use a mobile phone to enter into use with platforms. This primarily concerns women who live in remote rural areas.
It was possible moreover to identify two main facilitation procedures for knowledge exchange with female farmers in ICT platforms, as reflected in the Nasep. I complemented the analysis with responses from the institutional interviews (n=19). These are:

(1) virtual interfaces (possibility for farmers to enter into contact with advisors via blogs, online forums, online video interface);
(2) short message services (SMS) or interactive voice response services (IVRS) based on a phone number displayed on the platform. The farmer can then enter into contact with an advisor, either to receive advice over the phone, or to make a request for an individual visit at the farm or for group training / demonstration training.

These observations show that gender equality dimensions are present in the front-office dimension of platforms at policy intervention level and that it is possible to extract gender equality rationales from the policy frameworks. This does however not imply that the facilitation procedures in platforms are exhaustive with respect to the demands of women farmers. In sum, analysis shows that the objectives for using platforms in policy intervention can be gender specific.

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[88] Ministry of Information and Communications (2006); Ministry of Information and Communications of Kenya (2014); The Government of Kenya (2010).
[89] The Nasep, the ICT policy and the ASDS.

4.4.2. The place of ICT platforms in the policy work of the Kenyan Government

If the gender equality dimension is integrated into ICT platforms through policy work, then it can be expected that different gender equality dimensions will be included in the policy work and coordination processes of the Kenyan Government (cf. Table 4.2 (D)).

A specific gender equal framework guiding ICT platforms on the inclusion of gender equality objectives could not be identified through the national policies or the national action programmes. The institutional interviewees working at national level (n=3) confirm that such a type of framework has not yet been developed. However, the ASGMG is a gender mainstreaming tool for the agricultural sector that provides guidance and indicators of how gender equality should be considered in national action programmes / projects. It is stated in the ASGMG that the tool follows the gender equality principles outlined in the Constitution of Kenya, and was developed to support the integration of gender equality objectives in the ASDS. As such, it provides ethical guidance in respect of gender relations, but not limited to ICT-based farm advisory services.

The national policies and national action programmes followed by the institutional interviews (n=19) reveal that there is presently no evaluation system in place for measuring female farmers' access to and use of ICT platform services. According to the interviewees working at national level (n=3), there is no system that monitors and evaluates the overall performance of the ICT-based advisory services system. The main reason for this is a result of the high investment and maintenance costs of such system. The Government of Kenya is however investing in heavy data collection via the PHC. This census offers a precise macro-level understanding of the levels and location of internet access and use, and of ownership of ICT devices among the Kenyan population as a whole. The data can thus show potential inclusion or exclusion factors for women with respect to the question at hand. Moreover, by having such data collection system also shows that the Government seriously considers ICT development in Kenya, and how services supplied via platforms are reaching their farming population.

It is possible to formalise the institutional framework in which the ICT-based advisory services system of the Kenyan Government are embedded (Figure 4.2). It shows that a central place is given to knowledge-based platforms. It also demonstrates that the Kenyan Government is developing a large coordination system with a diversity of stakeholders to supply female and male farmers with advisory services and technical content via ICTs. I was nonetheless not able to identify the gender-bound quality assurance processes in place (to verify if ICT services and the technical content therein are inclusive of gender equality objectives). As a result, the tangible integration of gender equality through the coordination process becomes difficult to analyse. There is also a risk of disseminating technical content that is not considered important for the projects of women and men farmers. Still, Figure 4.2 highlights the ambition of the Kenyan Government to integrate objectives of gender equality in this ICT-based farm advisory services system.

Figure 4.2 also shows the strategy put in place by the Government for the financing of this ICT-based farm advisory services system. According to the Nasep, the ICT master plan and the ASDS, there is a stronger intention to involve actors based abroad, based on multi-actor partnerships to co-finance this system. The Nasep and the ICT policy emphasise that multi-actor involvement also guarantees its long-term sustainability. This provides evidence that the Government is seeking a financially sustainable, lasting way to provide female and male farmers with services and technical knowledge.

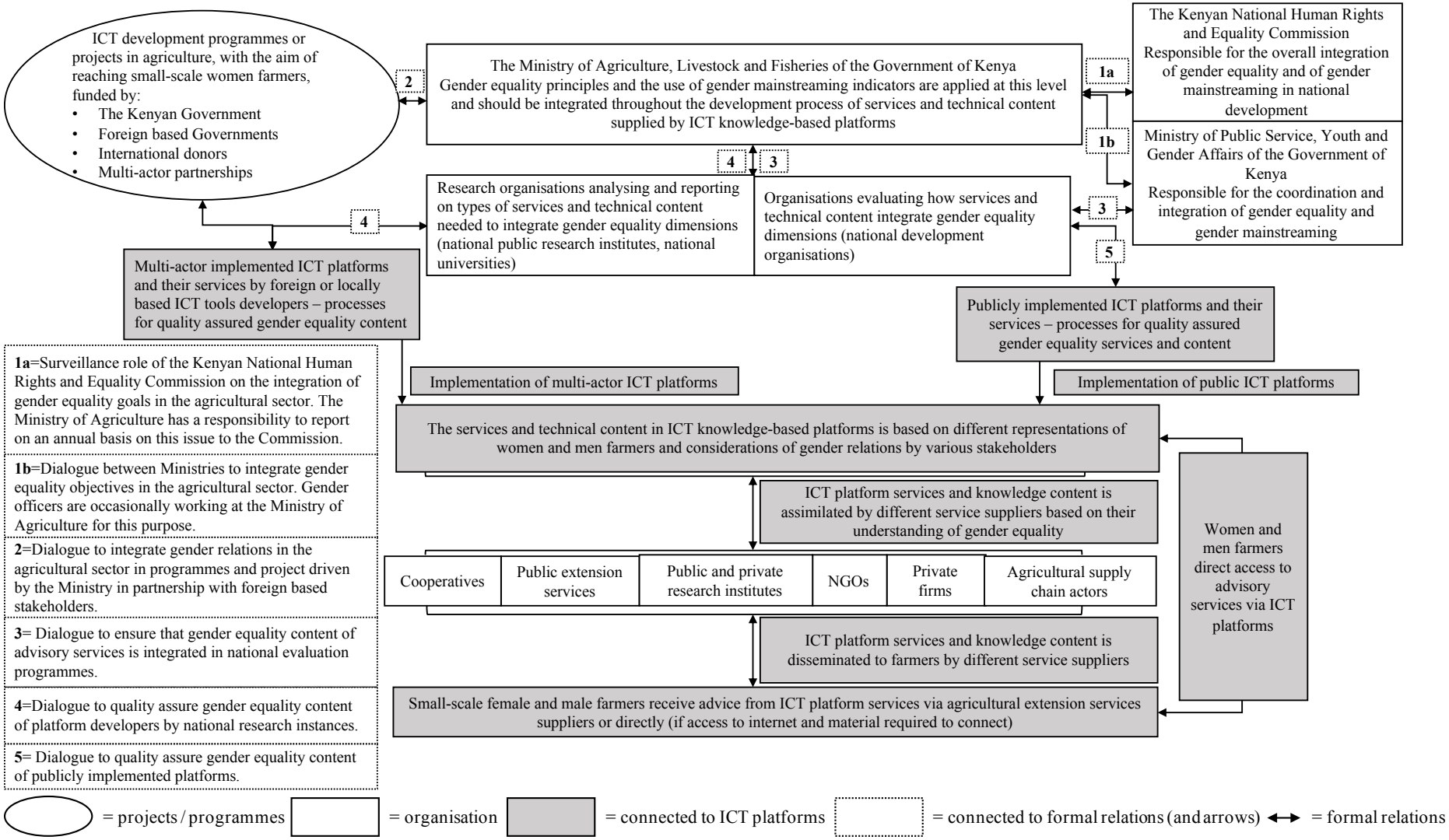

Figure 4.2: Institutional framework of the integration process of gender equality in an ICT-based farm advisory services system in Kenya.

4.5. *To conclude:* The political economic dimension of ICT platforms

The results demonstrate that gender equality is indeed a fundamental guiding principle to the Kenyan Government. It upholds gender relations as an objective of equity.

Furthermore, the analysis of policy documents provides evidence that knowledge-based platforms are considered as new tools of inclusiveness in farm advisory services innovation. ICT platforms are also viewed as possible solution to solve budgetary issues that arise with the upkeep of the national farm advisory services system. The results show that platforms are expected to reach female farmers more effectively, compared to traditional types of services, with a large diversity of services and technical content. The analysis of policy document also show that the Kenyan Government aims at developing partnerships to test these technologies, as it has limited room to manoeuvre and financial resources. Such partnerships may also provide an opportunity to this Government to develop databases for an ensured back-office dimension to support services (this will be elaborated upon further in Chapter 5).

Hence, knowledge-based platforms are used in policy intervention, with the specific purpose of supplying female farmers with agricultural services and knowledge. In that sense, platforms are considered by the Kenyan Government as an instrument of gender equality integration. In other words, they are used as a means for the Government to achieve gender equality objectives at national level.

The analysis of policy documents demonstrate that ICT platforms are more than mere technical tools, as they are used as instruments for the social integration of women. They comprehend a political, economic, and social dimension. They can be considered as a policy instrument as defined by Lascoumes & Le Gales (2007). *"A public policy instrument constitutes a device that is both technical and social, that organize specific social relations between the state and those it is addressed to, according to the representations and meanings it carries. It is a particular type of institution, a technical device with the generic purpose of carrying a concrete concept of the politics/society relationship and sustained by a concept of regulation."* (2007, p.4) [90]. Parallels from this definition can be drawn to the technical and social aspects of ICT knowledge-based platforms, and the social relations and implicit dimensions therein.

The results from this Chapter show that indeed, ICT platforms in farm advisory services intervention are not neutral devices, and the definition of a policy instrument allows us to enlighten this. Defining ICT platforms as policy instruments also makes it possible to understand the policy objectives developed by the Kenyan Government (i.e. why the Government has decided to use platforms in farm advisory services intervention and why they are used to achieve gender equality objectives). As a result, whether it is made explicit or not, they are carriers of gender relations hence bearing implicit representations of women and of gender norms. Consequently, considering ICT knowledge-based platforms as policy

[90] The definition of a policy instrument is accompanied by (and interlinked with) public policy instrumentation, accentuating the importance of understanding the effects produced by the choice of a certain instrument. *"Public policy instrumentation – in our understanding – means the set of problems posed by the choice and use of instruments (techniques, methods of operation, devices) that allow government policy to be made material and operational. Another way of formulating the issue is to say that it involves not only understanding the reasons that drive towards retaining one instrument rather than another, but also envisaging the effects produced by these choices."* (Lascoumes & Le Gales, 2007, p. 4). In this regard, The authors stress that policy instruments generate outcomes that are hard to measure at different levels of intervention. Cf. Appendix 2 for further readings on policy instruments.

instruments demonstrates the heuristic value of having chosen these devices. Therefore, it presently makes sense to apply a multi-level approach for understanding if these ICT policy instruments can be inclusive of women farmers and their specific demands or if they actually contribute to a digital gender divide. For that reason moreover, it becomes fundamental to perform an analysis of the different performance registers of platforms, to define general rules as to how women and men farmers can make the most of ICT platforms.

CHAPTER 5 - Variety of ICT platforms and gender equality objectives

Results from investigations including discussions with interviewees at the Kenyan Ministry of Agriculture and research bodies in Kenya show that there has been a significant development of knowledge-based platforms in advisory services intervention in this country. In this regard, the purpose of this chapter is to present this variety of platforms and to analyse performance rationales with respect to gender equality objectives (and thus the integration of women farmers) in platforms. Here, I study the gender dimension in what Gadrey (1990) refers to as the 'upper level' of service relations[91].

5.1. Identification of internet knowledge-based platforms in Kenya

The first step entails the identification of platforms, the criteria for their analysis with respect to gender, and with what rationales I have examined them. I identified the knowledge-based platforms in three steps. I based the selection criteria upon the definition of knowledge-based platforms presented in the introduction chapter of this thesis. Therefore, a platform should be:

(1) Internet-based,
(2) A shared repository for various types of cognitive resources, giving access to knowledge content and different types of ICT services,
(3) A virtual space or forum where:
    a) knowledge suppliers and users can interact via virtual spaces (blogs, chats, forums for discussion),
    b) the knowledge quality may be discussed, stored, and disseminated,
(4) A gateway, providing access to other types of resources, including links to websites and services.

Second, I conducted internet searches to identify platforms dealing with farm extension, based upon the above four dimensions. I was able to identify nine ICT platforms[92] in Kenya. Third, to cross-verify the preliminary selection of platforms, their actual identification and validation were done through dialogues with staff working at the Ministry of Agriculture (National and County level) (n=3), the University (n=2), and NGOs (n=3) in Kenya.

The nine identified platforms are:

- The National Farmers' Information Services (Nafis)
- AgriProFocus (APF)
- iShamba
- Infonet-Biovision
- iCow
- Seed Sector Platform Kenya (SSPK)
- Forum for Agricultural Research in Africa (FARA)
- Pan-African Farmers Organization (PAFO)
- Pan-African Agribusiness Agroindustry Consortium (PanAAC).

To study how gender relations are articulated in these nine platforms, I started with the findings from the literature review on knowledge-based platform development (cf. Chapter 1). Two key dimensions were thus used to structure the analysis:

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[91] Chapter 2, section 2.2.2.2.

[92] The list is not exhaustive but based upon the platform definition of this research. I was able to identify a total of nine knowledge-based platforms.

- The institutional dimension of platforms (types of partnerships, financial structures, objectives of inclusion of different social groups and sustainability of platforms)
- The rationales of the performance of platforms and their gender objectives (types of services and knowledge content, interactions, women farmers' access and use).

The platform analysis was based on:

(1) Internet searches for identification and analysis of relevant platform documents (annual reports, budgets, constitutive documents)
(2) Results from interviews with staff working at national or county level at the Ministry of Agriculture or the University (n=6)
(3) Findings from interviews of platform staff working with two platforms: Nafis and APF (n=13).

Based on these conceptual frameworks and materials, the results from the knowledge-based platform analysis are presented in Section 5.2 and 5.3.

5.2. Diversity of knowledge-based platforms

Three main results are hereby presented. Section 5.2.1 presents five major types of ICT platforms in farm advisory services intervention. The financial model types of platforms are presented in Section 5.2.2. The implicit dimensions of gender relations in platforms is analysed in Section 5.3.1.

5.2.1. Presentation of knowledge-based platform typologies

Nine ICT platforms supplying farm advisory services in Kenya were identified, and classified into five main types. These types were built by considering three categories, namely:

(1) The status of platforms. This category relates to the civic dimension of the platform performance analysis and the weight given to dimensions of gender equality by each stakeholder involved in these devices. We have seen that gender equality is a priority to the Kenyan Government. It can therefore be expected that platforms with Government involvement will aim to integrate women farmers into their activities.

(2) The financial structures of the platforms. Different actors involved in platform development may have different conceptions of what is considered as gender equal, which may or may not adhere to Kenyan women farmers' demands. This could be reflected through the financial set-ups of the platforms.

(3) The technical objectives of platforms. These concern: (a) the type of target group of platforms and if these devices explicitly aim at reaching women farmers, followed by (b) the ownership and quality assurance of services and knowledge content of platforms targeting women farmers' needs.

The five types are presented below, and findings are presented in Table 5.1. Also, see Box 5.1 for an in-depth elaboration upon the nine different platforms.

Type 1: State owned platforms. Type 1 corresponds to a platform fully integrated into the farm advisory services of the Government. The technical content is designed under the control of the Ministry's services. Type 1 platforms target the small-scale farmer in Kenya. This type

benefits from funding and in-kind contributions from the Government. Foreign-based financial support is not excluded but emanates from government funding.

Type 2: Foreign-based platforms, governing body and authority based abroad. Type 2 platforms are based upon various foreign-based public-private-NGO set-ups (with different configurations). Type 2 platforms benefit from financial support from private foreign-based financiers and public donors. These platforms have a particular agricultural thematic focus or are based on a specific aspect of the agricultural value chain, targeting any type of farmer. Technical content is not developed under the control of the Government of Kenya.

Type 3: Platforms run by Kenyan private independent advisors. Platforms that fall under Type 3 are considered as a service provider mandated by the Government of Kenya to disseminate technical content to farmers. Type 3 platforms can entirely or partly benefit from support from foreign investors (private) and/or foreign public donors. The technical content is developed within Kenya in partnership with different research organisations (but not necessarily public research institutes). The knowledge of the platforms' services can either be general or have a particular thematic focus and target the smallholder farmer.

Type 4: Kenyan agribusiness platform. Public-private set-ups is the main financing structure for Type 4 platforms. These partnerships can be comprised of: (a) foreign-based private actors only, (b) Kenyan private actors only, or (c) a mix of the two. These platforms do not benefit from financial support from the Kenyan Government. The technical content is owned by the platform and/or the financiers and is restricted to a particular agricultural crop. Hence, only such types of farmers are targeted.

Type 5: Multilateral Pan-African platforms, supporting farm organisations or the agribusiness industry. Type 5 platforms do not directly target the small-scale farmer. They are defined as continental platforms, with the aim of reaching individuals working in organisations that are connected to the agricultural sector. The platforms are run by African not-for-profit organisations, financed by international donors. The technical content is developed in expert groups, from various organisations (public, private, NGOs, research organisations, civil society organisations, cooperatives) and countries world-wide.

Table 5.1: Types of platforms emerging in Kenya and dimensions. (1) The status of platforms; (2) The financial structures of platforms; and (3) The technical objectives of platforms (target group, and ownership of services and technical content).

Type 1: State owned platform	
n°1: The National Farmers Information Service (Nafis)	(1) Implemented by the Kenyan Ministry of Agriculture; has national coverage in Kenya[1,28]. (2) Funded by the Government of Kenya, and financial and technical support from the Government of Sweden[2,27]. (3) Targeting Kenyan women and men farmers (with a special focus on the small-scale farmer). The platform supplies general agriculture and livestock knowledge. Knowledge content is co-produced with Kenyan institutes (essentially public organisations) and farmers[1,27].
Type 2: Foreign-based platforms, governing body and authority based abroad, having particular agricultural thematic focus	
n°2: AgriProFocus (APF)	(1) NGO registered and implemented from the Netherlands[3,28]. The strategic directions on content development decided from the Netherlands[3,27]. (2) Multi-stakeholder funded platform by the Government of the Netherlands, International development aid NGOs and private banks[3,27,28]. (3) Targeting individuals working in agricultural value chain, supplying general agriculture information[3,4,27,28]. Women farmers / women working in agriculture or livestock value chains are not explicitly targeted. Content developed with Dutch members[3,4].
n°3: iShamba	(1) Implemented by British NGO, national coverage in Kenya[5,28]. Mandate from the Kenyan Government to supply agricultural services to farmers[5,28]. (2) Funded by the Government of Sweden, the Government of the United Kingdom and the Government of Denmark via the Africa Enterprise Challenge Fund[6]. (3) Targeting Kenyan small scale farmer providing general agriculture knowledge[5,6]. Female farmers are not an explicit target. Knowledge content developed together with Kenyan farmers[6].
n°4: Infonet-Biovision	(1) The platform is owned by a non-profit Swiss organisation, which operates according to a Swiss Government agenda[7]. The information is disseminated in Kenya[7,28]. (2) PPP funded platform derived from the Biovision Foundation (35% Individual donors; 9% Donor Memberships Contributions; 12% Legacies; 26% Companies and Foundations; 18% Government agencies)[7]. (3) Targeting East African small-scale farmers, providing area-specific information (plant and livestock knowledge)[7,8,28]. The platform is not precise in terms of the type of small-scale farmers it targets (it is this group of workers in general).
Type 3: Platforms run by Kenyan private independent advisors	
n°5: iCow	(1) The platform is implemented via a private company called Greenlife[9,28]. Infonet-Biovision and The Global Alliance for Livestock Veterinary Medicines provides technical support[10,28]. (2) Public-private partnership platform funded by the Indigo Trust[11a,b] (UK trust fund under Sainsbury Family Charitable Trusts) and the foundation for Ethics in Globalization[12,28] (Swiss non-profit organisation). Public support from the Government of the US[10,28]. (3) Targeting Kenyan small-scale dairy farmers, both women and men farmers, supplying dairy farming information[9,10, 13,14]. Content developed together with farmers and dairy experts[13,14].

Type 4: Kenyan agribusiness platform	
n°6: Seed Sector Platform Kenya (SSPK)	(1) The platform is implemented by Agri Experience[15,28] (consulting firm specialised in advisory services for seed system development) and Kenya Markets Trust[16], receiving technical support from Adam Smith International (private company)[17,28]. (2) Public-private partnership platform funded by the Gatsby charitable Foundation[16,18,28] (funds originating from the Sainsbury food chain) and public support from the Government of the UK[19] and the Netherlands[16]. (3) Targeting Kenyan small-scale farmers, disseminating information on location of agro-seed dealers[15,16,19,28]. Women farmers are not an explicit target group. The technical content is developed with the agribusiness industry[15,16,19].
Type 5: Multilateral Pan-African platforms, supporting farm organisations or the agribusiness industry	
n°7: Forum for Agricultural Research in Africa (FARA)	(1) Non-profit public international network[20]. Supports sub-regional organisations and strengthens national agricultural research systems[21]. (2) Multilateral publicly-funded platform from the European Commission and the African Development Bank[21, 22]. (3) Targeting any agricultural organisations involved in agricultural research and extension[21,23,28].
n°8: Pan-African Farmers Organization (PAFO)	(1) Mandate from regional farmer organisations to develop and disseminate agriculture knowledge[24, 25]. Non-profit public organisation[24]. (2) Multilateral platform funded the European Union, the African Union[25], and national Governments (e.g. Kenya). (3) Targeting regional and national farmer-based organisations, disseminates agricultural knowledge in Africa for national farmer-based organisations[24,25,28].
n°9: Pan-African Agribusiness and Agroindustry Consortium (PanAAC)	(1) Mandate from African agribusiness members to develop and distribute agricultural knowledge[26,28]. (2) Multilateral public-private partnership-funded platform[21,26]. Public support from the European Commission. Private funding from agribusiness industry[26,28]. (3) Facilitates dialogue between agribusiness organisations and respective Government and civil society[26]. Disseminates agribusiness-related knowledge[26,28].

References: ([17]Adam Smith International 2016; [6]Africa Enterprise Challenge Fund 2015; [15]Agri Experience 2016; [3]AgriProFocus 2015, 2016b; [9]BCGT 2015; [14]Belot 2015; [7]Biovision Foundation 2015; [25]International Fund for Agricultural Development 2013; [12]Elea 2016; [22]EuropeAid Co-operation Office 2015; [20]Forum for Agricultural Research in Africa 2013; [21,23]Forum for Agricultural Reserach in Africa [21]2014, [23]2016; [10]GreenDreamsTech 2014; [11]Indigo Trust, [a]2013, [b]2016; [8]Infonet Biovision 2016; [16]Kenya Markets Trust 2016; [18]Lobbywatch 2004; [5]Mediae 2016; [2]Ministry of Agriculture of Kenya 2014; [4]Munjua 2015; [1]National Agricultural Farmers Information Service 2009; [26]Pan-African Agribusiness and Agroindustry Consortium 2016; [24]Pan African Farmers' Organization 2013; [13]TEDTalk 2012; [19]UKAid 2012; [27]individual interviews with platform staff; [28]Internet search).

Box 5.1: Presentation of the nine identified platforms per type.

One platform falls under type 1 (platform n°1)
The National Agriculture Farmer Information Service (Nafis) (platform n°1). Nafis is a public platform funded by the Government of Kenya and supported by the Government of Sweden (Ministry of Agriculture of Kenya 2014; The Government of Kenya 2013). It was established in 2009, under the National Agriculture and Livestock Extension Programme (Nalep). Presently, Nafis is under the Agricultural Sector Development Support (ASDS) programme, implemented by the Ministry of Agriculture (Ministry of Agriculture of Kenya 2014). The platform supplies a variety of services to farmers, e.g. voice call, online training modules and SMS services (via iShamba) related to different agricultural and livestock value chains. Public institutions such as the Kenya Agricultural and Livestock Research Organization (KALRO) provide sizeable in-kind contributions, especially regarding content development. Quarterly meetings (composed of 4-5 persons) are conducted on content development (and update) in collaboration with public agriculture research institutes and farmers. Two or more quarterly meetings can be conducted in the same quarter. There are furthermore extension officers and farmers available to answer questions from end users. Nafis has, on average, 40,000 visitors per month and a monthly target of 100,000 visitors. The platform's target is all types of women and men farmers in Kenya, with a particular focus on the small-scale farmer. Moreover, the platform explicitly targets women farmers with specific gender-targeted content and activities (for instance, poultry rearing, kitchen gardening, dairy farming).
Type 2: Three platforms (platform n°2, n°3 and n°4) that fall under type 2. For platform n°2 and n°4, the expertise to design the technical content is outside Kenya.
Platform n°2: AgriProFocus (APF) is a public-private partnership (PPP) platform, initially registered in 2005 as an NGO in the Netherlands (AgriProFocus 2016a). The platform receives funding from the Dutch Ministry of Foreign Affairs (80%), international NGOs, private companies and individual members. The platform develops and disseminates knowledge (soft and hard versions) within agricultural and livestock value chains, as well as on topics related to rural development (e.g. access to finance and markets). The technical content is developed by the Dutch member organisations of the platform. The platform also has a particular knowledge base on 'gender in value chains'. APF is present in 13 developing countries, Kenya being one of them. APF is not registered in any of the branch countries: the platform is hosted by member organisations. In Kenya, APF is hosted by HiVOS (International NGO). In 2015, APF had approximately 11,000 individual members worldwide and roughly 3,400 members in Kenya. It targets any type of agricultural producers (or individuals connected to the agricultural sector) throughout selected agricultural and/or livestock value chains. Women farmers / women working in different value chains are an explicit target in the 'gender in value chains' knowledge base. The gender knowledge base is not however integrated into the other knowledge bases dealing with agriculture or livestock value chains (further discussed in Chapter 6). **Platform n°3: iShamba** is an agricultural SMS and voice support service for farmers and is financed by the World Bank and Trademark East Africa Challenge Fund via the Africa Enterprise Challenge Fund (AEFC) (Track 2016). iShamba started in 2014. It operates via a platform that digitally manages the information, and through SMS diffusion and a call centre facility allowing dissemination of information without the requirement of a mobile network operator (Track 2016). iShamba targets all types of farmers in Kenya. Women farmers are not a categorical target of the platform. The project aims in assisting approximately 20,000 smallholder farmers in Kenya, with approximately 15,000 farmers signed up in 2015. **Platform n°4: Infonet-Biovision**, created in 2005, is an online platform, supplying trainers, extension workers and farmers with organic agricultural knowledge (Infonet Biovision 2016). The platform was created by the Biovision foundation (NGO) targeting African farmers. There are a number of case studies from Kenya. It is possible to download an offline Infonet-Biovision version for users having

restricted access to internet and/or a technical device. This platform is focused on organic farmers generally and female organic farmers are not an explicit target.
One platform falls under type 3 (platform nº5)
iCow (platform nº5) is a platform run by a private Kenyan company that receives support from a variety of foreign investors. This platform was developed by an independent advisor (a woman) who in 2016 had eight employees. iCow is a mobile application for Kenyan small-scale livestock farmers (GreenDreamsTech 2014). Hence, the technical content of the platform is focused on dairy farming, targeting the Kenyan dairy farmer (both women and men farmers), and is developed within Kenya. The application has an online platform containing videos for farmers, a Facebook page and a blog. iCow provides livestock farmers with extension advice via SMS and per phone in different languages, i.e. English, Kiswahili and local languages.
One platform falls under type 4 (platform nº6)
The Seed Sector Platform Kenya (SSPK) (platform nº6) is run by a private Kenyan-based seed consultancy firm. SSPK is funded by foreign-based financiers from the agrifood industry. The technical know-how and content of the platform are developed by a seed consultancy firm, Agri Experience, in partnership with a foreign-based private consultancy firm. The platform provides various online services (accessible only through the internet using a computer, tablet or smart phone). The platform targets agricultural crop (not livestock) farmers in Kenya. Information on gender-related content or indications as to whether women farmers are targeted were not found.
Thee platforms fall under type 5 (platform nº7, nº8 and nº9).
Platform nº7: The Forum for Agricultural Research in Africa (FARA) is a strategic platform created in 2001 (Forum for Agricultural Research in Africa 2016) by four sub-regional African organisations: (1) the North Africa Research Organisation, (2) the West and Central African Council for Agricultural Development, (3) the Centre for Coordination of Agricultural Resources and Development for Southern Africa, and (4) the association for strengthening agricultural research in East and Central Africa. The platform is achieving its objective via two continental platforms: (1) the Pan-African Farmers' Organisation (PAFO); and (2) the Pan-African Agribusiness and Agroindustry Consortium (PanAAC). The National Agricultural Research Systems (NARS) are, accordingly, the mechanisms for intervention at national level. Thus, both PAFO (platform nº8) and PanACC (platform nº9) are sub-platforms operating under FARA (Forum for Agricultural Research in Africa 2016). They were created in 2010 and 2007 respectively. FARA's 2014 annual report indicated that gender activities had to be prioritised in programme and project development that the platform supported (Forum for Agricultural Research in Africa 2014). **Platform nº8: On PAFOs** website there is a specific group space leading to a separate website (http://pafo-africa.net/), which is an open forum for discussion between various actors, i.e. research and development, civil society, NGOs, public and private (Pan African Farmers' Organization 2016). Anyone who has access to the internet can be become a member of the network or group space for free (Pan African Farmers' Organization 2016). The platform does not provide specific agricultural or livestock knowledge. Gender equality activities are occasionally integrated via PAFOs partnership-based projects (based on its thematic areas[93]). It is a forum for new innovations, up-coming and past events, and creation and launch of regional platforms, within the agricultural sector. **Platform nº9: PanAAC** is an African private-sector driven platform, working with agribusiness, agroindustry value-chains and support services (Pan-African Agribusiness and Agroindustry Consortium 2016). It is an interactive forum between the private and public sector and farmers. The platform develops and disseminates agricultural knowledge by connecting farmers with research

[93] Agricultural investment, climate change, agricultural research, partnerships, smallholder farming, strengthening of capacity and of networks, economic services (Pan African Farmers' Organization 2016).

institutions and government extension officers. Moreover, PanAAC links the farmers to different markets, given that they meet the quality and quantity required by the market(s). The platform has the mandate to establish country platforms via PPPs at regional and national level. I could not find data that supports the integration of gender objectives in the platform.

The typology indicates that there are large institutional variations among these ICT platforms (Table 5.1). There is a wide range of complex financial models and partnerships (PPP, public-private-NGO partnerships, private-private partnerships). Platforms can benefit either from the support of foreign public donors (via public development aid or intergovernmental organisations), from a mix of foreign donors and investors (via foundations or trusts), or from foreign investors alone (often with ties to the agrifood industry). Moreover, many of these platforms have heterogeneous objectives. For instance, only two out of the five platforms targeting small-scale farmers disseminate agricultural information relevant to all farming systems (Nafis and iShamba), whilst the three others have a thematic (Infonet-Biovision and iCow) or value-chain focus (APF). Women farmers are explicitly targeted in the services and knowledge content of the Nafis platform and the APF platform.

5.2.2. Financial models of the identified platforms and partnership patterns

Table 5.1 reveals a wide variability of partnerships with various stakeholders of different institutional status (private, public, NGO), and as a result diverse objectives. The different actors may not necessarily have a similar representation of gender equality as the Kenyan Government.

Here, appears the question of the dominant actors in platforms and the way by which they can impose their visions. Therefore, what is at stake here is not the individual position of the people working in these platforms, but the logic by which these ICT policy instruments are inserted in the overall strategy of certain transnational actors. As emphasised in the state of the art (Chapter 2), even if specific policies and national action programmes are used for gender equality inclusion, it does not imply that these actions are implemented[94]. A connection should be made to institutional compromises (Delorme & André 1983)[95], and the degree to which dimensions of gender equality will be considered in platforms depends upon the most influential actor.

Three main patterns of financial partnerships can be identified with regard to the nine platforms presented above. The partnerships constitute the financial models of these platforms.

- **Pattern 1: Public-public financial partnership pattern.** Constituting a coalition either between the Kenyan Government and a foreign-based Government or between different foreign-based Governments (platform n°1, platform n°3 and platform n°8).
- **Pattern 2: Public-private-NGO financial partnership pattern.** The public party is a foreign-based Government (platform n°2 and platform n°4).
- **Pattern 3: Foreign-based public-private financial partnership pattern.** The public parties are foreign-based Governments (platform n°5, platform n°6, platform n°7 and platform n°9).

The patterns of financial partnership, sources and size of financing of the nine knowledge-based platforms are presented in Table 5.2.

[94] Policy actions could also be absorbed in the processes of policy work as emphasised by Blatrix (2009).

[95] Cf. Appendix 3 for more information in institutional compromises.

Table 5.2: Financial models per platform and patterns of partnership

(1) Public-public partnerships: Nafis (platform n°1), iShamba (platform n°3) and PAFO (platform n°8) fall under the first type of partnership. The three platforms belong to different patterns. They are however based on similar financial models.	
Platform n°1: Nafis[1, 18,19]	- 100% financial assistance from the Kenyan Ministry of Agriculture with regard to infrastructure, technical expertise, and staff. - The annual budget for operations was 13,500 euros in 2015 and 32,300 euros in 2017. Of this, 20% is financed by the Government of Kenya and 80% by the Government of Sweden.
Platform n°3: iShamba[2,3,19]	- The start-up funding for iShamba was 542,054 euros (Africa Enterprise Challenge Fund 2015). Annual budget figures could not be retrieved. Financed by: - The Trade Mark East Africa Challenge Fund (TRAC). - TRAC is funded by TradeMark East Africa, which is a multi-donor initiative funded by the governments of Belgium, Canada, Denmark, Finland, Netherlands, Sweden, the United Kingdom and the United States.
Platform n°8: PAFO[4,15,19]	- PAFOs headquarters are based in Nairobi and benefits from in-kind financing from the Kenyan Government - PAFO received 183,000 euros out of FARA's 2014 budget. The total annual budget figures could not be retrieved. Financed by: - The European Union - The African Union - The Technical Centre for Agricultural and Rural Cooperation Joint International Institution of the African, Caribbean and Pacific Group of States and the European Union - The Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (the German development agency) - The New Partnership for Africa's Development via the Technical Cooperation Programme of the Food and Agriculture Organization of the United Nations
(2) Public-private-NGO partnerships: The APF (platform n°2) and Infonet-Biovision (platform n°4) fall under this financial partnership pattern. Both platforms are foreign-based, with the governing body and authority based abroad and having a precise agricultural thematic focus.	
Platform n°2: APF[5,6, 18,19]	- The total annual budget of the platform in 2015 was 5,324,730 euros and the Kenyan branch: 308,000 euros. - 40% financed by the Dutch Ministry of Foreign Affairs - 60% financed by Dutch NGOs and banks
Platform n°4: Infonet-Biovision[7,19]	- Annual budget figures could not be retrieved. Financed by the Biovision Foundation: - 35% individual donors - 9% donor membership contribution from different Swiss organisations and individuals (NGOs, not-for-profit, private enterprises, individuals) - 12% legacies - 26% companies and foundations - 18% foreign and Swiss government agencies
(3) Foreign based public-private partnerships: iCow (platform n°5), SSPK (platform n°6), FARA (platform n°7) and PanAAC (platform n°9) fall under this financial partnership pattern. However, their platform types diverge (cf. Table 5.1). The iCow platform is run by Kenyan private independent advisors whilst SSPK is a Kenyan agribusiness platform. FARA is a multilateral Pan-African platform, indirectly supporting farm organisations or the agribusiness industry. PanAAC is a multilateral Pan-African platform, supporting the agribusiness industry.	
Platform n°5: iCow[8,9,19]	Financed by: - United States Aid Agency for International Development - Indigo Trust (part of the Sainsbury Family Foundation)

	- Ethics in Globalization Challenge Fund (Swiss non-profit organisation)

Platform n°6: SSPK[10-14,19]	- Annual budget figures could not be retrieved.
	Financed by:
	- Kenya Market Trust, in turn financed by:
	  - The UK department for International Development
	  - The Gatsby Charitable Foundation (part of the Sainsbury Family Foundation)
	  - The Netherlands embassy

Platform n°7: FARA[15,16,19]	- FARA's total annual budget in 2014 was 23,514,145 euros. Financed by: - 86% the European Commission Trust, financed via European countries, and funding channelled via United Nations bodies and the World Bank. - African Development Bank - The Danish International Development Agency
Platform n°9: PanAAC[15,17,19]	- It was not possible to retrieve any annual budget figures for PanAAC. Financed by: - FARA - The Danish International Development Agency, Foreign Ministry of Canada - The European Cooperative for Rural Development, the European Union - The United Nations Development Programme - The Government of Senegal - The International Trade Centre (financed by different governments and the private sector)

References: ([1]Ministry of Agriculture of Kenya 2014; [2]Africa Enterprise Challenge Fund 2015; [3]Track 2016; [4]Pan African Farmers' Organization 2013; [5]AgriProFocus 2016b; [6]AgriProFocus 2015; [7]Biovision Foundation 2015; [8]GreenDreamsTech 2014; [9]Elea 2016; [10]Indigo Trust 2013; [11]Kenya Markets Trust 2016; [12]Agri Experience 2016; [13]Adam Smith International 2016; [14]UKAid 2012; [15]Forum for Agricultural Research in Africa 2014; [16]Forum for Agricultural Research in Africa 2016; [17]Pan-African Agribusiness and Agroindustry Consortium 2016; [18]individual interviews; [19]Internet search).

The results show that all nine platforms benefit either from the support of foreign donors (via public development aid or intergovernmental organisations), a mix of foreign donors and investors (via foundations or trusts), or solely support from foreign investors, often tied to the agro-food industry. Table 5.2 also provides evidence in a high variance of stakeholders that finance platforms in Kenya. Given the heterogeneous objectives, these partnerships can result in mission misalignment in the set-up of the financial platform partnerships. Due to an imbalance in power relations between the public and the private sector, the least dominant party would have to concede to the most influential actor[96] as emphasised in earlier studies (Blowfield & Dolan 2014; Murphy et al. 2014). Here, Table 5.2 reveals that some of the platforms benefit to a higher degree from international foundations or direct private support (Infonet-Biovision, APF, SSPK, iCow). Such results raise questions about the possible independence that platform developers have with respect to the donors and/or financiers, as stressed in the economic literature analysing PPP development (Mann 2017; Meagher 2017).

One intention of financiers of platforms emanating from the agribusiness industry based in industrialised countries, could be to advocate for a certain product or good, via platform services and technical content. McGoey (2016) in particular emphasises this issue in the case

[96] See Appendix 3 on institutional compromises.

of the partnership between the Bill Gates Foundation and Coca-Cola or Monsanto, and their joint aim to boost agricultural productivity in sub-Saharan Africa. The author stresses that this is also a way for donors to expand: (1) their influence as a donor, and (2) their reach as multinational corporation. Hence, in our case study, some actors involved in the development of these different platforms could propose to provide these services on the basis of an economic model where the costs of advisory support were integrated into the price of products (supply of agricultural inputs such as seeds or pesticides, marketing of agricultural products). This type of model can give the impression of a free service provided thanks to the PPP (the service is integrated into an agricultural product that is sold to the farmer). This could also explain why platforms are so attractive to many different types of stakeholders. It becomes evident in the case of certain platform types where the interests lie (type 2, 3 and 4 platforms, Table 5.2), and in those cases, the interests at stake have consequences on the content of the knowledge made available for both women and men farmers in Kenya and influences technological choice.

Table 5.2 also tells us about the timespan of ICT platforms and thus the long-term sustainability of the system. External donors and platform developers may want to test the effectiveness of the technology in different developing economies, of which Kenya is one. With platforms, they can impose a certain timespan for the product and test its efficiency and ability to replace the traditional farm advisory services system. The perpetuity of the services should therefore be questioned since the Kenyan Government is contributing financially to only very few of these platforms. Private financiers can suspend/withdraw funding and services supplied by platforms if the innovation turns out not to generate a return on investment. Public donors can withdraw their support if the government of the country considers that it is not relevant to their foreign-based agenda to support these types of interventions.

5.3. Evidence in the integration of gender equality objectives in platforms

The analysis of the nine platforms shows that these devices are at different levels of gender equality integration (Table 5.3). The respective columns of this table correspond to:

(1) Technical content that is inclusive of women farmers (column a)
(2) A gender-bound monitoring system to evaluate the outcomes of services and knowledge dissemination (column b)
(3) Women with senior positions in the platforms (column c)
(4) Type of gender-equal framework used for quality assurance of knowledge content and activities (i.e. gender mainstreaming and/or affirmative action) (column d)

These four dimensions have been developed based on previous gender studies. On the one hand, they emphasise on the importance of the consideration of women and their needs in the knowledge economy (Walby 2011) (cf. Section 2.2.2.2, Chapter 2) and the integration of gender equality dimensions in the services economy, via the innovations performance framework (Debusscher 2011; Hafkin & Huyer 2008) (cf. Section 2.2.2.3, Chapter 2). On the other hand, scientific research and international actors have documented the importance of having women in leadership positions to be able to influence to extent to which gender dimensions are considered in policy intervention and their instruments (McCarthy & Kilic 2015; World Economic Forum 2004).

Out of the six platforms that target the small-scale farmer (Nafis, APF, iShamba, Infonet-Biovision, iCow and SSPK), all platforms with the exception of SSPK supplies online and offline types of services to farmers (in case they do not have access to the internet) (cf. Column a, Table 5.3). This shows that efforts are made to reach remote farmers who do not have access

to internet services. The results from the scientific literature (Chapter 1) show that women farmers are the most concerned in this case. Observations provide evidence that efforts are made by these five platforms with regard to gender inclusion. Furthermore, I could identify three out of the nine platforms that display the fact of having gender-targeted technical content, where only two of these three platforms seem to operationalise the topic at hand. The two platforms are Nafis and APF.

Data used for monitoring the system in place and measuring performances, in particular the number of women and men farmers accessing and using platform services is studied in Table 5.3 (Column b). I could only identify one platform, APF, that make a general statement or provides evidence of having gender-disaggregated data.

Furthermore, the number of employed women in the nine platforms is also examined in this table (cf. Column c). The purpose of this exercise was to get an understanding of whether gender equality is a dimension that is prioritised internally by the platforms. The type of positions given to women in the platforms is important since it determines their level of influence upon decision-making (thus decisions on types of services and technical content directed at women farmers for instance). I was able to retrieve this information from six platforms, and found evidence of differences between gender with regard to the types of positions given to women compared to men. There is a fairly balanced number of technical staff across platforms (Nafis, APF, Infonet-Biovision, iCow, SSPK and FARA), and quite a large number of women in high-level positions in the platform structures. In this regard, the analysis brings new information concerning the place of women in the structures of the platforms, via the use of gender principles (in this particular case through affirmative action measures). For instance, observations from this Table show that iCow was created by a woman, where more than 50% of the staff are women. There are two exceptions however: APF and Infonet-Biovision. Interestingly, these two platforms also fall under type 2: 'foreign based platforms, governing body and authority based abroad'. One may thus wonder to what extent the prioritisation of gender and equality differs between different institutional platform types and why it is that platforms based in developed countries are the least gender equal. This point will be examined more closely in Chapter 6.

I could find evidence of only three platforms using gender mainstreaming (APF) or gender mainstreaming and affirmative action (Nafis and FARA) (cf. Table 5.3, Column d). Out of these platforms, it was also difficult to discern how these gender guidelines were used in real terms to effectively integrate gender equality and women farmers' demands into their operations. In other words, it is not because the platforms in question display the use of gender mainstreaming, that there is an effective implementation. Such conclusions can be connected to evidence from the scientific literature, where some authors demonstrate that gender principles do not actually make a significant difference to gender equality (Verloo 2005; Walby 2005; Debusscher 2011; Stratigaki 2005), and that affirmed commitment to gender mainstreaming in policy work is empty rhetoric (Shortall 2015; Bock 2015). This is further elaborated upon in Chapter 6 of two platforms.

These results also call for further analyses of three rationales of performance that relate to: (1) the economic versus social interests of private actors in platforms; (2) the monitoring of an ICT-based dissemination system to ensure that it is gender inclusive; and (3) the subjectivity of technical content in platforms.

Table 5.3: Objectives regarding women integration in the nine identified platforms in the Kenyan farm advisory services system.

Platform	(a) Type of technical content that is inclusive of women farmers (access and use)	(b) Gender-bound monitoring system	(c) Women with senior positions in platforms	(d) Use of gender mainstreaming and/or affirmative action
Nafis[1,2, 14, 15]	- Services can be accessed via the platform (videos, content for reading), per SMS (via a partnership with iShamba), or the phone[1]. - Develops targeted technical content for women farmers.	There is not a monitoring system in place at the moment and thus no gender disaggregated data.	- The head of the ASDS programme is a woman (in 2018). - 0 Nafis staff are women (out of 1 staff member in 2018).	- Follows the national gender policy. - Applies gender mainstreaming for content development. - Affirmative action measures are applied when relevant.
APF[3,4, 14,15]	- Services can be accessed via the platform and off-line events organised by the platform[3]. - Partners develop gender-targeted content that is disseminated on the platform (gender in value chains)[3,4].	The platform has gender-disaggregated data[4].	- 1 out of 8 women on the Board in 2016[4] - 8 women out of the APF staff working at the headquarters (14 total staff in 2016[4])	Use of gender mainstreaming although not stated at the platform. Affirmative action is not used.
iShamba[5,15]	- Services primarily available per the mobile phone (SMS), the mobile-based platform or the iShamba online platform[5]. - Specific targeted technical content for women farmers could not be identified.	Could not identify a statement of having gender-disaggregated data.	Could not identify the number of women holding senior positions in platform.	Could not find evidence of the use of gender mainstreaming or affirmative action.
Infonet-Biovision[6,15]	- Both an online and offline version of the technical content. Services can be accessed per SMS (through a partnership with iCow).[6] - Specific targeted technical content for women farmers could not be identified.	Could not identify a statement of having gender-disaggregated data.	- 2 out of 3 staff members are women.[6] - The executive director is a man.[6]	Could not find evidence of the use of gender mainstreaming or affirmative action.
iCow[7,15]	- Services primarily available via the mobile phone (SMS), the mobile-based platform or the iCow online platform. Internet services are not required to access iCow services.[7] - Specific targeted technical content for women farmers could not be identified.	Could not identify a statement of having gender-disaggregated data.	- Founder and CEO of iCow is a woman (in 2018).[7] - 1 woman on the Board (out of 2 in 2018).[7]	Could not find evidence of the use of gender mainstreaming or affirmative action.

			- 7 of the iCow staff members are women (12 in total) in 2018 [7]	
SSPK[8,15]	- Services available online only (must have access to the internet)[8]. - Specific targeted technical content for women farmers could not be identified.	Could not identify a statement of having gender-disaggregated data.	- Platform implemented by Agri Experience. The firm has a total of 13 employees, and 7 are women. The founder and CEO is a woman.	Could not find evidence of the use of gender mainstreaming or affirmative action.
FARA[9,10,11,15]	- Services available online only (must have access to the internet)[10]. - The platform does not target the farmer per se. There are however demonstration videos and reading materials showing how FARA integrates women farmers through their projects with different partners. The platform showcases gender as a cross-cutting area but at the moment there is no content to be found.[10]	Could not identify a statement of having gender-disaggregated data but the platform has made a statement on their website that this is under construction.[9]	- 29 staff are women out of 59 in 2014.[11] - The chairperson of FARA is a woman in 2018.[10,11] - FARA has employed one women in charge of gender-related back-office activities in 2014.[11]	- Use of gender mainstreaming in different projects to include gender equal activities with partner organisations.[11] - 1/3 quota is applied (affirmative action)[9]
PAFO[12,15]	- Services available online only (must have access to the internet)[12]. - The platform does not target the farmer per se. Specific targeted technical content for women farmers could not be identified.	Could not identify a statement of having gender-disaggregated data.	Could not identify the number of women holding senior positions in platform.	Could not find evidence of the use of gender mainstreaming or affirmative action. Given that PAFO is financed by FARA, it could apply the gender principles instated by its mother platform.
PanAAC[13,15]	- Services available online only (must have access to the internet)[13]. - The platform does not target the farmer per se. Specific targeted technical content for women farmers could not be identified.	Could not identify a statement of having gender-disaggregated data.	Could not identify the number of women holding senior positions in platform.	Since FARA financially supports PanACC, it would be expected that gender mainstreaming and affirmative action are applied. I could not find data providing evidence of this.

Source: ([1]National Agricultural Farmers Information Service 2009; [2]Ministry of Agriculture of Kenya 2014; [3]AgriProFocus 2016a; [4]AgriProFocus 2016b; [5]Mediae 2016; [6]Infonet Biovision 2016; [7]GreenDreamsTech 2014; [8]Agri Experience 2016; [9]Forum for Agricultural Research in Africa 2013; [10]Forum for Agricultural Research in Africa 2018; [11]Forum for Agricultural Research in Africa 2014; [12]Pan African Farmers' Organization 2016; [13]Pan-African Agribusiness and Agroindustry Consortium 2016; [14]individual interviews with platform staff; [15]internet search).

5.4. *To conclude:* Three findings raise questions about women farmers' inclusion in platforms

The first outcome relates to the consideration of the civic dimension of platform performance. This dimension of performances become ambivalent in multi-actor partnerships and all platforms but one (Nafis) are based on such partnerships. Here, parallels can be drawn with Lascoumes & Le Gales' (2007) study on the deciphering of the implicit properties of policy instruments. Such tools should not be considered as neutral. Platforms are inserted into networks of interests. Thus, the interpretations of Table 5.1 and 5.2 show that the civic dimension could become jeopardised with an increase in the number of private-sector actors financing platform operations for two main reasons. One, the dissemination of ICT advisory services with such large spectra of objectives questions the overall coherence of the system (i.e. various target groups, different objectives and power relations influencing the types of services and technical content that should be disseminated through platforms). Two, increased risks of withdrawal exist when such devices are implemented by actors other than the state, for governments have different idiosyncratic constraints compared to private sector actors. Public interventions have an obligation to provide lasting services, for instance by ensuring accessible and relevant knowledge to women farmers. Only one of the platforms analysed here, Nafis, is under the control of the Kenyan Government. All the other platforms are controlled by foreign-based stakeholders who can, at any moment, decide to suspend their activities or withdraw entirely from the country.

The monitoring of gender equality goals in the ICT-based farm advisory services system is also an issue at hand, and relates to the technical dimension of platform performance (i.e. the capacity of platforms to reach to their target group). Results from a previous chapter (cf. Figure 4.2), show that the Kenyan Government is reflecting upon this question. The state-owned platform Nafis has clear annual targets and monitors the number of annual visits (Table 5.4). As shown in Table 5.4, compared to the total farm population above or equal to 18 years of age, the reach of Nafis may however appear scanty (target of 1.2 million individuals a year and reach circa half a million out of approximately 20 million individuals). Yet, one major barrier to establish a robust farm advisory back-office system is the high investment and recurrent costs[97]. So, the fact that there are set targets and a way of measuring the number of visits provide evidence of a first platform performance rationale in place for the Government to examine the technical performance of the Nafis platform.

Table 5.4: Nafis platform reach amongst Kenyan agricultural producers

Total number of individuals above or equal to 18 years of age in Kenya in 2009	19,855,290
Members of households working on farms above or equal to 18 years of age in Kenya (persons, PHC, 2009)	6,732,854
Members of households working on farms above or equal to 18 years of age in Kenya who said they use the internet (persons, PHC 2009)	162,113
Number of visits to Nafis per year (visits) in 2015	480,000
Target of number of visits per year for Nafis (visits) per year	1,200,000

Source: PHC data, 2009; platform interviews.

Given the challenges ahead in developing and engaging in the upkeep of this type of system, measuring the effectiveness of platforms in the integration of women farmers' demands

[97] Source: Interviews of staff working at the Ministry of Agriculture national level and from the University.

becomes a real issue however. It is difficult for the Government to evaluate the performance of platforms and their technical content when they are not the main developers or owners.

The third finding relates to the number of foreign-based actors involved in platform development and the type of technical content targeting women farmers in the platforms (cf. Table 5.1). The results raise the question of potential technological lock-in effects[98] (Arthur 1989; Landel 2015), when the knowledge that is disseminated is produced in foreign countries and/or is linked to specific economic interests of the agribusiness sector (Box 5.2).

Box 5.2: An example of the contribution of a platform to a potential lock-in effect.

A concrete example of the contribution of PPP-based platforms to a lock-in situation is the case of the SSPK platform (n°6). This is an international initiative from the seed sector industry to provide advisory services for seed sector development, in parallel with seed sales in Kenya. The platform is indirectly funded by the Gatsby Charitable Foundation[99], financing genetically modified crops and improved seeds, and also having economic and political relations with the agribusiness industry (for instance, Monsanto). The trust is managed by Adam Smith International, a private consultancy firm. Agri Experience, a seed consultancy firm, and Kenya Markets Trust (KMT) are the implementing bodies of the platform. The platform connects farmers to seed suppliers in Kenya and supplies, in parallel, free seed advisory services.

The provided services are highly standardised however. One concrete example is the case of hybrid maize variety. There is information on the general characteristics of different types of hybrid maize for the individuals visiting SSPK under the 'SeedWorks' link (it is also possible to download this information). With these general crop characteristics, there is equally information about the organisation that maintains the seed variety. There are then two options for entering into contact with the agricultural input suppliers: (1) under the 'Industry Directory' link, which provides contacts to various suppliers (e.g. crop seed suppliers, agrochemical and fertilizer suppliers); or (2) under the 'SeedShop' link that asks the visitor to specify her/his geographical location (i.e. county in Kenya). It is then possible to download information about different input suppliers in that specific county.

In the case of the SSPK platform, we see that the technical advice is explicitly connected to the product. As such, the type of knowledge that is disseminated seems to be based on the economic

[98] Cf. Appendix 4 for the definition of technological lock-in.

[99] According to Lobbywatch (2004), the Gatsby Charitable Foundation was founded by Lord David Sainsbury of Turville. Sainsbury was UK Science Minister in Tony Blair's government, from 1998. He was also a member of the ministerial biotechnology committee, Sci-Bio, responsible for national policy on genetically modified (GM) crops and foods. Sainsbury invested heavily in two plant genetics-related investment companies (Diatech Ltd and Innotech Investments Ltd). Innotech had a substantial stake in a firm called Paradigm Genetics involved in a joint GM-related venture with Monsanto. Diatech was granted three patents for GM products (between 1996 and 1999). Via the Gatsby Charitable Foundation, Sainsbury put millions into the study of plant genetics. He gave circa 2 million pounds per year to the Sainsbury Laboratory of the John Innes Centre, conducting GM crop research. Lord Sainsbury financially supported the Laboratory in 1987 and his Gatsby Foundation has remained its principal source of funding, although it also receives over 800,000 British pounds per year from the Biotechnology and Biological Science Research Council, for which Sainsbury was responsible in his ministerial role. Like his biotech investments, his Gatsby contributions were administered through a blind trust run by his solicitor Judith Portrait when Sainsbury became UK Science Minister. Although he did not attend Gatsby meetings or make decisions, Sainsbury retained the power to appoint and dismiss its trustees. For some, the choice of an unelected biotech investor and food industrialist to be Science Minister, based within the Department of Trade and Industry, was more than emblematic of the UK's corporate-science culture. Lord David Sainsbury still has important influence in the academic sphere. Indeed, in 2011 he was elected as Chancellor of the University of Cambridge (to present) (Sainsbury 2018).

incentives of the stakeholders, particularly those financing the platform. As a result, one hypothesis is that such types of platform could contribute to a lock-in situation (in this case to the use of certain types of pesticides and high-input agricultural crops).

These summarised, and actually intertwined, critical points provide evidence of a new sphere of policy intervention for the Kenyan Government. The results show that it is expected of ICT platforms to support the Kenyan Government in achieving gender equality policy objectives. The Government is presently developing an institutional coordination framework of the integration process of gender equality in the ICT-based farm advisory services system (cf. Figure 4.2, Chapter 4). The findings provide evidence in a large diversity of platform types and financial patterns however. As previously stressed, it could be that the most dominant actors in platforms could impose their visions of what is considered as gender equal. Therefore, there is a need to better understand the precise mechanisms by which the gender dimension will be taken into account in the performance rationales of platforms, and in particular to support this institutional coordination process.

Besides, the results that support these emerging stakes open up a debate concerning fundamental points in ICT platforms, and they need to be addressed to ensure that platforms are inclusive of gender equality objectives. For now, there is still room for improvement with regard to platform performance on aspects of social inclusion and innovation. Along the same lines, the following chapter presents the results of an in-depth analysis in the consideration of women farmers and their demands in two different platforms that display rationales of gender inclusion: Nafis and APF.

CHAPTER 6 - The capacity of ICT knowledge-based platforms to provide services to female farmers

An in-depth analysis of the consideration of women farmers and their demands in ICT platforms is presented in this Chapter. More precisely, the integration of Kenyan female farmers' demands for technical knowledge in the two knowledge-based platforms that have gender equality performance rationales is examined: Nafis and AgriProFocus (APF). This chapter corresponds to an analysis at the 'lower level' of services relations (Gadrey 1990). It relates to the 'co-production of knowledge' level, and examines whether the supply of advisory services from ICT platforms meets the demands of women farmers. The analysis is based upon the five performance dimensions at the services supply level of platforms: the financial, the technical, the relational, the innovation, and the civic dimension (cf. Section 2.2.2.3, Chapter 2).

The chapter is structured according to three main sections that allow us to discuss demand and supply standpoints. **Section 6.1** presents an analysis of women farmers' demands for technical knowledge inspired by the dimensions from the gross national happiness (GNH) index (Ura et al. 2013) and the social integration of gender equality objectives. Farmers' demands in knowledge-based platform rationales (supply and demand level) is analysed in **Section 6.2**. **Section 6.3** presents an in-depth investigation of the integration of women farmers and their demands in two different platform types Nafis and AgriProFocus (APF) (supply level).

The analyses of this Chapter are based upon different qualitative data: (1) interviews with small-scale female farmers' at a local level (Machakos county, n=26); (2) interviews of staff working at the Ministry of Agriculture at national or county level, the University and a Coffee Cooperative Union (n=20); (3) interviews with platform staff working at Nafis or APF (n=13); and (4) analysis of Nafis and APF platform documents (annual reports, budgets, administrative documents).

6.1. Women farmers' multidimensional demands

A review of the literature shows that women may have specific demands because they are placed in particular social relations (Ferber & Nelson 2003; Barker & Feiner 2004; Harcourt 2016). More precisely, they may have multiple roles at the farm (as agricultural workers, care workers, business women, community leaders and/or members, group members and/or leaders, community and family members), and thus their demands are heterogonous when it comes to (1) types of services, but also (2) type of technical content (Doss & Morris 2001; Hill & Vigneri 2014; Deen-Swarray et al. 2012; Quisumbing & Pandolfelli 2010; Johnson et al. 2016). Figure 6.1 presents an integrated model based on the nine dimensions of the Gross National Happiness (GNH) index used to process the interviews of the women regarding their multiple areas of demands (n=26), vis-à-vis their farm activity.

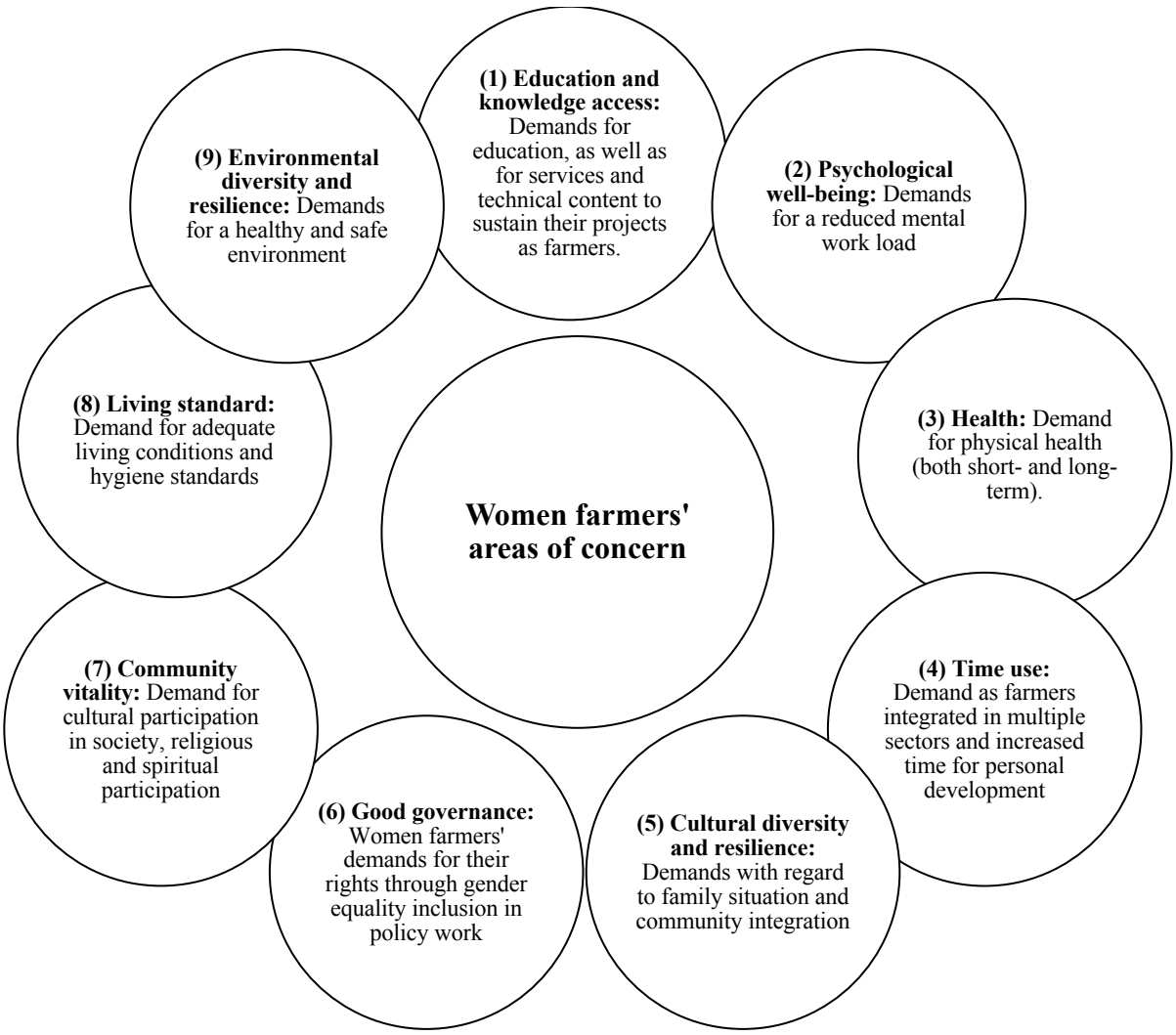

Figure 6.1: Multiple areas of women farmers' areas of concern regarding farm activity[100].

The nine dimensions presented in Figure 6.1 aim at collecting information with respect to these different dimensions. These results are presented below.

6.1.1. Education and knowledge access

One explicit demand from the 26 interviewed women farmers was to improve their literacy levels and to access education. The results from the interviews also provide evidence of their demands for enhanced IT-literacy, in particular to be able to use internet-based advisory services. In this context, the women farmers have different demands for accessing services and technical content to sustain their farm projects themselves.

In this regard, results reveal obstacles that impede the women farmers' access to knowledge and information based on their priorities and expectations. Findings from the interviews show that these obstacles relate to their integration in society. The social context in which they are embedded can hinder these women farmers in accessing: (1) services and consequently technical knowledge from ICT devices (as a result of low literacy levels and their consequent

[100] Reconstructed figure based on the nine dimensions of the gross national happiness index (Ura et al. 2013). Cf. Appendix 16 for further information.

inability to use platforms), (2) relevant institutions, and (3) local organisations, such as coffee cooperatives. For example, 22 of the 26 interviewees stated that they adopted the farm technologies and practices they were taught, but that the number of trainings and the knowledge was insufficient. The reasons for this knowledge shortage were: (a) their husband received the training and did not share the information with his spouse (the case for trainings organised by the coffee cooperatives), and (b) even though the woman was the main agricultural worker at the farm, certain topics were not considered as a 'woman's crop' and women were therefore excluded from a training on the topic. In this regard, there is a particular demand for interactive advice and exchange of knowledge in collective spaces[101].

Here, findings confirm that the women farmers (i) especially access technical knowledge via direct interaction with different types of services providers or through peers, and (ii) have a particular demand for co-production of knowledge. A majority of the interviewed women access technical knowledge through: (a) public extension officers and community meetings (94%); (b) group trainings (88%); (c) via the radio (88%); (d) neighbours and contact farmers (56%); and (e) through the TV (50%)[102,103]. It would thus be expected that ICT platforms provide services and disseminate knowledge that are adjusted to women farmers' demands for service relations and specific modes of interaction, with regard to both the modalities and content of services (cf. the innovations performance framework Gadrey & Gallouj (1998); Gallouj et al. (1999); Labarthe (2006), Chapter 2) .

Moreover, findings from the review of the literature, interviews with women farmers and government officials, show that women farmers have specific demands with regards to types of technical content. In first, on nutritional aspects, which is well documented in the literature (Kadiyala et al. 2016; Malapit & Quisumbing 2015; Doss & Morris 2001; Harris & Clark 2014), and revealed from the findings of the interviews with the women farmers. In second, results show that women farmers have specific demands for accessing knowledge that relates to food and animal production. Findings stress that it is to ensure household food security, which is linked to nutritional aspects (Quisumbing & Pandolfelli 2010; Meinzen-Dick et al. 2014; Hill & Vigneri 2014), and to their role as care workers (Folbre 2006). In third, to achieve financial independence even when you do not necessarily access resources (e.g. a bank account, land title deeds, insurance), there is a specific demand for knowledge on farm diversification (Deen-Swarray et al. 2012; Meinzen-Dick et al. 2014). In particular, the request for technical support on products that are not dependent on access to land.

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[101] All of the interviewed women farmers (26/26) mentioned that the field officers they meet via different collective spaces (e.g. via women's groups) rarely asks them what type of subject they would like to be trained in and how they are performing (levels of adoption). Also, 19 out of 26 women farmers mentioned that it is rare that someone asks for their advice on agricultural or livestock issues (it is the husband who is addressed). It implies that a number of farm women probably have a certain amount of knowledge stored (implicit and explicit), which is rarely shared (and put into practice) in larger forums.

[102] None out of these women declared accessing agricultural knowledge via internet services. Reasons for this is that none of them own a computer nor have access to internet (26/26 women confirm this). Findings from the 2009 census data provides evidence in the low use of the internet for female farmers in rural areas (less than 2%). In this regard, very few female headed farming household own a computer (less than 1%). Hence, it cannot be excluded that the low access to agricultural knowledge via internet services is linked to these two factors.

[103] The interviewed female farmers were asked to rank the five prioritised choices for accessing technical knowledge out of [13] options, namely: (i) individual visits on farm (individual trainings), (ii) demonstration days, (iii) field visit to other farms, (iv) agricultural shows, (v) group trainings, (vi) television program, (vii) office call, (viii) radio program, (ix) video tape, (x) leaflets and posters, (xi) farmer field schools, (xii) newspaper, (xiii) information on-line (via the internet). The results show a distinct priority for individual trainings / visits at the farm. Another preference is field visits to other farms followed by group trainings. Thus, in person trainings and co-constructing and co-producing knowledge is a key priority to these female farmers.

Fourth, the qualitative interviews provide evidence in specific requests by women farmers for knowledge about land title deed access, as supported by previous research (Meinzen-Dick et al. 2017; Johnson et al. 2016). Lastly, the importance to be able to access knowledge and services from different organisations (e.g. cooperative societies) came out as a demand from the women farmer interviewees. The issue experienced by the interviewed women is that they are not always allowed to become members of cooperative societies because of the land ownership requirement. As a result, they do not benefit from different types of trainings provided by such organisations. Such results are coherent with findings from other literature (Fletschner & Kenney 2014; Meinzen-Dick et al. 2014).

6.1.2. Psychological well-being

Overall, the interviewed female farmers stated that they were satisfied with their lives (25/26). A majority of them (20/26) described however a heavy mental load, having a large number of responsibilities and tasks to take care of every day. This was connected to the fact they did not feel in a position to take any leave or rest because they were not compensated for their work and/or could not be replaced. This dimension can be related to the economics of care developed by feminist economists (Nelson 1995; Zachorowska-Mazirkiewicz 2015). It is emphasised in these scientific papers that the dual role of women (i.e. formal labour and care labour – or in the past classified as *'women's work'* Nelson (1995, p.136)) places a heavy mental (and physical) workload upon women. Hence, the results corroborates with earlier evidence from these authors. Here, it could be expected of platforms to consider women farmers dual labour burden via the civic dimension of the innovations performance register to ensure that to access services via platforms does not lead to an increased workload.

6.1.3. Health

The interviewed women farmers said that being in good physical health was a priority. In this regard, the women farmers' concerns mainly related to their exposure to smoke when cooking (for their eye sight and respiratory system). Some of the interviewed women (5/26) said they were concerned about their exposure to agrochemicals during coffee season, and what the possible health risks could be for them. These women demanded up-to-date information and knowledge about how to deal with these concerns. Other health concerns also specific to women relates to their biological features, i.e. sexual and reproductive health, maternal health (Tolhurst et al. 2012; WHO 2012). An internet platform could provide them with this type of information and offer alternative solutions but such features have not been identified among the analysed platforms in this thesis.

6.1.4. Time use

The struggle to establish a day-to-day balance between work, including domestic duties (with regard to their roles at the farm), sleep and personal development came out as a key issue to the women farmers (26/26). Admittedly, having these multiple roles as farmers implied that they had different demands. It also provided evidence of the heavy burden weighing on these women[104]. As emphasised in the ICT report published by the World Bank (George et al. 2011) and the 2014 report by the Food and Agriculture Organisation, ICTs could be seen as a means for supplying women farmers more effectively with knowledge, which could enable them to save time during the day (e.g. not have to travel to extension offices for advice).

[104] This is however not taken for granted by the Kenyan Government (cf. Chapter 4).

6.1.5. Cultural diversity and resilience

This dimension relates to the demands of women farmers to make use of knowledge and information, and other resources to address needs relating to their family situation. Access to knowledge about nutritive food for the family members came out as a concern to the women farmers (26/26). Access to knowledge via different types of innovations and technologies, such as ICT platforms, could help to ensure that women farmers have the necessary cognitive resources to be able to produce nutritious food for all family members. Such hypothesis can be supported by the empirically based paper from Kadiyala et al. (2016). Their analysis explores the feasibility of supplying child nutrition behaviour changes among women farmers, through platforms services that are connected to video programme services. Their findings reveal that there is a need to continuously develop adequate content based on the norms, values and traditions at microscale level. This dimension also included the integration of women farmers into their community, and the ways in which they could nurture different relationships with neighbours/other farmers. It turned out that women's integration into the community (as a demand) was a decisive factor to them for security reasons: for food and water security (if needed, the interviewed women felt confident enough to ask for food and water from their neighbours), and for security in the strict sense, i.e. guaranteed protection of the family members, the household and the farm.

6.1.6. Good governance

The results from the interviews provide evidence of women farmers' demands for the right to good living standards (healthy and safe environment and public institutions[105]) (26/26). In this respect, all of the interviewed women were aware of their equal right to resources through the Constitution of Kenya and the Gender Equality Policy of the Kenyan Government. One particular element that came out as fundamental through the interviews with the women farmers was their demand to permanently access farm land, the homestead and livestock. By this, they meant to own or be able to use these resources (25/26 women wanted to be the formal owners of the farm land, livestock and of their homestead). Indeed, access to land title deeds is a particularly important aspect since it in turn enables the access to economic resources such as insurance, and a bank account.

Women's right to land was already a topic for debate in the 1990s/2000s (Jackson 1996; Jiggins 1989). These feminist economists stress that denying women farmers access to land rights, limits their access to and control over the proceeds of their own labour. Accordingly, the difficulty of land access for women lies in the patriarchal and social structures. The interview results corroborates with these literature findings. The women farmers report that the fundamental principles at national level (i.e. their equal right to land) had not yet enabled a change at the micro-level, partly due to societal constructs (and fear of being excluded from the community), and partly due to the fact that they did not fully know how to even begin demanding these rights (which institute, the processes, the cost implications).

Moreover, specific demands of the women farmers also related to their access to advisory services and knowledge through policy work. In this context, findings from the interviews with them show that they wished to be visited on a more regular basis (because they did not have the time nor income to travel to the extension offices). In a scenario where ICTs are replacing

[105] This sub-dimension also takes into account the household per capita income. I did not report on this variable because more that 50% of the sample could not provide this information.

traditional types of advisory services, it thus becomes fundamental to have a gender equality inclusive ICT-based farm advisory services system that addresses women farmers' demands, and that is consistent at macro-, meso- and micro-level.

6.1.7. Shared culture and religion

Inclusion in the community and religious affiliation came out as fundamental to the interviewed female farmers (26/26). Shared identities, through community belonging (via shared culture, values, norms, spirituality, and religious beliefs) was clearly a key priority and specific demand. Even if they had a heavy workload during the days, the interviewees prioritised these types of gatherings, for instance the participation in different groups (e.g. farmers groups, micro-finance groups, local community groups). I will provide further evidence in Chapter 8 of the importance of collective discussion points, and the fact that in Kenya these points determine women farmers' internet access and use, and consequently access to ICT platforms.

6.1.8. Living standards

This dimension relates to women farmers' demands to reside in a household that is safe (i.e. that the type of construction material is not harmful to their health, type of cooking technologies that do not emit smoke, adequate hygiene facilities, etc.). It also corresponds to women farmers' demands for good livestock conditions. For this, the women farmers need access to the right services and knowledge. ICTs could offer possibilities in supplying these farmers with services and knowledge more rapidly than traditional types of advisory services (e.g. by providing the information they need for a construction material and where they can purchase it).

6.1.9. Environmental resilience and diversity

This dimension includes women farmers' access to a safe and reliable environment. In this regard, a subject reported by the women farmers as a point of concern was the changing weather patterns, longer periods of drought, and difficulties in knowing when to plant. There is a large amount of scientific literature stressing that women farmers are especially vulnerable the impacts of climate change, and natural hazards, because they are considered as more part of a marginalised strata of the population (Jost et al. 2016; Kristjanson et al. 2012; Jiri et al. 2017), even though they have a more dominant role in the agricultural workforce in Africa (Godfray et al. 2010; International Labor Organization 2016a). For this dimension, ICTs could play a role as services providers, knowledge base and information system (e.g. early warning systems, updates on meteorological weather conditions).

The nine dimensions resume the interviewed women farmers' different demands for resources. Figure 6.1 shows that as a result of their roles as farmers, they have multifaceted priorities, expectations and needs. Consequently, they need access to various types of services and knowledge.

In sum, the multidimensional demands of female farmers spur service suppliers (or suppliers of knowledge) to be precise and adjusted to the demands of this heterogeneous group of women. It implies that the services and technical knowledge disseminated via platforms needs to be co-constructed with women farmers. The question is whether ICT platform developers and involved actors take these specific demands for interactive service relations into account. This will be examined in the following section.

6.2. Women farmers' expectations in ICT knowledge-based platform rationales

6.2.1. Strategic co-production concerns for different stakeholders

As reported in the literature (Gadrey & Gallouj 1998; Falzon & Cerf 2015), knowledge generation to solve a specific problem requires interactions among peers and between the service provider and the client, both to specify the problems encountered and to devise the solution. With this issue in mind, I studied the functioning of platforms to identify female farmers' vision of the type of service the platform should deliver.

In-depth interviews and analyses were conducted for two platforms providing extension services to all types of farmers: nº1, Nafis and nº2, AgriProFocus (APF) (cf. Table 5.1, Ch. 5). These results were analysed with respect to the objectives of politico-administrative documents (strategic concerns identified in the National Agricultural Sector Extension Policy – Nasep) and in light of the expectations of potential clients and other stakeholders, as expressed in the institutional interviews with government employees, farmers' organisation representatives, and farmers themselves (Table 6.1).

The results summarised in Table 6.1 show contradictory views as to the level of interaction that must be secured in knowledge-based platforms. For the interviewed female farmers, a high level of co-production of knowledge (both for identifying problems and building solutions) is a constant demand, but it does not appear as a priority in the two platforms strategies. The women farmer interviews show a clear and unanimous demand for close interaction with farm advisors and grounded advice. They mention individual advice as well as group training sessions. They insist on the need to associate this advice to visits to individual farms and on the usefulness of field visits to other farms, followed by group trainings and demonstration days.

At the government level, the importance given to interaction between public extension officers and farmers is acknowledged. Interviewees confirm that knowledge co-production is considered important but there is little emphasis on this point in policy documents (the Cooperative Societies Act and the Nasep). In addition, resources that could finance a large network of farm advisors are missing. Public funding of agricultural extension services is being reduced. The interviewees working for the Ministry of Agriculture (at national or local level) are aware of the importance of knowledge co-construction for famers, but because of their reduced funding they are unable to reach all farmers.

Regarding this issue of interaction with women farmers, the strategies of the two platforms that were analysed in depth (Nafis and AgriProFocus – APF) differ. The Nafis platform organises quarterly meetings on content development. During these meetings, there is always one farmers' representative present. On the other hand, systematic feedback loop is missing. Even though the platform has a blog to interact with platform users, the interviewees confirmed that they had little direct interaction with their users via the platforms (especially regarding the quality of the services provided by Nafis). The interviewees from the Nafis platform also cited the difficulty in reaching all Kenyan farmers although one of the platform's objectives is to reach more farmers more efficiently through the use of ICT services.

APF does not develop content in Kenya. The platform developers compile the content of knowledge that will be made available to farmers together with Dutch partners. They use the platform as a tool to disseminate this knowledge in developing countries. APF has an online forum on the platform where platform members can interact with each other, but there is no

APF expert responding to clients' questions/concerns. APF staff are present in Nairobi but it is not part of the platform's strategy to meet with end users on their farms (through international, national, or local members of APF, e.g. the Dutch NGO HiVOS in Kenya). Staff meet farmers at fairs or events that are organised by APF, mostly held in Nairobi. Nonetheless, the rarity of these events and their centralised location limit their impact.

Table 6.1: Strategic co-production concerns for different stakeholders

Strategic concern	**Type of respondents**	**Number of respondents**
Is interaction between farmer and service provider important? Is co-production of knowledge between farmer and service provider a priority?	Women farmers (n=29[106])	29/29 consider interaction between farmer and service provider important. All interviewed women said that they preferred face-to-face advice and interacting directly with a farm advisor at the farm.
	Nafis (n=4)	4/4 mentioned the importance of interaction with the farmers to update the platform knowledge base.
	APF (n=9)	5/9 mentioned the importance of interaction with the target groups (via the platforms and partner organisations).
	Governmental institutions (n=16)	- Importance of interaction mentioned in Nasep: 14/16 mentioned the importance of interaction - 7/18 mentioned that services cannot only be demand driven
	Cooperative Unions (n=4)	4/4 considered interaction between farmer and service provider important. 2/4 answered that building advice with farmers is key.
Are individual (in person) visits to the farm a priority for the exchange of agricultural knowledge?	Women farmers (n=29)	29/29 expressed a demand for individual trainings and visits to individual farms
	Nafis (n=4)	4/4 answered that the cost is too high to have an individual service and the platform should be able to cover all farmers
	APF (n=9)	9/9 answered that this is not a strategic concern to the platform
	Governmental institutions (n=16)	- Individual visits mentioned in Nasep but not a priority (complementary tool to ICT services) - 5/16 answered yes to this question – individual visits are too costly but are to be replaced by group trainings with farm visits and ICT tools
	Cooperative Unions (n=4)	2/4 answered yes to this question. However very costly.
Are farmer groups an important institution for knowledge sharing?	Women farmers (n=29)	28/29 considered farmers' groups an important institution for knowledge sharing (one female farmer is not a member of any group). 29/29 felt that group trainings and demonstration days are important.
	Nafis (n=4)	2/4 cited the importance of farmer groups to disseminate information. 2/4 mentioned that group trainings are important for knowledge exchange, but it is not a strategic concern to the platform
	APF (n=9)	5/9 answered that group interaction is important but not a strategic concern to the platform.
	Governmental institutions (n=16)	- As per Nasep, the groups' approach is a priority for the delivery of advisory services to various social groups, in particular disadvantaged groups - 14/16 mentioned the importance of groups. 13/16 also stressed the importance of demonstration days

[106] n=29 are the combined answers from the interviews with (i) female farmers on internet use and supply of two platforms (n=3), and (ii) female farmers on accessibility and content of farm advisory services (n=26).

	Cooperative Unions (n=4)	4/4 answered that groups are a priority. Machakos Cooperative Union has employed an extension officer specifically for this purpose. 4 /4 considered that group training and demonstration days should be strategic concern for the cooperatives to share agricultural knowledge

As findings provide evidence in, the two platforms interact and co-produce knowledge with women and men farmers to a certain extent, but none of the platforms offer individual visits at famer level. This is however a specific demand from the farmers. This limited interaction has direct consequences on the content of the knowledge that is produced back-office. Even though some of these farmers knew about one of these platforms and had access to the internet, feedback from farmers and local extension workers suggests that farmers may be reluctant to use the platforms. Reasons given were that the information was not specific enough to their needs; some of the additional services (such as a voice call) were tedious and expensive; and they felt they had a lack of involvement regarding content development. One of the interviewed farmers who had been introduced to Nafis confirmed that improved dialogue between service provider and end user should be a priority.

6.2.2. A gap between the vision of farm women and the vision of platform designers as to the essential conditions for building relevant advice

The results also show a strong emphasis by the interviewed female farmers on collective access to knowledge, whereas this dimension is overlooked by the platforms. In this regard, the questions from previous sections aimed at understanding the role given to farmers' groups in generating technical knowledge and information exchange were put to all stakeholders.

The women farmers indicated that it was in these groups that they shared experiences both among themselves and with external agents. It was usually through the groups that the female farmers organised trainings on different topics (poultry farming, dairy farming, gardening, rabbit rearing). These findings echo those of Ong'ayo et al. (2016) from two other counties in Kenya. Demonstration days and group trainings are two of the interviewed women farmers' four preferred training options.

These two types of knowledge-exchange forum are mentioned in government documents such as the Nasep (Ministry of Agriculture of Kenya 2012), and are recognised as important venues for knowledge exchange by interviewees. Representatives of governmental organisations confirm that groups are essential to farmers for acquiring and sharing new knowledge. The importance of groups is also mentioned in the Nasep as one of the tools used to reach farmers with advisory services, because it corresponds to women farmers' demand and because it is considered to be more cost-efficient than individual advice. It is also noted that e-services in agriculture and ICT platforms could be used to support farmers in this regard.

At the cooperative level, groups are considered to be important focal points for cooperative union staff to meet with their farming members. According to the interviewees, knowledge and information are exchanged at this level. Group trainings are organised by the Union (micro-finance group trainings, poultry trainings). For instance, the Machakos Cooperative Union (60,000 small-scale farming members) has employed one agriculture and livestock officer for this specific purpose to meet a demand from the farmers. Such general agreement regarding the importance of groups and collective organisations for farm advice is shared by the interviewed platforms staff. Both Nafis and APF interviewees acknowledged groups as important knowledge-sharing forums for farmers. However, no concrete steps were proposed to adapt the

platform to this pattern. At the platform level, farm groups and knowledge-sharing forums were not considered a priority for the design and management of the tool.

These results highlight a rather large gap between the vision of female farmers and the vision of platform designers as to the essential conditions for building relevant advice. However, they also suggest routes for progress. For instance, new arrangements between women farmer groups, local extension officers and platform developers could be co-designed, in order to favour collective access to and use of platform resources and to include feed-back from female farmers into the platform back-office activities (this is further elaborated on in Chapter 8). This section has given a detailed demonstration of how platform rationales meet the demands of women farmers. I will now present an in-depth analysis of the gender equality performance rationales of the Nafis and the APF platform (thus based at the supply level of services).

6.3. Performance rationale analysis of gender equality integration in two ICT platforms

6.3.1. Female farmers' demands with the innovations performance analysis framework

To assess whether these platforms have rationales for integrating gender equality, I conducted an analysis of the performance aims of two platforms: Nafis (n=4) and APF (n=9). I used as a basis the framework for evaluating the performance of farm advisory services and its five dimensions – (1) financial; (2) technical; (3) relational; (4) innovation; and (5) civic – and then developed counterfactual hypotheses for each dimension (cf. Table 6.2).

6.3.2. The financial dimension

In the financial dimension, if platforms are inclusive of female farmers, then it is expected to find gender-bound financial indicators (i.e. gender disaggregated budgeting, in kind contributions to ensure that the needs of women farmers are considered in the development of services, financial reporting procedures integrating women farmers' demands).

As previously mentioned in Chapter 5, **the National Farmers' Information Services (Nafis)**[107] platform benefits from substantial in-kind contributions. Indeed, Nafis collaborates with two private firms in information and technology (IT) development: Teknobyte Kenya and Speechnet Limited. The public agency, the Agriculture Information Resource Centre, supports Nafis in content development and has a link to the Nafis platform on their website. The Kenya National Library Services are the database content owners. They stock the content from their servers. Some farmers or farming experts and the Kenya Agriculture and Livestock Research Organization (KALRO) are the main content development partners. The content is however not gender bound[108]. As per demand, this can be done but it is not a standard indicator the platform reports to. Likewise, Nafis does not have a gender-disaggregated budget (Source: Nafis platform manager).

[107] The Kenyan Government finances the functioning and implementation of Nafis in partnership with the Swedish International Development Agency (Sida) via the Agricultural Sector Development Support Programme (ASDSP). The platform started in 2009 during the National Agriculture and Livestock Extension Programme (Nalep). At the end of the Nalep programme period, the programme was extended to Nalep II, which in 2012 was replaced by ASDSP. The purpose of the programme is to support the implementation of the agricultural sector development strategy (ASDS).

[108] The platform develops gender-related content on demand, but this is not mandatory (Source: interview with Nafis manager).

Table 6.2: Counterfactual hypotheses for analysing the performance rationales of gender equality integration in the Nafis and the APF platform.

Counter-factual hypothesis	**Indicators for data analysis**	**Nafis (Yes/ No)**	**APF (Yes/No)**
A – Financial: If platforms are inclusive of female farmers, then it is expected to find gender-bound financial indicators	A.1: Gender disaggregated budgeting	No	No
	A.2: In kind contributions to ensure that the needs of women farmers are considered in the development of services and knowledge content	Yes, partly*	Yes, partly
	A.3: Financial reporting procedures integrating women farmers' demands	Yes, limited**	Yes, partly
B – Technical: If platforms are inclusive of female farmers, then it is expected to find platform services that are adjusted to women farmers' needs of access and ability to use services	B.1: Procedures in place facilitating knowledge exchange between platform staff and women farmers	Yes, limited	Yes, limited
	B.2: Monitoring tools to evaluate if female farmers access and use the services provided by the platform, and also if services are used differently	No	No
C – Relational: If platforms are inclusive of female farmers, then it is expected to find platform services that is adjusted to women farmers' demands for service relations and specific modes of interaction	C.1: Gender-bound monitoring system assessing the degree of personalisation (the frequency of visits and the duration of visits)	No	No
	C.2: System measuring women farmers' loyalty to the platform	No	Yes, limited
	C.3: Gender-bound activities that relate to service relations (personalisation of service, nature of contract)	Yes, limited	Yes, partly
D – Innovation: If platforms are inclusive of female farmers, then it is expected to find gender-targeted back-office interventions	D.1: Overall gender equality bound monitoring and evaluation system in place	No	No
	D.2: R&D policy and activities that are inclusive of gender equality	No	No
	D.3: Gender disaggregated data	No	Yes
	D.4: Staff conducting gender back-office activities evaluating the performance of platform services (e.g. gender researcher)	Yes, partly	No
	D.5: Gender equality inclusive coordination system (that connects front-office and back-office activities)	Yes, limited	No
E – Civic: If platforms are inclusive of female farmers, then it is expected to find the use of gender-bound principles guiding platforms in their actions to be inclusive of women farmers	E.1: The use, implementation, monitoring and evaluation of gender mainstreaming and affirmative action used by platforms with regard to women farmers and their demands.	Yes, partly	No
	E.2: Adequate representation of women farmers' demands to adjust services (and technical content) accordingly in platform design	Yes	Yes, limited

* **Yes, partly** means that only part of the platform activities report on / supports the implementation of gender equality performance rationales
** **Yes, limited** means that gender equality rationales are a reported concern but there is no evidence to support rationale implementation

Furthermore, findings from interviews and administrative documents indicate that the financial monitoring and reporting system of Nafis is not bound to gender activities[109]. In this context, the long-term financial strategy for the platform is to become a PPP platform. According to findings from the interviews with Nafis staff, such financial partnerships could help improve the overall performance of Nafis, and especially regarding gender equality integration (i.e. implementing a database that is bound to gender-equality indicators for financial and operational activities).

At present, **AgriProFocus (APF)** does not have a gender-disaggregated budget. With regard to in kind-contributions, the Dutch NGOs are the main collaborators and contributors of APF for content development (i.e. these partners develop content and AFP disseminates it via the platform). The only content that is gender bound concerns the 'gender in value-chains' knowledge base[110].

The platform is moreover changing its financial strategy (9/9). The aim is to become less financially dependent on the Dutch Government and increasingly to rely on revenues from paying members. Working with gender equality is however a specific demand by the Dutch Government. Thus, implementing a long-term publicly independent financial strategy implies that there could be a risk for decreased implementation of gender equality activities or of the integration of women farmers' demands into the platform policies and activities. It is only the 'gender in value chains' knowledge base that is subject to gender-bound financial monitoring and reporting. The other knowledge bases are not tied to this type of condition. Yet, if gender equality is an important dimension to the platform's strategic objectives, the overall budget and financial monitoring and reporting should be bound to gender activities. The findings from interviews and administrative documents show that this is not the case for the APF platform.

6.3.3. The technical dimension

In the technical dimension, if platforms are inclusive of female farmers, then it is expected to find platform services that are adjusted to women farmers' needs of access and ability to use services (i.e. procedures in place facilitating knowledge exchange between platform staff and women farmers, monitoring tools to evaluate if female farmers access and use the services provided by the platform, and also if services are used differently).

Before 2014, ASDSP was an agricultural extension sector coordination unit and **Nafis** was an ICT device supplying complementary e-services to farmers on any agricultural and livestock technology. Since 2014, the ASDSP has focused on value chain development, supporting sector coordination through the intergovernmental secretariat established by the Kenyan Government. In this context, Nafis also changed its technical content focus: it now supplies complementary e-services to farmers organised per value chain, covering 19 agricultural and livestock value chains (cf. Box 6.1 on the means of access to Nafis services).

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[109] It includes the number of financial reporting procedures in place to verify: whether women and men farmers' demands are effectively integrated into the platform; the amount dedicated specifically to knowledge facilitation activities between staff, partners and female farmers; the amount dedicated to a monitoring and evaluation system based on female farmer's multidimensional demands.

[110] APF includes a set of a different 'knowledge bases' or agricultural and livestock value chains (pork value chain, dairy and livestock), horticulture, sustainable agriculture, as well as cross-cutting thematic ones (gender in value chains, access to finance, organised farmers, youth and agribusiness).

Box 6.1: Means of access to Nafis services and technical content

Besides the platform services, to access the knowledge per value chain, the Nafis platform offers farmers the possibility of going via other ICT services[111] (e.g. interactive voice response, educational videos, voice call, phone numbers to agricultural extension officers per county and expertise). Moreover, hard copies of gender-related training materials can be downloaded from the platform. There are however certain conditions (and difficulties) for accessing the platform (IT skills, IT literacy, ability to read, internet connection and entering into use with computer, smart phone or a tablet). Nafis staff are aware of these obstacles and the fact that they especially concern women farmers. As a result, they have developed other services connected to the platform (for instance, SMS-based advisory services via a partnership with the iShamba platform that does not require internet connection).

As emphasised in Box 6.1, the services Nafis offers to its target groups remain highly standardised. The platform technical content that relates to the 19 different value chains can be read online and then downloaded onto an ICT device, and if necessary printed. It is also possible to access other ICT services via the platform. Farmers can equally call an integrated voice response service for help or ask a question on the Nafis blog. The platform does not however provide physical advice (i.e. there are no staff available to go and meet farmers upon request). Nor are there specific 'gender standards' or procedures in place facilitating knowledge exchange between platform staff and women farmers.

Based on government priorities, Nafis needs to adhere to the national gender policy. Working with gender equality integration is also a demand from the Swedish Government. Yet Nafis does not have gender-bound indicators in place to measure the performance of such a system. According to the interviewees (n=4), establishing and maintaining a robust monitoring system is costly and requires human resources. The platform is therefore using the free software Google analytics, which does not have the ability to discern the number of users per gender, gender per county, or the types of services the customers are using. It only shows from which country the users are. It does not either distinguish whether it is the same or different individuals accessing the platform, and the profile of these persons. These results show however that monitoring is a concern and that efforts are being made.

All in all, findings indicate that Nafis has standardised platform rationales in place to reach their women farmers. Moreover, I could not find evidence of monitoring tools in place for evaluating the performance of the services provided by the platform, especially related to the gender dimension and what is considered important to women (cf. Figure 6.1).

[111] The platform provides information via their website and through mobile phones. The information is entered locally through the internet by extension officers and accessed via the Nafis website or through mobile phones. iShamba is the main partner providing SMS services via the platform. At the website, there are also agriculture county executives that any farmer can call or email. Moreover, there are specific agricultural extension officers' contacts per county and district. A farmer can choose to contact extension officers with expertise in one particular area of agriculture or one type of livestock, such as dairy cattle or maize production. The platform covers both general agricultural topics, such as natural resource management and agro-weather tool advisory services, and more precise ones such as rabbit farming, mushroom production, indigenous chicken rearing, sweet potato farming, etc. The information is presented with text, graphics, audio and video. The main objective is that farmers should be able to search for any agricultural theme on the platform, and then download the content. Yet no services based on farming women's priorities and expectations have been developed or evaluated.

In the case of the **APF platform**, it is the Dutch platform members that develop different gender-related documents and 'toolkits'. It is possible to download soft versions of the various training materials from the 'gender in value chains' knowledge base. In this knowledge base, services and content of the training material is adapted, based on the demands of online members and different gender equality criteria. If a specific gender training is carried out in cooperation with one of the network members, the developed methods and tools of the training material remain the same. It is rather the selection of tools and methods that is adjusted (Source: APF gender expert). Gender in value chains is the only knowledge base having gender-bound indicators in place (Source: APF gender expert).

Likewise, the interviews with APF staff provide an initial understanding of various obstacles to women farmers' access of the platform (for instance, they face higher difficulties in using the internet, and without connection it is not possible to access platform services) (n=9). Particular concerns relate to: (i) the required access to a computer and the internet; (ii) different knowledge bases not being used effectively; and (iii) insufficient financial means to access platform members (for trainings, events, fairs). In this regard, there is an on-going discussion about making the services of the platform accessible via SMS to the end user, based the assumption that most small-scale farmers, including women, own and use a mobile phone to access APF services[112].

An online survey was conducted in cooperation with the APF staff to assess the levels of standardisation of the platform services, which also relates to the terms and conditions of access to the platform, put in relation to the priorities and needs of the platform users (n=30). Four women and six men who said they worked on the family farm with primary production activities (livestock and/or crop farming) were selected for further analysis[113] (i.e. 10 out of 30 respondents). The answers from the respondents in regard to the APF platform services was organised into three main categories (cf. Table 6.3):

(1) The advantages, and are mostly linked to standardised activities such as networking, accessing general agricultural information and time saving.
(2) The disadvantages, and relate to the lack of context-related agricultural knowledge, cyber security problems and increased reputational risks for agricultural businesses, and exclusion of disadvantaged social groups (i.e. an absence of understanding of the needs of Kenyan farmers and a problem of access to the platform).
(3) The stated improvements mainly concern an increased demand for less standardised services (e.g. more interactive services) There is also a demand for more updated knowledge databases.

[112] In this regard, the 2009 census data show that 46% of the female-headed households and 47% of the male-headed farming household own a mobile phone. Findings from the individual interviews with farming women (n=26) confirm that they have access to a mobile phone and are using the device. This implies that if an SMS technology was available (awareness creation), and it was a priority to them, they could access the technology. On the other hand, findings indicate that co-production of knowledge, face-to-face intervention and access to knowledge via farmer groups are prioritised by these women. Hence, even if such services existed, it would not necessarily imply that these women would be using the services supplied by the platform.

[113] Six individuals have university education, three have tertiary education and one has secondary education. All ten individuals use internet themselves daily (with the exception of one man and one woman, who use internet on a weekly basis). One out of ten individuals prefer meeting in person individually to exchange agricultural knowledge. Five out of ten individuals prefer using internet services to access agricultural knowledge (either via the mobile phone or from a computer, at cyber cafés or their workplace). The individual AFP users were asked about platform improvements based on their needs.

Table 6.3: Advantages and disadvantages with the APF platform according to farming members and suggested improvements

(1) Advantages (n=10)	(2) Disadvantages (n=10)	(3) Improvements (n=10)
Business contacts and networking	No detailed professional information about farming	Increased need for service relations (e.g. add a chat service)
Sharing experiences with other farmers in the sector	In a competitive business environment, other users competing for clientele can use propaganda to undermine another user's business	Increased focus on the needs of the users rather than on the promotion of the platform
Getting general agricultural information	Any negative information can flow in and remain online, and this can ruin or undermine one's business	Connect farmers to development partners for technological innovation purposes
Convenient, time saving, up to date information	Centralized workshops, being unable to meet members at the grass-root level	Engage farmers often and exhaustively
Interaction possibilities	Exclude certain social groups (illiterate persons who cannot access without internet)	Keeping members up to date with information every time and new products
Platform to learn from other farmers	Lack of public awareness	Market awareness
Easy access to the internet	Data insecurity, data manipulation, login failures	Weekly updates and more data uploads

Source: Primary data collection, 2016.

Findings show that the individuals using APF services are educated and have access to various material means (computer, smart phone, tablet). These types of farmers are different to the women farmers (based on the household typologies, cf. Appendix 11) analysed in this research (with regard to difference in education, use of the internet, access to material and immaterial means). Their expectations are nevertheless similar to those of the interviewed women farmers (n=26), with a demand for more context-related services, where the degree of standardisation of services is low (i.e. a demand for co-production of knowledge). This is however not a strategic concern to the platform. There is very limited face-to-face or group interaction with the target group (occasionally during APF organised events or fairs). Also, the APF platform does not report having monitoring tools in place to assess whether female farmers use the services provided by the platform.

6.3.4. The relational dimension

In the relational dimension, if platforms are inclusive of female farmers, then one would expect to find services that is adjusted to their demands for service relations and specific modes of interaction (i.e. gender-bound monitoring system assessing the degree of personalisation (the frequency of visits and the duration of visits); a system measuring women farmers' loyalty to the platform; and gender-bound activities that relate to service relations (personalisation of service, nature of contract)).

Findings from the interviews with the women farmers (n=26) show that co-production of knowledge through interactive advice is a priority. In this regard, there is some virtual interaction between **Nafis** staff and their target groups (Source: Nafis platform manager). Nafis

users can interact with the platform designers using a virtual feedback link or a blog for content improvements. In this context, there is weekly online interaction between Nafis volunteers (farmers or experts on an agricultural topic) and farmers.

Conversely, the interviewed Nafis platform staff could not tell the degree of personalisation or women farmers' loyalty to the platform (n=4). The reason was because the platform did not yet have an appropriate monitoring system in place. On the other hand, the platform did have gender-bound activities that were included in the annual work plan. These specifically related to the types of services and technical content considered relevant to women farmers, based on Nafis quarterly meetings. In these meetings, where one farmer was always present, the participants discussed improvements to the interaction modalities of the Nafis services (for example, if possible solutions could be to enter into contact with remote women farmers through virtual interaction and/or organised trainings per county). There is therefore evidence of certain 'gender standards' in place for knowledge development, and reflection on the types of modalities that could better address women farmers' demands. Some modalities had however not been put into practice because of the high costs, and as it turns out, they mainly concerned the interactive and interpersonal services (e.g. county sensitisation trainings of Nafis services, physical meetings with farmers).

There is moreover no monitoring and evaluation system assessing the performance of gender-bound relational indicators. In other words, the platform does not have a monitoring system in place measuring the services used by women farmers in Kenya[114]. It also shows that online, and especially personal, interaction between the Nafis staff and women farmers is limited.

Based on the **APF** annual reports and according to all APF interviewees (n=9), the degree of personalisation and client loyalty is a strategic concern to the APF platform, as it is part of its core mandate. Evaluating the performance of these indicators is however a concern (Source: APF interviewees working at management level, n=4). In 2015, 900 out of 11,000 online members were linked to the 'gender in value chains' knowledge base. The interviewees could not tell the number of active versus passive members[115] of the platform but there was a higher number of passive members. In this context, the platform staff are concerned about the non-usability of the platform, given that it is a broad platform that tends to draw mainly passive members, where some are not willing to share knowledge content.

The platform has developed two major types of services for farmers/agricultural producers: (1) activities on the platform (online activities); and (2) offline activities. The platform supplies different services to APF members, via a set of knowledge bases (where clients can: interact with each other and APF staff, read online or download agricultural and livestock-related materials, access other ICT services and platforms). APF staff do not expect all farmers to access their online services (especially individuals who do not have the ability to do so). In this regard, the offline services provide complementary activities linked to the platform. These

[114] There are moreover no evaluation measures nor indicators assessing how Nafis is performing concerning the different governmental policies and legislative documents such as the Constitution of Kenya, with regard to gender equality integration.

[115] According to the survey on APF users (n=10), the frequency rates for accessing the platform varies. The majority are non-regular users of the platform, i.e. less than half use the platform services daily – three visits to APF daily, one person once a week, four once a month and two say they never use the platform. Three individuals use the online platform. The other seven attends offline activities organised by APF, i.e. networking events. Two also said they interacted with APF staff over the phone (for advice). The main reason for using APF services is to access knowledge about agriculture and agricultural practices. The most common reasons for visiting the APF platform are for: (1) information sharing and learning, and (2) to make contacts in the agribusiness sector.

include workshops, trainings, organised fairs, events and 'business-to-business' workshops. Another example of an offline activity that is part of the 'gender in value chain knowledge base' is the 'gender-coaching track'. If requested, APF staff train gender coaches in organisations that are members of the platform, who in turn train smallholder farmers. The offline activities are supposed to reach female farmers who do not have access to the online platform services.

In this context, none of the above-mentioned activities has the obligation to integrate gender equality into their services and activities, with the exception of the 'gender in value chains' knowledge base. For the gender-coaching track activity, a contract can be established as an informal agreement between supplier and target group. It involves several physical follow-up visits to farm households or over the phone. The APF staff does not directly implement such activities: the members of APF are the implementers.

The 'gender in value chains' knowledge base is the only area that has the obligation to develop gender-bound activities and to follow gender-equality indicators.

The results show that gender relations are to a certain extent considered in this front-office dimension of APF platform services (via the 'gender in value-chains' knowledge-base). Findings show that they have a high number of passive users as a result of non-personal and standardised services supplied by the platform. None of the knowledge bases (in total 9), with the exception of gender in value chains, are not yet obliged to have gender-bound activities.

A finding that is valid for both platform is the fact that there are no contractual agreements between the services delivered by the platforms and the target groups (for instance that clients will be contacted on a monthly basis by platform staff). The required condition is to become a member of the platforms (membership is free but it is a prerequisite to become a member to get access to the different services). However, one possibility to adjust services to women and men farmers could be to demand of visitors when they enter into use with the platforms to fill in individual data (gender, economic activity, farm project).

6.3.5. The innovation dimension

If platforms are inclusive of female farmers in the innovation dimension, then it is expected to find gender-targeted back-office interventions (i.e. an overall gender equality bound monitoring and evaluation system in place, R&D policy and activities that are inclusive of gender equality dimensions, gender disaggregated data, staff conducting gender back-office activities evaluating the performance of platform services, gender equality inclusive coordination system).

There is a gender researcher working for ASDSP, who supports **Nafis** on a voluntary basis. Although it is not part of their work description to integrate gender equality in the Nafis platform, this person is generally involved in meetings on knowledge development and cross-verifies gender-bound technical content that is uploaded on the platform portal.

The interviewees confirm not being able to adequately integrate gender-bound back-office work due to a financial concern. As a result, Nafis has the intention to be financed through a PPP setup (cf. Section 6.4.2). This type of model would allow for the platform to strengthen its gender-bound innovation trajectories. Furthermore, given that it is a state-owned platform, the institutional coordination procedures are developed by the Kenyan Government, to which the

platform adheres[116]. Nafis staff confirm cooperating with the Ministry of Gender on questions of gender equality integration in platform activities and technical content. Upon request, a gender officer from the Ministry of Gender supports Nafis platform staff in this development process. This occurs two to three times per year to develop technical content that is 'gender sensitive' or specifically targeting women farmers' needs (e.g. tomato production in greenhouses).

I was able to identify that dimensions of gender equality are, to a certain extent, present in Nafis back-office interventions. There is hence enough evidence showing that the integration of women farmers in Nafis back-office work is on the agenda.

There is no R&D policy nor are there financial means devoted to back-office activities in the **APF platform**. According to the platform interviews and APF documents, with the exception of gender-disaggregated data[117], the network has no monitoring and evaluation system assessing the performance of the different value chains with regard to the integration of gender equality. There is no staff in charge of back-office activities. In addition, there are no full-time APF employees to work on the integration of gender equality. Only one employee is paid to work one day a week on gender issues, at international level. This person is not employed for back-office activities and there is no dedicated budget in this regard.

According to all interviewees, the long-term strategy for the research work is the responsibility of the platforms' Dutch partners, i.e. several NGOs and their collaboration with Dutch universities. The platform disseminates emerging innovations from their partners on the platform. As a result, the APF does not have any gender-bound innovation trajectories in place. Moreover, the platform has no explicit coordination procedures for the integration of gender equality, especially related to back office work (and its connection to front-office activities).

6.3.6. The civic dimension

The civic dimension relates to the use, implementation, monitoring and evaluation of gender mainstreaming and affirmative action used by the platforms to integrate women's priorities, expectations and needs. Explicit and implicit representations of women within these platforms are also part of this dimension.

These priorities have been analysed according to the definition of gender relations and a woman farmer presented in Chapter 2 (Section 2.2.1), as well as the household typologies based on the 2009 census data (cf. Appendix 11), and the results presenting the multidimensional demands of small-scale women farmers in Machakos county (n=26) (cf. Figure 6.1).

Nafis follows gender action guidelines and develops and implements platform activities based on the principles of gender equality and a representation of the 'Kenyan woman farmer' as per

[116] Cf. Figure 4.2 (Chapter 4) for the institutional framework of the inclusion process of gender relations in the ICT-based farm advisory services system of the Kenyan Government. This coordination structure is still however at a stage where the integration of gender relations at meso- and micro-level is unclear. It can therefore not be expected yet of Nafis to have fully integrated gender equality dimensions across its operations.

[117] The platform monitors the number of female- and male-registered members for both the offline and online activities. In Kenya for instance, 31% of the registered members in 2014 were women.

national policy frameworks. In that sense, evidence show that gender equality is a strategic concern to the platform[118].

At internal level Nafis uses affirmative action and gender mainstreaming for the development of knowledge content (in having specific content developed for women farmers). Since Nafis operates under the ASDSP and is a state-owned platform, they have adopted the definition of gender equality and gender mainstreaming from the gender policy of the Kenyan Government[119]. Nafis staff also gets support from the Gender and Social Inclusion (GSI) Guideline for gender equality integration. This is a document that the ASDSP uses for ensured social inclusion[120] across programme activities. Given that Nafis is partially supported by this programme, it is expected of the platform to adhere to the GSI guideline. This guideline presents tools to support the implementation of gender and social inclusion. Moreover, as part of the ASDSP, Nafis follows the one-third principle of affirmative action.

The platform is moreover obliged to develop gender-bound knowledge content and activities based on the definition of women in agriculture as per the Agricultural Sector Development Strategy (ASDS) and the Agricultural Sector Gender Mainstreaming Guideline (ASGMG). Thus, Nafis acknowledges that women farmers have various needs and concerns, where agriculture is both a domestic and a commercial activity to them. It moreover perceives them as the main contributing labour force in agriculture in Kenya.

Because it is a demand from the main donor of **AFP**, the platform uses gender mainstreaming. However, it does not have a definition of gender equality nor of gender mainstreaming. The action guideline is explained during offline activities (i.e. trainings) but there is no explicit description on the platform website, in annual reports or strategic frameworks. The platform does not claim to use affirmative action.

The APF interviewees recognise similar priorities of female farmers as those of the interviewed women farmers in Machakos (n=26). Certain priorities are considered in the 'gender in value chains' knowledge base (such as women's need to access different types of knowledge, depending on their farm activity). These are, however, neither reflected nor mainstreamed across the other knowledge bases. An aspect that should be stressed regarding the 'gender in value chains' knowledge base and subsequent gender activities (e.g. the gender coaching track) is that it is not implemented in all country branches. For instance, the gender in value chains knowledge base does not exist in Kenya, although it was one of the first countries to test and implement the gender coaching track offline activity. It started in 2012 but was disrupted, re-started again in 2013 and ended in 2014. It was not successful in Kenya for various reasons: (1) no demand from the members, (2) the network coordinators did not have enough financial means to implement the activity, and (3) the difficulty for members to work continuously with the gender coaching track as it requires internal funding.

In sum, I could not find enough evidence to confirm that the APF uses gender-bound principles guiding its actions to be inclusive of women farmers. Gender-equality performance rationales

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[118] It should however be mentioned that Nafis does not have any evaluation tools in place measuring the performance of gender mainstreaming in effectively integrating women farmers' demands in the platform. Thus, there is no actual understanding of whether the knowledge content is/could be prioritised by these women.

[119] According to this policy, gender mainstreaming *"is the consistent integration of gender concerns into the design, implementation, monitoring, and evaluation of policies, plans, programmes, activities and projects at all levels."* (Ministry of Gender of Kenya 2011, p.24).

[120] The GSI framework is a donor requirement from the Swedish Government.

appears as being fragmented at management level in the platform (i.e. there is no evidence of a definition of gender equality and gender mainstreaming, APF does not have a gender policy). Conclusions from such results tell us that additional effort is required to integrate gender equality objectives at APF management level.

6.4. *To conclude:* ICT platform rationales underpinning gender equality policy objectives

The analysis of the performance rationales demonstrates that objectives of gender equality are present to some extent in the front- and back-office activities of Nafis (cf. Table 6.2). For APF, the women farmers' demands are in some cases present in front-office activities. Gender equality dimensions are not included in the back-office activities of APF but this is because back-office activities are in general not of strategic concern to the platform.

Table 6.2 provides evidence moreover of differences between the prioritised performance rationales of the two platforms. The civic dimension is the prioritised rationale for gender equality integration in the Nafis platform. The financial and innovation dimension is also a strategic concern. Nafis staff are elaborating on possibilities to ensure the long-term sustainability of the platform, to measure platform performance services, and to ensure that its technical content is adjusted to women farmers' demands. At the same time, the relational dimension appears to be the core performance rationale for gender equality inclusion in the APF platform. The financial dimension is also a concern reported by APF when it comes to gender performance rationales. Evidence shows that these platforms do not operate according to the same principal performance criterion and thus strategic objective, which relates to their platform type. These results converge with the points for discussion raised in Section 5.3.2 (Chapter 5), where it is emphasised that the consideration of the civic dimension can become compromised in foreign PPP-based platforms. Results from this section support this hypothesis.

Hence, analysis of the five performance dimensions point towards several mechanisms (institutional, cultural, financial, technical, relational) that are not yet fully integrated in Nafis and the APF. They are however needed for the inclusion of gender equality objectives and the demands for interactive and co-produced advice of women farmers in platforms. These relate to:

(a) Front-office activities, and correspond to services that meet the demands of both women and men farmers concerning co-production of services, interaction and established service relations. It also corresponds to the type of technical content disseminated in platforms, and in making sure that it addresses farmers' multidimensional demands.
(b) Back-office activities, which involve gender-bound monitoring and evaluation systems, and have gender research staff, followed by robust databases that are updated on a regular basis and, most importantly, are inclusive of women and men farmers' priorities.
(c) An institutional coordination system that creates the necessary organisational structures so that platforms can provide adequate less standardised advisory services to women and men farmers in Kenya.
(d) Financial means of platforms to ensure that the supply of services and technical content meet the demands of women and men farmers. In other words, the guaranteed means necessary to ensure that there is gender-bound front-office and back-office activities, as well as a gender-inclusive ICT-based coordination system at platform level.

Another point of concern relates to the implementation of gender equality objectives and actions based the use of gender principles. Findings show that there are still gender integration issues

in both platforms even though gender mainstreaming is applied, and that the specific demands of women farmers are not fully considered in these two ICT platforms. This applies to both the modalities of services and the type of technical content offered by the platforms. Such evidence demonstrate that it is important for services and knowledge content to be context specific, even if this gender principle is used as basis for the implementation of gender equality actions. As several authors have emphasised, policy actions that are based upon the gender mainstreaming principle must take into consideration the social structures that are proper to one specific context (Verloo 2005; Walby 2005; Debusscher 2011; Bock 2015). Thus, a general question open to debate is whether gender mainstreaming actually can support gender-equality integration in strategic processes, as the paper by Shortall (2015) emphasises. As emphasised in the state of the art (Chapter 2), if gender principles are to support the implementation of gender equality actions, these need to be adjusted to the local milieu. Such actions also needs to be planned and budgeted for in the long-term as stressed in the empirically based paper by Debusscher (2011). The findings from this Chapter evidently attest to earlier research findings. The results also provide evidence in the importance of using an integrated analysis of the different performance registers of platforms, in order to bring out interrelated levers of action.

Summarised, the results from the different sections of this Chapter disclose the difficulties of operational implementation of gender equality dimensions, beyond the display of gender-equality performance rationales.

Results from the analysis also reveal that the platform stakeholders have the ability to influence women farmers' access to these devices and the type of technical content they should be able to access. Chapter 7 presents this access but from the perspective of the Kenyan female and male farmer. It allows us to understand how knowledge-based platforms can reach the farming population in Kenya.

CHAPTER 7 - Access to the internet and knowledge-based platforms for female and male farmers in Kenya

A key requirement for the monitoring of agricultural technical support systems that rely on knowledge-based platforms is access to internet services. Such access is also crucial for women farmers' ability to use the platforms provided. In this chapter, I aim at providing evidence of and discussing three areas that influence Kenyan women farmers' access to and use of the internet, and therefore their capacity to enter into contact with internet-based platforms.

- The first area related to **the economic status of women**. Women's insertion in the formal and informal sector in a given society may affect their access to the internet and ICTs. This factor is considered fundamental since feminist economists have shown how women's access to resources depend upon their insertion in the labour market (Barker & Feiner 2004; Ferber & Nelson 2003). Access to technological innovations (the internet and ICTs) and knowledge can be classified as different types of resources.
- The second area corresponds to **the level of education**. This relates to the cognitive resources of women (language, literacy and IT literacy). It could have an effect upon their use of internet services and ICT devices as reported in other situations (Hilbert 2011; Hafkin & Huyer 2008).
- The third area concerns **the social status in the household** corresponds to how women farmers access resources based on norms and behavioural patterns as a result of their social integration. This could affect if and how women use the internet. This dimension relates to social constructs, the cultural and community context: (a) marital status (monogamous, polygamous, never married, widowed), and (b) relationship status (household head[121] or spouse). The research report by Gillwald et al. (2010) and the empirically-based paper by Anderson et al. (2017) show that intra-household social status has an impact on decision making and control over resources.

Based on data analysis from the 2009 population and housing census (PHC), this chapter is organised as follows: **Section 7.1** presents the access to the internet and ICT devices for different samples of the population. **Section 7.2** presents the results from the descriptive statistics analysis, with the aim of providing evidence in differences between rural Kenyan women's and men's use of the internet with regard the three areas presented above. Here, I analyse two sub-groups: (a) All rural individual's above or equal to 18 years of age who say they use the internet but do not have a computer at home, and (b) All rural individual's above or equal to 18 years of age who say they use the internet, and who have a computer at home. **Section 7.3.1** presents a synopsis of the variables that influence rural women's and men's use of the internet in Kenya in each of the five main economic activities (agricultural worker, work for pay, family business, homemaker or full time student). I report on the marginal effects. **Section 7.3.2** narrows down the analysis, and presents the variables that influence rural women farmers' use of internet services through a regression analysis.

[121] *"Household head is defined as individual who administers the household or individual who is considered to be responsible for the household by the other household members. Distinction was made between de jure female heads (e.g., widow, single, divorced, or separated) and de facto female heads (e.g., wives of male migrants or with ill spouses)"* (Ragasa et al. 2013).

7.1. Access to internet services: a key point determining use of ICT knowledge-based platforms by women farmers in Kenya

7.1.1. Access to the internet in Kenya

A condition to enter into use with any of the nine knowledge-based platforms presented in previous chapters (Ch. 5 and Ch. 6), is access to the internet. Table 7.1 presents the internet access for the total Kenyan population, the rural population, and the farm population in rural Kenya per gender in 2009.

Table 7.1: Individual internet access per gender in Kenya in 2009.

Geographical area	**Accessing the internet**		**Not accessing the internet**	
	Women	***Men***	***Women***	***Men***
Total Kenya	738,491 (7%)	984,722 (10%)	10,226,458 (93%)	9,628,832 (90%)
Rural Kenya	245,843 (2%)	333,389 (3%)	11,747,699 (98%)	11,295,704 (97%)
Farmers in rural Kenya	51,568 (1.5%)	57,979 (2.3%)	3,311,013 (98.5%)	2,444,784 (97.7%)
Percentages in brackets represent the number of individuals who report using the internet out of the total women or men farmer population above or equal to 18 years of age				

Source: PHC special data processing.

The results show that 93% of women and 90% of men in Kenya declared not accessing the internet. The data reveal that there is a gap in internet access between the overall Kenyan population and individuals living in rural Kenya. Figures from Table 7.1 also show that women in general, but especially rural women farmers, are in a disadvantaged situation when it comes to accessing the internet and the services it may offer. 1.5% rural women farmers above or equal to 18 years of age reported accessing the internet in 2009 (i.e. 51,568 out of 3,362,581). For rural men farmers, 2.3% reported to have accessed the internet in 2009.

All in all, the 2009 census data show that accessibility to internet services in Kenya is limited. This is especially the case in rural areas, where 2% of women and 3% of men accessed the internet. However, given that the last national census was conducted in 2009, there is evidence that the number of individuals accessing internet services in 2016 has increased. According to statistics from the International Telecommunication Union (2018a), the internet penetration rate was 45% in 2016, so internet use is increasing steadily. Several studies provide evidence of this trend (BMI 2015; GSMA 2015), including the complementary survey that I administered in two counties in 2016 (Machakos and Makueni counties) in Kenya Eastern Province.

In this regard, data on internet use were collected from a random sample (n=1,179) from two counties (Machakos and Makueni) that were coffee producing members of the Machakos Cooperative Union. The Cooperative Union has 60,000 members. Any farmer wanting to market their coffee has to join a cooperative that is a member of this Union. Coffee producers account for 24% of the farmers in these two counties. During the survey conducted in 2016, 21% of this subpopulation of coffee producers reported using the internet, which corresponds to a population of about 12,000 farmers. Extension services report that in this area coffee producers are more prone to use internet than are other types of farmers. However, even with the assumption that use of the internet by the other farmers equals zero, this result indicates an increase of the rate of internet use in the area. In 2009, for the whole area, only 4,522 individuals with a farming activity (coffee and non-coffee producers) reported using internet services in these two counties.

Even though the numbers increase, the most reliable data source (i.e. the census data) shows that an obstacle for entering into use with internet platforms could be the difficulty in accessing internet. There are however other means, via various types of ICT devices (i.e. the radio, the computer, the mobile phone, the television) to access platforms and the services that they offer. This brings us to the following section.

7.1.2. Access to ICTs as possible ways enter into use with platforms

Some authors have analysed the potential of various ICT tools and services for supplying knowledge and services to farmers (Courtois & Subervie 2015; Van Campenhout 2017; Jensen 2010). Others have conducted literature reviews on this issue (Deichmann et al. 2016; Aker et al. 2016). In this regard, ICTs for knowledge supply comprehends a variety of devices. I show in Chapter 5 and Chapter 6 that the analysed platforms use communication modalities other than the internet to provide services to their farmers. These include SMS services via the mobile phone, and agricultural shows via radio and/or television. For example, the state-owned platform Nafis enables farmers to connect via its portal or through interactive voice response and SMS (via the iShamba platform). Occasionally, Nafis technical content is disseminated via radio programmes.

In this context, Hudson et al. (2017) report that female participation in most ICTs is lower than that of men in several African countries. Out of different ICT devices, rural women's access to radio is the highest, although men are still more likely to access and use the device and related services. Gillwald et al. (2010), who carried out a study across 17 African countries, confirm that the average number of hours listened to the radio, per day, is higher for men compared to women.

Here, the 2009 census data show that a lower number of women above or equal to 18 years of age in rural Kenya, irrespective of economic activity, accessed services from (1) radio, (2) a mobile phone, (3) television, and (4) a computer (cf. Figure 7.1). It is especially the case for women farmers who report not accessing computer services (74% women to 68% men). Here, Figure 7.1 reports on the number and proportion of individuals in rural Kenya accessing any of these ICT devices per four economic activities accounting for 82% of the total rural working population (i.e. 10,453,514 out of 12,777,884). It is important to mention that this Figure reports on the individuals who declare accessing services from these ICT devices or not, and who report to have respective device at home**.** This explains why the number of individuals differ per ICT devices in Figure 7.1. These individuals were working: as a homemaker, at the family agricultural holding, with a family business or for pay.

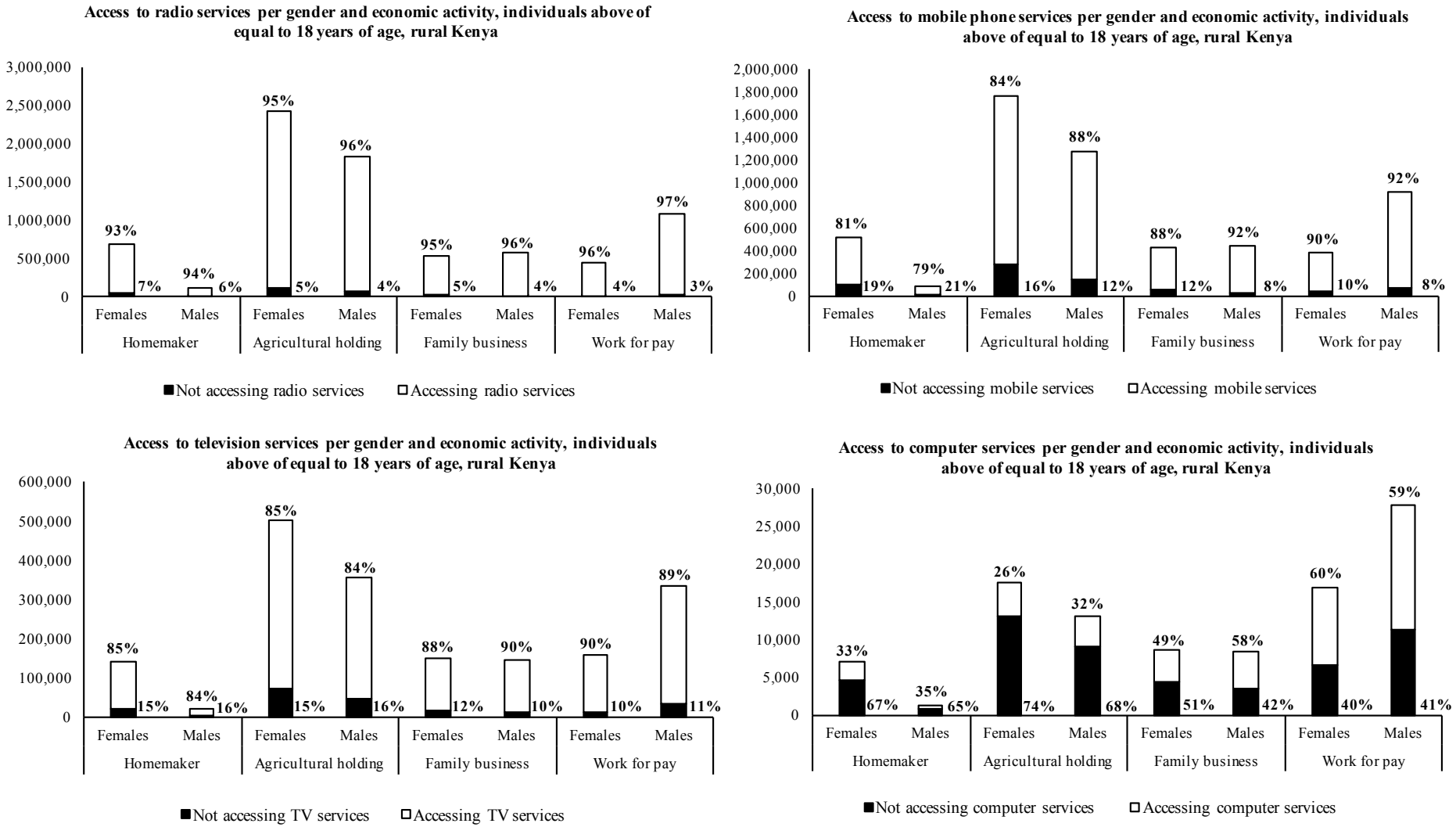

Figure 7.1: Number of females and males above or equal to 18 years of age in rural Kenya in 2009 accessing ICT services from the radio, the mobile phone, the television and the computer in the past month, residing in a household that have the respective devices ($n_{females}$=6,696,493; n_{males}=6,081,391). (Source: PHC special data processing).

There is nonetheless one exception: a higher proportion of women report accessing services from the computer in the economic activity 'work for pay' (60% of females' state using computer services compared to 59% males in this category), even though a larger number of men work for pay. This may mean that when women need to access a service (e.g. to carry out a work-related task), they may be more prone to using such devices compared to men.

Most women report working at the family agricultural holding. Yet a lower proportion of female farmers report accessing services from any of the ICT devices, compared to other economic activities. It follows that female farmers are the most disadvantaged socio-economic group.

Part of the literature highlights however that to get a real understanding of this digital gender divide (Alozie & Akpan-Obong 2017; Mumporeze & Prieler 2017), and how ICT platforms can avoid becoming a vector of exclusion (Rodriguez et al. 2015), one must analyse the reported levels of internet use with respect to different socio-economic factors.

7.2. Internet use in Kenya

7.2.1. Internet use and economic activity

Internet use differs per working status and gender for individuals in rural Kenya (cf. Table 7.2). Working at one's own family agricultural holding was the most common occupation in rural Kenya in 2009 for the population over or equal to 18 years of age. A higher number of women worked at the farm compared to men. In total, 3,362,581 rural women reported working at the farm in 2009, compared to 2,502,763 rural men. Farmers, as opposed to other occupational categories (e.g. working for pay) had less access to the internet in 2009 (cf. Table 7.1).

Table 7.2 presents the reported individual levels of internet use per gender and the five main declared economic activities in rural Kenya in 2009[122]. It shows the differences in internet use between individuals who declare not have a computer in the household (column A) versus those who do (column B).

Table 7.2: Reported levels of internet use per gender and economic activity in rural Kenya.

Economic activity	**A: Individuals not having a computer at home and using the internet**		**B: Individuals having a computer at home and using the internet**	
	Women	***Men***	***Women***	***Men***
Worked for pay	36,489 (6%)	88,903 (7%)	7,896 (47%)	14,494 (52%)
Family business	16,672 (2%)	24,590 (3%)	2,651 (31%)	3,808 (45%)
Agriculture holding	48,859 (1%)	54,885 (2%)	2,709 (15%)	3,094 (23%)
Homemaker	15,114 (2%)	4,045 (2%)	1,470 (21%)	308 (25%)
Full time student	22,060 (6%)	32,062 (6%)	3,073 (40%)	4,130 (44%)
Percentages in brackets represent the number of individuals who reported using the internet, out of the total rural population above or equal to 18 years of age				

Source: PHC special data processing.

With regard to individuals who reported not to have a computer at home, the 'full time student' and, particularly, the 'worked for pay' economic activities seem to increase the likelihood of rural women's and men's use of the internet compared to the other categories (Table 7.2,

[122] Out of a total of 15 economic activities, the other 10 economic activities report 10.4% of the total rural population (1,334,831 out of 12,777,884 individuals).

column A). The proportion of female farmers using internet services is lower compared to their male counterparts (i.e. 1% to 2% respectively). The proportion of women who are homemakers or are full-time students report using internet services at the same rate as the proportion of men in these categories.

Furthermore, there is a difference between females and males using the internet per economic activity, and having a computer at home[123] (Table 7.2, column B). Proportionately, a larger number of men (irrespective of economic activity) use the internet compared to women, even when there is a computer in the home. The difference is significant between women and men working at the agricultural holding: a smaller proportion of female farmers use internet services compared to men farmers. The economic activity with the highest proportion of individuals using internet services is the 'worked for pay' category, with 47% females and 52% males.

The situation between women and men has not really changed however: a higher number of men are using internet services irrespective of economic activity. This seems to imply that women do not use internet services from home to the same extent as men. The reasons for this may be multiple, some not necessarily positive (cultural barriers and norms, social constructs, digital exclusion). Others could relate to women's priorities (they rather use internet services elsewhere, e.g. in collective spaces rather than at home). This is discussed further in Chapter 8. Data from the table reveal two main findings. First, the levels of internet use increase significantly for any economic activity and gender when there is a computer available in the home. Second, rural women, and especially women farmers, report the lowest levels of internet use irrespective of whether there is a computer at home or not. For women farmers who do not have a computer at home, the reported levels of internet use are at 1% (compared to 2% for men farmers). With a computer at home, 15% of women farmers report using the internet compared to 23% of men farmers. Overall, individuals who consider themselves as farmers (i.e. agriculture holding, cf. Table 7.2) report lower levels of internet use compared to other economic activities.

Hence, Table 7.2 tells us that women farmers are in an underprivileged position when it comes to internet use in rural Kenya in 2009. Empirical findings (cf. Chapter 1) from feminist scholars conducting research on the gendered digital divide and exclusion emphasise problems that relate to (1) the lower levels of education of women farmers, and (2) social constructs at intra-household level (i.e. gender differences in social status and therefore their unequal access to economic resources). This brings us to the following section.

7.2.2. Education and internet use

7.2.2.1. Internet use and levels of education between women and men farmers

Table 7.3 presents the reported levels of internet use per women and men farmers and education levels. Column A presents these data for households that declare not having a computer at home. The same variables are reported in column B but for households that do have a computer at home.

Data in Table 7.3, column A, provides evidence that a lower number of individual farmers in rural Kenya, irrespective of gender, who never attended the Kenyan educational system, used

[123] It is noteworthy that less than 1% of the total number of farming individuals above or equal to 18 years of age in rural Kenya that have a computer at home.

the internet in 2009. Only 8,783 out of 913,735 women farmers who never attended school reported using the internet in 2009. The figure reports similar levels for men farmers in this category. The reported internet use levels for individual farmers who previously attended school are also low (2% of women and men farmers). The levels of internet use increased slightly for women and men farmers who were currently attending school (4% and 5% respectively).

Of the individuals who reported to have a computer at home, there are differences in the levels of internet use between women and men and per educational status (cf. Table 7.3, column B). Findings from the literature indicate that there is a relationship between level of education, internet use and gender, which affects women negatively (Gillwald et al. 2010; Wafula-Kwake & Ocholla, 2007). This is due to the fact that a lower proportion of women attended/attend school compared to men.

Table 7.3: Reported internet use per levels of education and gender in rural Kenya.

Level of education	**A: Individuals not having a computer at home using the internet**		**B: Individuals having a computer at home using the internet**	
	Women farmers	***Men farmers***	***Women farmers***	***Men farmers***
Never attended school	8,783 (1%)	5,342 (1%)	65 (4%)	34 (5%)
Previously attended school	34,170 (2%)	40,248 (2%)	2,197 (15%)	2,410 (23%)
Currently attending school	5,728 (4%)	9,129 (5%)	443(32%)	642 (34%)
Percentages in brackets represent the number of individuals who reported using the internet, out of the total rural women or men farmer population above or equal to 18 years of age.				

Source: PHC special data processing.

For individuals currently attending any type of educational system, 32% of women farmers compared to 34% of men farmers use internet services. It is evident from Table 7.3 that for individuals who never attended any type of educational system, the levels of internet use are the lowest, and that this especially concerns women farmers (4% of female farmers use the internet, compared to 5% of male farmers). The largest discrepancy between women and men farmers in rural Kenya in 2009 is found amongst individuals who previously attended the Kenyan schooling system. In rural households owning a computer, 15% of female farmers reported using internet services, compared to 23% of male farmers.

These results show that women farmers currently attending school may be in an advantaged position as regards the use of internet services and consequently access and use of services offered by internet-based platforms. These differences could also be explained by the fact that a younger generation of female farmers might be more educated and thus IT literate. One

hypothesis could be that national education schemes put in place by the Kenyan Government since 1984[124] have improved women farmers' access to education, especially since the 1990s[125].

Based on such public interventions by the Kenyan Government, targeting women in rural areas, age and education variables related to internet use become pertinent. Where platform developers aim at reaching women farmers, it becomes relevant to analyse these different groups of women, more particularly those who claim to use the internet to a larger extent. I have therefore used as a basis female farmers who report that they have a computer at home (because it allows us to understand better the characteristics of this group of women with regard to internet use). As such, it may reveal critical points to be considered by internet-based platform developers.

7.2.2.2. Education of women farmers having a computer at home for internet use

The boxplot distribution figures in this section present interactions between the levels of education, age and internet use for women farmers who report having a computer at home. Figure 7.2 presents the boxplot distribution levels of internet use and age for female farmers who have never attended any type of schooling system. Figure 7.3 is the same but for women farmers having previously attended school. Women farmers currently attending the Kenyan educational system is presented in Figure 7.4. Our findings show that the median age differs, as does the number of female farmers per respective category.

The median age for female farmers having a computer at home, previously educated, using the internet, is 35 years, compared to 54 for individuals that have never attended school. For the female farmers currently attending school and who have a computer at home, the median age for using internet services is 22 years. Such analysis needs to be completed with the number of observations per respective category and boxplot distribution. Of the female farmers with a formal education ($n_{females}$=2,197 out of 14,345), 15% use internet services, compared to 4% of women farmers who never received any education ($n_{females}$=65 out of 1,800). In total, 32% of individuals currently attending school use internet services ($n_{females}$=443 out of 1,389).

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[124] As per public policy objectives, the Kenyan Government has, since 1984, a formal educational structure in place (Ministry of Education of Kenya 2012). Primary school is free of charge and compulsory for all Kenyan citizens. Yet the Government recognises failures in the educational system that have created certain inequalities in society and led to knowledge gaps, especially amongst the most disadvantaged part of the Kenyan population (women and girls residing in rural arid and semi-arid lands and urban areas). *"In 1984 the Government abolished the 7-4-2-3 system of education and A-levels and restructured education and training to the current 8-4-4 system. The rationale behind this was to make the education system more practically oriented and more responsive to the needs of the country and its people. However, anticipated results did not materialise in spite of rationalising the curriculum. The heavy emphasis on academic examinations promoted only the cognitive domain. It led to social injustice by categorizing schools and favouring only the intellectually gifted. Together with limited increases in the number of places for learners in secondary education, nearly 80% of learners leave school to join the informal sector. The education system has unintentionally depicted them as failures and widened the gap between rich and poor. It has divided the nation into white collar workers and labourers with associated attitudes and has created a generation of young people with inappropriate attitudes to work"* (2012, p.41).

[125] *"Articles 20, 35, 42, and 43 of the Constitution state clearly that every person has the right to education. If the State claims that it does not have the resources to implement the right, a court, tribunal, or other authority shall be guided by the principle that it is the responsibility of the State to show that the resources are not available to meet that constitutional right. The State will give priority to factoring in access to vulnerable groups or individuals (women, older members of society, persons with disabilities, children, youth, members of minority or marginalised communities, and members of particular ethnic, religious or cultural communities)"* (Ministry of Education of Kenya 2012). One specific target is for instance: *"Expansion of public universities to have a capacity of at least 5,000 students each by 2015, and an increase in the proportion of all students studying science-related courses to 50 %, with at least one third of these being women, by the year 2010"* (2012, p.41).

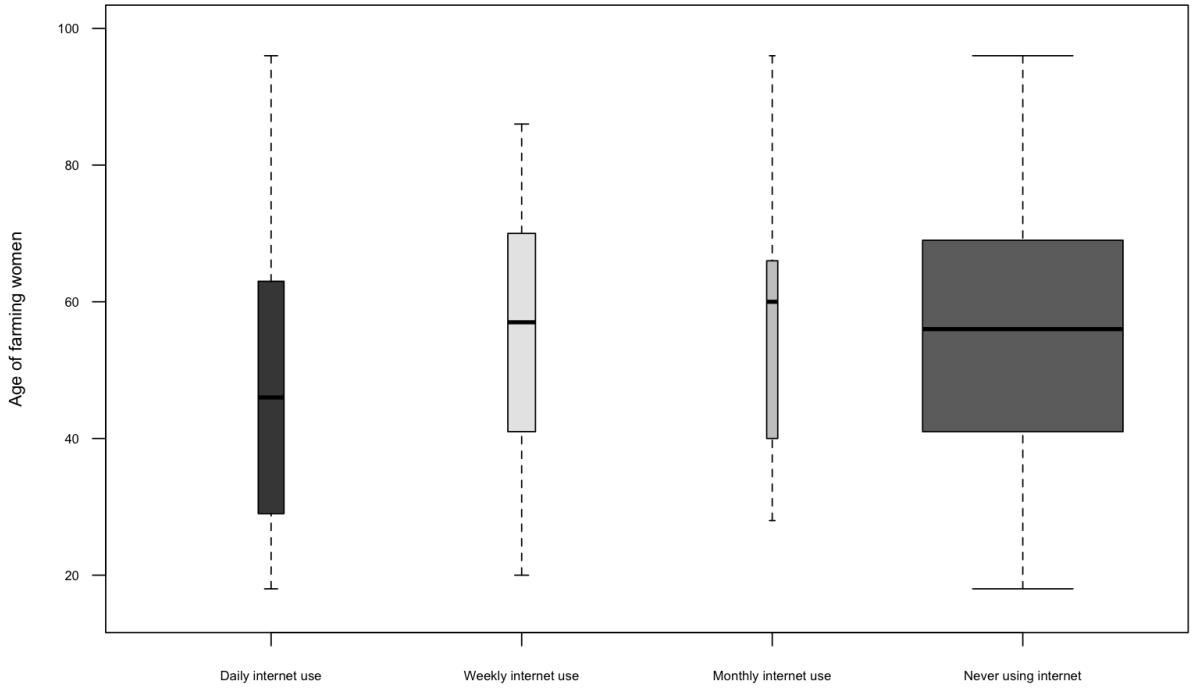

Figure 7.2: Boxplot distribution of the number of women farmers above or equal to 18 years of age who have never attended school in rural Kenya in 2009 having a computer at home using/not using internet services: $n_{females}$=1,800. *NB: Yearly internet use has been removed from the figure because of the reported low number (n=2). (Source: PHC special data processing).

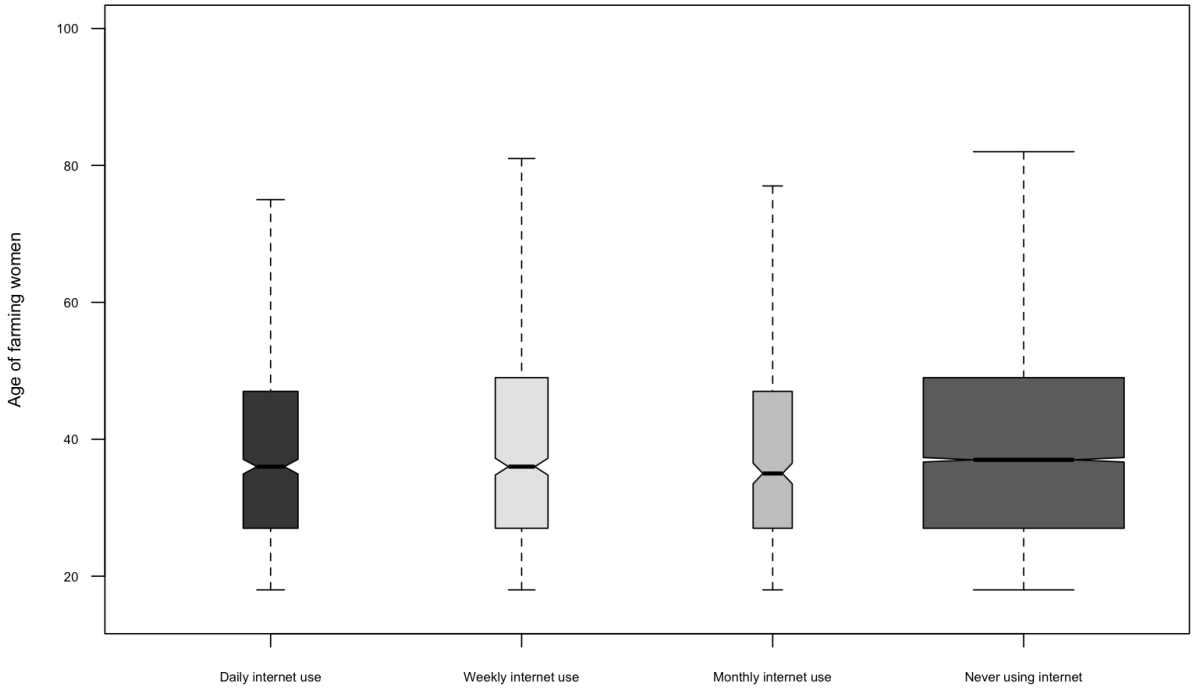

Figure 7.3: Boxplot distribution of the number of women farmers above or equal to 18 years of age having previously attended school in rural Kenya in 2009, who have a computer at home using/not using internet services, $n_{females}$=14,345. *NB: Yearly internet use has been removed from the figure because of the reported low number (n=91). (Source: PHC special data processing).

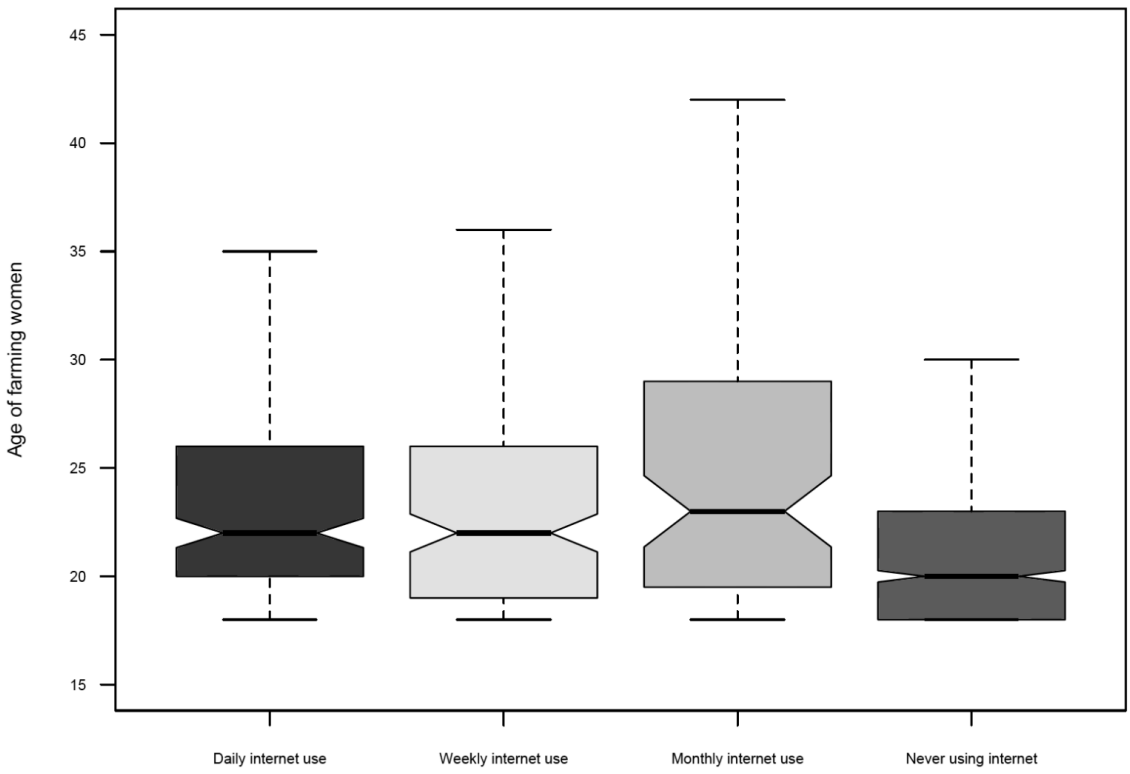

Figure 7.4: Boxplot distribution of the number of women farmers above or equal to 18 years of age currently attending school in rural Kenya in 2009 having a computer at home using/not using internet services, $n_{females}$=1,389. *NB: Yearly internet use has been removed from the figure because of the reported low number (n=7). (Source: PHC special data processing).

The results thus indicate that female farmers currently getting an education or with an education are more prone to using internet services compared to the women who do not have a formal education. The boxplots show that level of education, in particular, but also age, seem to influence these women's ability to use internet services.

The literature shows that unequal social status (marital status and relationship) within the home can become a source of digital exclusion (Anderson et al. 2017). This point is elaborated on below.

7.2.3. Intra-household status of women and men farmers, and internet use

7.2.3.1. Marital status

The census data above show that the levels of internet use vary between women and men farmers, although not significantly between the three main marital statuses (i.e. married monogamous, polygamous and widowed). Regardless of marital status, women farmers are more disadvantaged with regard to internet use than are men. Moreover, as shown in Table 7.4, a lower proportion of married or widowed female farmers report to use internet services, compared to men farmers in the same categories, irrespective of computer availability at home (column B) or not (column A).

Table 7.4: Reported levels of internet use per gender and marital status in rural Kenya in 2009.

Marital status	**A: Individuals not having a computer at home and using the internet**		**B: Individuals having a computer at home and using the internet**	
	Women farmers	***Men farmers***	***Women farmers***	***Men farmers***
Married monogamously	27,743 (1%)	28,282 (2%)	1,755 (16%)	1,686 (24%)
Married polygamously	5,096 (1%)	3,286 (2%)	118 (8%)	141 (19%)
Widowed	3,025 (1%)	537 (1%)	104 (9%)	25 (17%)
Percentage in brackets represent the number of individuals who report using the internet, out of the total rural women or men farmer population above or equal to 18 years of age.				

Source: PHC special data processing.

Furthermore, among individuals who report having a computer at home, a larger number of female farmers tend to use internet services when married in a monogamous setting[126] (i.e. 16% internet use, compared to 8% in a polygamous setting and 9% of female widowers). One hypothesis could thus be that women farmers who are married monogamously may have a more advantaged intra-household social status compared to women farmers who are widowers or married polygamously. Another assumption could be that there are differences in the levels of education between these groups of women farmers.

In this regard, findings based on the census data show that a higher proportion of female farmers using internet services (16%), who are also the youngest, with a median age of 37, report being in a monogamous marital setting. Regarding female widowers, 9% reported using internet services. This group of women farmers are also the eldest, with a median age of 60 years. The median age for women farmers in polygamous marriages, who use internet services, is 42. This category also has the lowest proportionate rate of female internet users: 8%. The latter two results seem to be connected to the level of education, for these two categories encompass the highest proportion of individuals who never received any type of education (33% widowers and 21% of females married polygamously compared to 8% of women married monogamously).

Hence, to respond to the hypotheses above, internet use seems to be determined to a greater extent by education than by marital status. I will elaborate on this in the econometric analysis presented in Section 7.3.2. For now, dynamics between relationship status, gender and internet use will be explored.

7.2.3.2. Relationship status

Data analysis from the census data shows that a lower number of women farmers in rural Kenya are household heads compared to men farmers. Overall, a majority of male farmers report bring household heads, whilst a larger number of female farmers report being spouses.

Table 7.5 reports on the levels of internet use per relationship status (household head or spouse) for women and men farmers in rural Kenya. Column A presents the data for individuals who do not have a computer at home, whilst column B reports on individuals having a computer

[126] This marital situation is the most common type across rural areas in Kenya, where 55% of individuals above or equal to 18 years of age are married monogamously. Most female farming household heads are widowed (90%), whilst males who are household heads are mainly monogamously married (76%).

from home. In general, we find that regardless of relationship status, a smaller proportion of female farmers' use internet services.

Table 7.5: Reported levels of internet use per relationship status and gender in rural Kenya in 2009

Marital status	**A: Individuals not having a computer at home and using the internet**		**B: Individuals having a computer at home and using the internet**	
	Women farmers	***Men farmers***	***Women farmers***	***Men farmers***
Household head	12,056 (1%)	30,805 (2%)	476 (13%)	1,812 (25%)
Spouse	20,673 (1%)	349 (2%)	1,385 (16%)	18 (20%)
Percentages in brackets represent the number of individuals who report using the internet, out of the total rural female or male farmer population above or equal to 18 years of age				

Source: PHC special data processing.

This table shows moreover that the levels of internet use per relationship status (household head or spouse) between women and men farmers do not differ in column A. These numbers change however in column B, i.e. for individual farmers who report having a computer at home. Here, 13% of the women farmers who are household heads in this category use internet services (with a median age of 44, $n_{females}$=476 out of 3,574), compared to 16% of women who declare themselves as spouses (with a median age of 38, $n_{females}$=1,385 out of 8,477).

In sum, Table 7.5 shows that it does not seem to be the intra-household social status that has a significant effect on the internet use levels between women and men farmers in rural Kenya. Empirical findings generally stress however that social roles, such as intra-household status, do matter with regard to access to various economic resources (Agarwal 1997), in this case ICT devices and services. It was therefore expected to find a relationship between the levels of internet use and the two respective statuses, i.e. household head and spouses, and namely a larger proportion of female household heads using internet services compared to women who said they were spouses. Some scholars have indeed reported that this is one of the factors contributing to a gendered digital divide since they have an impact upon decision making within the household (Hafkin & Taggart, 2001; Kole, 2001). In this respect, due to pre-existing gender norms, women may choose not to challenge existing constructs, and to avoid conflicts, despite social status (Spence 2010; Buskens & Webb 2009[127]). It might therefore be the reason for the low levels of internet use, irrespective of relationship status, as per Table 7.5.

The descriptive statistics presented in this section provide an understanding of possible socio-economic variables that may influence women farmers' use of internet services. Findings from this data show that a digital divide may be emerging between women and men farmers. The question is thus how internet knowledge-based platforms can be inclusive of women farmers, rather than contributing to this divide. One ICT device that seems to noticeably increase the likelihood of farmers women using the internet, thus allowing them to make use of platforms, is the access to a computer. In this regard, I have conducted an econometric study to corroborate on the one hand if 'computer availability' is correlated to internet use, and if there are differences between rural women and men with regard to this variable. On the other hand, the

[127] *"Their [women's] use of ICTs, however, often challenges and upsets existing gender roles and the gendered 'norms' within existing public spaces. Women experience independence through the physical act of using ICTs, and create socio-economic gains. At the same time, because their use of these technologies enables them to handle their triple roles better, it can be argued that ICT use contributes to the maintenance and possibly even strengthening of the traditional gendered division of labour and thus to the general gender imbalance".* (Buskens & Webb 2009, p.5).

regression analysis presents an attempt at explaining the socio-economic factors that influence internet use of rural women and men in Kenya.

7.3. Factors influencing internet use in Kenya: reporting on the marginal effects

7.3.1. Internet use per gender in rural Kenya

Table 7.6 reports on the marginal effects of internet use among active women and men for the five main economic activities (i.e. full time student, homemaker, agriculture holding, family business, and work for pay) in rural Kenya[128]. This analysis was conducted to derive some understanding of the interrelated variables concerning individuals' use of the internet in rural Kenya. The sample of the rural Kenyan population was selected for various reasons. First, this thesis bases its case on female farmers. A majority of the farming population resides in rural areas in Kenya (86%), which is why the study only included individuals based in rural Kenya. Second, as farming is considered as a profession, I only selected individuals above the legal working age, that is, above or equal to 18 years of age in Kenya. Third, to decrease the level of heterogeneity of the sample, the five major economic activities were selected (cf. Section 7.2.1).

I refer to use of the internet as an endogenous dichotomous variable. 'Internet use' is a merged coefficient between different reported levels of frequency in internet use (i.e. daily, weekly, monthly, yearly). This coefficient was merged (1) because of the low number of responses per respective frequency rate, and (2) in order to get an overall understanding of the exogenous variables having an impact upon individuals' use of the internet. Cf. Box 7.1 for an explanation on how to read the exogenous coefficients. Using a Probit regression (Stata 13), the following set of exogenous variables have been considered:

(1) Individual variables: age [continuous variable], education [currently attending school, previously attended school, never attended school], economic activity [work for pay, work at own family agricultural holding, full time student, homemaker, family business].
(2) Family variables: marital status [married monogamous, married polygamous, widowed, never married, separated, divorced], relationship status [household head, spouse].
(3) ICT variables at individual use level (can be used to access the internet): presence of a computer at home [yes, no], presence of a mobile phone at home [yes, no].
(4) Control variables: 44 counties in Kenya and 17 main employment types (cf. Chapter 3 for further details of the variables).

For the male sample, the R^2 gives us the percentage of the variation of the endogenous variable, which is explained by the variation of the selected exogenous variables. The coefficient is fairly good, with 33% of the observed behaviour regarding internet use being explained by the selected variable. However, some variables may be missing. For the female sample, R^2 is lower at 24% but still satisfactory. Interestingly, we may suspect that the behaviour of women is more volatile and does not explicitly rely on structural variables (e.g. age, economic activity), but rather on opportunities they can have or individual specific willingness to engage in the use of the internet. To stabilise the dataset, control variables have been added, and are the coefficients for 17 main employment types and the 44 Kenyan counties. All the regressions control for the specific location unobservables. These were not reported, for convenience.

[128] Cf. Appendix 10 of different regression analyses.

Box 7.1: An example of how to read the exogenous coefficients from Table 7.6.

Table 7.6 reports on the marginal effects of internet use for employed women and men in rural Kenya. The examples below show how to interpret the data from this table with respect to the three main sets of exogenous variables.

(a) The [age] variable. This is the only continuous variable of the dataset. On Table 7.6, the age coefficient has a significantly negative relationship to use of the internet, even though it is very small: less than 1% for both genders. This implies that as we age, the probability of using the internet decreases, but by very little.

(b) The [currently attending school (ref: never attended school)] variable. The level of significance and coefficient value is relative to the referenced (i.e. ref.) variable. For example, women currently attending school have a 1.8% higher probability of using the internet, and is significantly positive compared to those women who have never attended school (cf. Table 7.6).

(c) The [computer at home] variable. This is a yes or no variable and in this case, the individual either has a computer at home or does not. This variable is then related to the endogenous one. For example, having a computer at home increases the likelihood of women using the internet by 7% (cf. Table 7.6).

Results from Table 7.6 show that all variables are correlated to internet use for rural women. Concerning rural men, fewer variables show a correlation with internet use.

All coefficients for the various economic activities presented in Table 7.6 show a correlation to internet use for both rural women and rural men. In general, the economic activities for both genders have a negative relationship ($p<0.01$) to internet use, in relation to 'worked for pay' (with the exception of the 'family business' coefficient for rural men). We may therefore consider that individuals who do not have a formal job have fewer chances of using the internet, especially in the case of (a) full time students (coefficient is 2.5% for rural women and 5% for rural men), and (b) homemakers (coefficient is 3% for rural women and 4% for rural men).

The coefficients for different educational levels report a correlation with regard to internet use (cf. Table 7.6). Currently attending school increases the probability of using the internet by 1.8% for rural women, compared to those who have never received an education. Results are similar for rural men in the same category, and the coefficient is even higher: 3.2%. Thus, for individuals currently attending school in rural Kenya, there is a higher likelihood that men use the internet compared to women. This could suggest that going to school is not enough to reduce inequality. Previously attending school significantly increases the probability of using the internet for both women and men, although by very little (the coefficient is less than 1% in both scenarios) compared to individuals who have never been educated.

Age has a negative relationship with internet use for both women and men. The interpretation of the coefficients is the following: the increase of age by one year decreases the probability of using the internet, but only by 0.03% for men and 0.008% for women. The results show is that there is a correlation between internet use and age, but a weak one. Based on the results from the boxplot distributions (Section 7.2.2.2) however, it was expected of the age coefficient to be more important[129]. We may thus deduce that it is rather socio-economic variables and in

[129] The age variable is indeed statistically significant, yet with a small coefficient. If we had shared the variable (making it a non-linear relationship) by age categories, i.e. 'young individuals / youth', 'middle-age individuals' and 'senior individuals', other effects may have been captured, but then it becomes very arbitrary for the choice of categories. Also, the purpose of a non-linear regression on age is to find fractures at certain thresholds (between young and old individuals), and not higher coefficients.

particular having attended school or not that determines whether women and men farmers use the internet or not.

Table 7.6: Variables that are interrelated with internet use by rural women and rural men above or equal to 18 years of age in five main economic activities in Kenya. Marginal effects reported (dy/dx).

Variables	**Rural women (dy/dx)**	**Rural men (dy/dx)**
Full time student (ref.: worked for pay)	-0.025*** (0.00079)	-0.05*** (0.00107)
Homemaker (ref.: worked for pay)	-0.03*** (0.00039)	-0.04*** (0.00082)
Family agriculture holding (ref.: worked for pay)	-0.004*** (0.00029)	-0.004*** (0.00037)
Family business (ref.: worked for pay)	-0.0017*** (0.00029)	0.0012*** (0.00035)
Currently attending school (ref.: never attended school)	0.018*** (0.00044)	0.03*** (0.0006)
Previously attended school (ref.: never attended school)	0.0018*** (0.0002)	0.0072*** (0.00041)
Age	-0.00008*** (0.000005)	-0.0003*** (0.000008)
Divorced (ref.: monogamous)	-0.004*** (0.0007)	0.0026** (0.0013)
Polygamous (ref.: monogamous)	-0.0015*** (0.00019)	0.00014 (0.00036)
Never married (ref.: monogamous)	0.006*** (0.00031)	0.016*** (0.00036)
Separated (ref.: monogamous)	-0.003*** (0.00058)	-0.00005 (0.0009)
Widowed (ref.: monogamous)	-0.003*** (0.0003)	-0.0004 (0.00096)
Relationship status (0=household head; 1=spouse)	-0.0014*** (0.00015)	-0.005*** (0.00091)
Computer at home (0=no; 1=yes)	0.07*** (0.00025)	0.12*** (0.00032)
Telephone at home (0=no; 1=yes)	0.01*** (0.00016)	0.025*** (0.00028)
Dependent variable (dichotomous variable): Internet use (0=never use internet; 1=use internet)		
	Number of observations of women = 4,247,732 Pseudo R^2 (McFadden) women = 0.2398 Number of observations of men = 3,073,211 Pseudo R^2 (McFadden) men = 0.3304 ***p < 0.01 **p < 0.05 *p < 0.1 Standard error in brackets Controlling for 17 main employment types in Kenya Controlling for 44 counties in Kenya	

Source: PHC special data processing.

The variable coefficients for any marital status are very low. Hence, even though there is a correlation between internet use and marital status demonstrated by the p-value[130], a decreased or increased likelihood of internet use of rural women and men is limited[131]. Results support the census data, showing that different marital statuses do not seem to exacerbate a digital divide.

Individuals who say they are household heads have a higher probability of using the internet compared to those who are spouses. The coefficients in Table 7.6 show that irrespective of gender, household heads have a higher probability of using the internet compared to those who are spouses. Nonetheless, the coefficient is very low, which means that the effect is not that important.

Furthermore, results of the 'computer at home' variable provide evidence that the regression analysis and the descriptive statistics from Section 7.2.1 corroborate. The coefficients show that there is a strong correlation between internet use and an individual's access to a computer. Having a computer at home significantly ($p<0.01$) increases the probability of using the internet, by 12% for rural men and circa 7% for rural women. Opinions in some of the scientific literature reveal that investing into computers[132] via IT-literacy programmes in rural areas could enable agricultural producers, and especially women farmers, to enter into use with ICTs, and

[130] Being a divorced man shows a correlation to internet use. The coefficient is positive but only by around 0.3%, compared to monogamously married men. On the other hand, for women who are divorced, the probability of internet use decreases by 0.4% (significantly negative, $p<0.01$), compared to monogamously married women. This is however the opposite pattern for men and may relate to social constructs in society and financial opportunities. The status 'divorced' could, on the one hand, imply social rejection for women (i.e. it is frowned on to be a divorced woman but not a divorced man), thus having less access to resources. An alternative explanation may be that divorced couples may not separate on equal terms, which puts the woman in more marginalised situation and thus not able to pay for certain services. Moreover, men married in a polygamous setting increase their probability of using the internet, compared to monogamously married men. As we may have expected, this coefficient turns out not to be significant. It is also very small. It is based on the assumption that the two marital statuses do not have a large differential impact upon the ability to use the internet. However, the probability of using the internet decreases for women married in a polygamous setting, compared to monogamously married women (significantly negative, though small coefficient at 0.15%). Surprisingly, being a polygamously married woman seems to decrease the likelihood of using the internet (compared to monogamously married women). This could be related to differences in socio-economic factors and/or intra-household status between these groups of women when it comes to the use of internet services (overall household income, who decides what to do with the disposable income, [un]equal access to resources, etc.). Individuals who say they are not married have a significantly increased likelihood of using the internet, compared to individuals who are married monogamously. This applies to both women and men ($p<0.01$). Even though for both women and men the fact of not being married increases the probability of using the internet, the coefficient is higher for men (1.7% for men and 0.6% for women). Furthermore, the fact of being a monogamously married woman increases the probability of using the internet, compared to women who are separated or widowed. Both coefficients are however very small: 0.033% and 0.032% respectively. This could mean that separated or widowed women are in a disadvantaged situation compared to monogamously married women because they are single carers of the household and don't have the time to use the internet. In the same two cases but for men, the coefficients are very small and not significant.

[131] Differences in internet use for the different marital statuses suggest however that women use the internet less than do men. One interpretation of the coefficients could therefore be that marital status (any type) does not affect men's use of the internet, whilst for women it does to a certain degree. It should be kept in mind that even though the coefficients are statistically significant, they are generally very small. Another hypothesis could be that monogamously married women are better off, having a higher likelihood of using the internet (except for women who are not married). It is nonetheless difficult to interpret and compare the different marital status variables, given that the reason behind the difference between women and men could be multiple and implicit. For instance, women have other priorities and/or commitments than those of men, finally leading to a lower probability of women using the internet.

[132] In their review of the literature, Aker et al. (2016) discuss human–computer interaction (HCI), that focuses heavily on how technology can be used and manipulated by poor and low-literate populations.

thus platforms (Aker et al. 2016). Therefore, and as expected, in both cases the coefficient is significantly positive and very high, yet different between women and men. The results in Table 7.6 and the analysis of descriptive statistics (Section 7.2.1) demonstrate that rural women use the internet to a lesser extent than do rural men when a computer is available at home. This difference could stem from various factors, for instance unequal access to education, leading to illiteracy (and IT-illiteracy), as emphasised by Hilbert (2011) and also supported by results generated from the census data. Alozie & Akpan-Obong (2017) posit that these differences could be related to the fact that women are confined to the role of spectators and occasional consumers of ICTs. They are of the opinion that to bridge a digital gender divide in the use of technology, rural women in developing countries need to be targeted, so that they can become comfortable using and designing computer technology, and working in virtual spaces. This will be discussed further in Chapter 8.

Men and women who report to have a mobile phone at home are more likely to use the internet ($p<0.01$), by 2.5% for men and 1% for women. It could be that the impact of computers on internet use is greater than that of the telephone. An assumption could be that the purchase of the computer is intended to connect to the internet and use its services, which may not necessarily the intended purpose of a telephone. It could also be that the mobile phone is limited when it comes to using the internet and consequently ICT platforms.

In sum, the data show that rural women and men in Kenya currently attending school have a higher probability of using the internet compared to the other groups of rural women and men. Lower coefficients for women show that they have a decreased likelihood of using the internet compared to men in the same category. Likewise, the presence of ICTs, and especially computers, increases the likelihood of females and males using the internet. The computer variable coefficients are high for both rural women and rural men. By looking at the coefficients for this ICT device, however, women appear to be more disadvantaged compared to men. Having a computer at home represents an investment. There is a vast scientific literature (Hafkin & Huyer 2008; Antonio & Tuffley 2014; Alozie & Akpan-Obong 2017; Hilbert 2011; Mumporeze & Prieler 2017), stressing that women do not have the same access to ICT devices as a result of discriminating intra-household gendered structures (for instance, that it is the men who are the final decision makers in regards to investments). Evidence from the census data presented in Section 7.2.1 reveals that the levels of internet use increase for individuals accessing a computer in rural Kenya. They also show, however, that rural women are at a disadvantage irrespective of economic activities, educational status or intra-household status. I will now explore variables that could be correlated with women farmers' use of the internet in rural Kenya.

7.3.2. Women farmers' internet use

Table 7.7 reports the marginal effects of internet use among women who report working on their own family agricultural holding in rural Kenya (above or equal to 18 years of age). The table shows the correlation between socio-economic variables and the reported internet use of Kenyan women farmers[133]. The R^2 of 10.25% show that women farmers' use of the internet

[133] The motives behind this sub-sample of the Kenyan population are multiple. As previously emphasised, this research analyses the inclusion of gender relations on ICT platforms, via public policy intervention. It is therefore of relevance to analyse this sub-sample. First, individuals above or equal to 18 years of age were selected. The main reason behind this filtering was to keep the population above the legal working age in Kenya (because a farmer / agricultural worker is an economic activity). Second, since this dissertation bases its case specifically on gender relations of a sub-sample, namely female and male farmers, the sample is restricted to this part of the

may be related to a set of qualitative variables not captured through structural variables. The endogenous and dichotomous variable, 'Internet use', is a merged variable between different reported levels of frequency in internet use (cf. previous section for further explanation).

Table 7.7: Variables that are interrelated with internet use for women farmers above or equal to 18 years of age, rural Kenya. Marginal effects reported (dy/dx).

Variables	Rural women farmers (dy/dx)	Std. err.
Currently attending school (ref.: no education)	0.0135***	(0.00054)
Previously attended school (ref.: no education)	0.0013***	(0.0002)
Age	-0.00003***	(0.0000006)
Divorced (ref.: married monogamous)	-0.002*	(0.00088)
Married polygamous (ref.: married monogamous)	-0.0005**	(0.00021)
Never married (ref.: married monogamous)	0.003***	(0.0005)
Separated (ref.: married monogamous)	-0.003***	(0.00008)
Widowed (ref.: married monogamous)	-0.0023***	(0.0003)
Relationship status (0=household head; 1=spouse)	-0.0012***	(0.0002)
Computer at home (0=no; 1=yes)	0.05***	(0.00034)
Mobile phone at home (0=no; 1=yes)	0.0065***	(0.00017)
Small scale farmer (0=no; 1=yes)	-0.0041***	(0.00023)
Informal sector (0=no; 1=yes)	0.0002	(0.00023)
Dependent variable (dichotomous variable): Internet use (0=never use internet; 1=use internet)		
	Number of observations women = 2,549,340 Pseudo R^2 women (McFadden) = 0.1025 ***p < 0.01 **p < 0.05 *p < 0.1 Controlling for 44 counties in Kenya	

Source: PHC special data processing.

As for the rest of the population, currently attending school increases the probability of using the internet (1.35%, significantly positive), compared to women farmers who have no education. The fact of having attended school increases the probability of using the internet, however by very little (coefficient is less than 1%), compared to women farmers who have no education. As we may have expected, the use of internet is thus related to education. The 'currently attending school' variable is especially interesting in its interference with internet use, as presented in Table 7.6 and Section 7.2.2.

Age has a negative relationship with internet use, even though the coefficient is very small (less than 1%). When the individual's age increases by one year, the probability of using the internet decreases, but only by 0.003%. These results corroborate with the descriptive statistics data analysis. It shows that the younger part of the female farming population tends to use the internet to a higher degree, although it seems to connected to educational status to a larger extent than age (cf. also Section 7.3.1, p. 20 on further explanations of the age variable). The census data show that the levels of internet use increase substantially for women farmers who are currently attending school. This also happens to be the younger part of the women farmer population.

population. Third, and as stated in Section 7.3.1, 86% of the farmers are based in rural Kenya. Therefore, I analyse the population based in rural Kenya. Also, the filter 'women farmer above or equal to 18 years of age residing in rural areas of Kenya' was purposely chosen to connect the statistical analyses to the qualitative surveys with the small-scale female farmers (n=26). Fourth, compared to Table 7.6, two out of the 17 'main employers' reported by farm women in rural Kenya are reported in the dataset [small scale farmer, employed in the informal sector]. In the previous analysis, all 17 main employment types were kept to stabilise the dataset. These two employment types are the main ones reported by female farmers above or equal to 18 years of age in rural Kenya. These two variables were also kept to reduce the level of heterogeneity in the dataset.

The probability of using the internet decreases for women farmers married in a polygamous relationship, compared those who are monogamously married (negative, though very small coefficient, 0.2%). For women who reported not being married, the likelihood of using the internet increased by 0.03% compared to women married in a monogamous relationship. Compared to monogamously married women, those who are separated or widowed have a decreased probability of using the internet. Both coefficients are however very small, i.e. 0.03% and 0.02% respectively. Generally, the different marital statuses of women farmers decrease the likelihood of them using the internet, compared to monogamously married women (except for unmarried women). These results are consistent with the coefficients presented in Table 7.6. The relationship between the exogenous variables per marital status and internet use is quite small. Marital status is not the main explanatory variable when it comes to understanding the internet use of women farmers.

Contrary to what the results show in Section 7.2.3.2, there is a decreased likelihood that female farmers who are spouses use the internet, compared to household heads. However, the coefficients are very low and therefore provide evidence of the fact that there is no causal link between any of the two relationship statuses, or between women and men farmers. The literature (Codjoe 2010; Agarwal 1997) suggests that coefficients could have been expected to be higher.

Having a computer at home ($p<0.01$) increases the probability of using the internet by 5%. The coefficient is high and so is the level of significance. It shows that a computer present in the home increases the likelihood that female farmers will use the internet. In Section 7.2, I assessed more in depth the patterns of internet use between women farmers and men farmers who say they have a computer at home. These results show that a higher proportion of women report using the internet when a computer is available at home. Yet, there is still a gap between genders. The data show that men farmers are at an advantage compared to women farmers. This corroborates the findings from the descriptive statistics and the econometric analysis.

In this regard, in the reports by the World Bank and the FAO (George et al. 2011; The Food and Agriculture Organisation 2014), computers are presented as ICT solutions that can enable farmers in developing countries to use technical content made available via the internet, for example on knowledge-based platforms. In the same reports, it is however stressed that women farmers computer access may not be equal to that of men farmers because of various socio-economic barriers (education, intra-household social status). Hafkin & Huyer (2008) put forward similar arguments. Such obstacles may consequently prevent women farmers from using services offered by knowledge-based platforms. Here, the analysis shows that computer access largely increases women farmers' possibility to use platforms, but that education interferes as one fundamental variable.

Women who report to have a mobile phone at home have an increased likelihood of using the internet. The coefficient is very small (less than 1%). It was expected that this coefficient would be higher since, in a number of articles in the economic literature, authors make the assumption that mobile-based internet platforms have the highest potential in reaching farmers with services (Karippacheril et al. 2013; Courtois & Subervie 2015; Ogutu et al. 2014). As it appears here, computers have a stronger relation to the likelihood of using the internet compared to the mobile phone.

Women who report 'self-employed small-scale farming' as their main employment type have a negative likelihood of using the internet. The coefficient is nonetheless less than 1%. Working

in the informal sector does not have a significant relationship with internet use (the coefficient is also very small). Interpretations of such a result could mean that small-scale women farmers are to a larger extent excluded from entering into use with internet services compared to those who report working informally.

In sum, women farmers currently attending school have a higher probability of using internet services. Thus, similar to previous econometric analysis but for a large sample of the population, such results may imply that equal access to education is not enough to reduce a digital gender divide. As a result, such findings complement analyses from the descriptive statistics section (cf. Section 7.2). Moreover, the presence of a computer increases the likelihood for female farmers of using the internet. Section 7.2 provides strong evidence of this. It should however be emphasised here that the reported internet use figures are generally lower for women farmers compared to men farmers, which brings us to the last section of this Chapter.

7.4. *In conclusion:* A digital gender divide is becoming reality

Analysis of the census data points towards the fact that a digital divide between rural women and men farmers in Kenya is emerging. In Chapter 1 of this thesis a digital gender divide is defined as: *"the differential access to and use of ICTs by gender as indicated by lower numbers of women who access and utilize ICTs compared to men"* (Alozie & Akpan-Obong 2017, p.3). Results from this chapter confirm a discrepancy in access to and use of internet services between women and men. Given this evidence, the question is how ICT platforms can be inclusive of women farmers and not contribute to this digital divide.

This is not an easy task at hand for platform developers targeting women farmers with their services, since the data precisely show that this divide is related to their economic status as agricultural workers. Three main findings demonstrate this. First, there is a difference between genders, where a lower proportion of women, and mainly female farmers, use internet services, compared to men. Second, in rural Kenya, women who work on their agricultural holding use internet services to the lowest extent. Proportionately, female farmers who do not have a computer at home are the most disadvantaged socio-economic group among rural women. Third, they generally have lower educational levels compared to non-women farmers in rural areas.

Results also provide strong evidence that having a computer at home significantly increases the probability of women and men farmers using the internet. Findings equally show that men use the internet to a larger extent in this case. Hence, interpretations of the census data tell us that the reported low levels of internet use among women farmers can become a barrier for them to access services and technical content from internet platforms. This becomes an issue for the platform developers and financiers, since they are targeting female farmers with services. Platforms designers report that this is a concern, and one way for solving this issue is for platforms to offer alterative solutions of access (cf. Ch. 6 for the Nafis and the APF platform). We have seen previously that some of these platforms offer services to farmers via ICT devices that do not require internet connection (e.g. radio shows, SMS service, interactive voice response, TV shows). Findings from Section 7.1.2 show nonetheless that there are differences between rural women and rural men in their access to ICT devices other than platforms. Again, women, and particularly female farmers, are at a disadvantage.

Based on evidence put forward in this chapter, even if the levels of internet access are increasing, there is a discrepancy between rural women and men (both in internet access and in

internet use). The census data also show that equal access to education and/or having a computer at home will not alone solve the gender inequality problem in this particular context. It is therefore unlikely that women farmers will benefit from ICTs and platforms, or from the opportunities these technological innovations may generate. This, in turn, deepens the socio-economic divide between women and men farmers in Kenya. Unless gender-specific constraints on the use of internet services, and consequently of ICT platforms, are recognised, an emerging digital gender divide may therefore well become a reality in this country.

In this respect, Chapter 8 provides evidence at a micro-level on how Kenyan women farmers innovate to access and use services and technical knowledge supplied by platforms. It also presents an analysis at the meso-level of platform development, exploring possible organisational aspects around the collective dimension of internet platforms. This allows us to elaborate upon the means of manoeuvre brought by agricultural advisers in acting as mediators to support women and men farmers to access knowledge-based platform services.

CHAPTER 8 - Innovative practices by women farmers to overcome a digital divide?

The purpose of this Chapter is to consider in more detail how women farmers innovate to access resources and, in this case, to access the internet and ICT platforms in agriculture. It explores the means whereby women farmers make use of knowledge and internet services through their insertion in social relations.

The chapter is divided into four main Sections. Women farmers' rationales for knowledge exchange in collective spaces are presented and discussed in **Section 8.1**. This first Section is based upon findings from the individual surveys of small-scale women farmers in Machakos county. In **Section 8.2**, this demand for accessing cognitive resources at shared points is analysed at national level. The 2009 census data provide evidence of the importance of collective spaces for women farmers to use internet services. They specify the internet use locations for all individuals above or equal to 18 years of age in rural Kenya. The econometric analysis results in **Section 8.3** corroborate with the results from the descriptive statistics. I conducted this analysis to get an in-depth understanding of the interrelated variables in relation to the place or device from which female and male farmers in rural Kenya said they use the internet. Based on findings from individual surveys of extension officers working at the Ministry of Agriculture at national and Machakos county level, **Section 8.4** discusses the role of farm advisors as mediators between groups of women farmers and internet-based platforms in agriculture.

8.1. The importance of collective spaces for women to make use of knowledge

In Section 6.3.2, the analysis of interviews with small-scale women farmers (n=26) provides evidence in the importance of collective spaces for interaction and co-production of knowledge. This Section focuses on the significance of collective points for women farmers as forums where they meet and may access knowledge-based platforms through investing in computers and the internet.

As emphasised in Chapter 7, having a computer at home increases women and men farmers' chances of using the internet and consequently their possibility to benefit from platform services. I also provide evidence in Chapter 6 that interaction with peers in groups is a priority to women farmers. Hence, these collective spaces could represent a solution to platform developers for reaching women farmers with services and technical content. What is however not elaborated upon in Chapter 6 are female farmers' rationales for attending groups.

In this context, Table 8.1 presents the different rationales for belonging to various groups, i.e. the benefits that groups provide to the interviewed women. In total, eight different types of groups were identified.

As Table 8.1 evidences, all of the interviewed women belonged to at least one group, with an average of three, that they participated in on a weekly basis, and most of these groups are local community groups (26/26). Being a member of various groups is a priority to these women as it is one of the major sources of information and knowledge. On average, they spend 1 hour and a half per week in group meetings[134]. This is relatively significant, given the amount of time they spend on 'personal development': 2.8 hours/day, versus number of working hours per day: 13.6 hours/day.

[134] Not all groups meet every week.

Table 8.1: Rationales of women farmers for being a group member (n=26).

Different Groups	**Rationales of women farmers for being a group member**						
	Financial support	Farm knowledge	Moral support	Basic needs	Material needs	Spiritual growth	Institutions
Agricultural producers group – 5/26	Yes	Yes	No	No	Yes	No	Yes
Livestock producers group – 2/26	Yes	Yes	No	No	No	No	Yes
Income generating group – 2/26	Yes	No	Yes	No	Yes	No	Yes
Micro-finance group – 21/26	Yes	Yes, but not in all groups	Yes	Yes, to food	Yes	Yes	No
Forestry group – 1/26	Yes	Yes	Yes	No	Yes	No	Yes
Local community group – 26/26	Yes sometimes	Yes	Yes	Yes, to food	Yes	No	No
Religious group – 6/26	No	No	Yes	No	No	Yes	No
Water group – 3/26	Yes	Yes	Yes	No	Yes	No	Yes

Source: Primary data collection 2014; 2015.

The surveyed women reported that it was important to be a member of these groups. They saw them as a major means of accessing agricultural knowledge and providing a forum for discussing the adoption of new practices (cf. Table 8.1). Within the local community groups, some women reported that they organised agricultural and livestock trainings (for instance, on poultry management). This generally concerns women farmers who are not members of a livestock, an agricultural or a micro-finance group[135]. In addition to having a financial and material function, local community groups serve as 'solidarity' support, where the members help each other in various community happenings (e.g. in case of a funeral). Groups are also a basis for collective activities, for instance attending trainings or demonstration days organised by different institutes. Analysis from the interviews shows that these women farmers can organise themselves and that frequenting such types of organisational and collective spaces is a priority to them. It equally demonstrates that exchanging and sharing knowledge is an economically important cognitive resource to these women. Hence, such patterns of organisation could be a specific gate for them to enter into interaction with knowledge-based platforms.

In this context, it is worth reflecting upon what means these women could use to get access to the content of a knowledge based platform, if it were a priority to them. The small proportion

[135] Besides, some of the micro-finance groups (they go by different names: 'merry-go-round', village savings and loans groups), can be attached to the primary coffee cooperative union in the area. This implies that they meet at the cooperative centre in Machakos county. At times, these women farmers are called for training by the union, on topics related to their farming activities (e.g. on coffee management, micro-finance management) and they gather at the site as a group. They also organise trainings themselves via micro-finance groups, most often via interaction with board members from the cooperative society. Through groups that are attached to certain institutes, even if it is not the core function of the group, the women manage to access technical knowledge to strengthen their skills.

of women farmers who report using the internet (cf. Ch. 7) does not necessarily imply that they are less potentially likely to use internet services if these were available in groups. Some difficulties of access to the internet that are reported by women farmers could lie in the fact that computers (also enabling internet access) are not considered as devices that could be used in fora important to them. In fact, internet access is usually viewed as an individual activity, in economic analyses and statistics (International Telecommunication Union 2010; International Telecommunication Union 2018a; George et al. 2011) as well as in extension activities. The importance of collective points for internet use is therefore a dimension that is given little attention. Moreover, findings reported in the next section, based on the 2009 census data, show that collective points are important for women farmers to access internet services. They could also be spaces where female farmers exchange and share knowledge, and start to use ICT platforms. This bring us to the following Section.

8.2. Women and men farmers access points for entering into the use of the internet

Internet services can be accessed via different agencies or devices. The census indicates several access points for entering into the use of internet services: (1) community centre, (2) a cyber café, (3) an educational centre, (4) a friend's house, (5) via the mobile phone, (6) the workplace, or (7) the home. Women and men farmers report accessing the internet from different location points.

8.2.1. Differences in internet use locations between women and men farmers

Results from the 2009 census provide evidence of the importance of collective points for internet use, and especially to Kenyan female farmers. The data also show that there is a difference between non-agricultural producers and individuals working at the farm in rural Kenya. For individuals having a main occupation in addition to working at the farm, a larger proportion of both genders use the internet from a cyber café or via the mobile phone. Compared to men, a larger number of women use the internet from community or educational centres. Among farmers, 45% of the women and 44% of the men report that their main channels for internet use are cyber cafés and educational or community centres.

Out of 3,362,581 female farmers and 2,502,763 male farmers[136], 33,406 and 32,141 reported using internet services from various collective points or with ICT devices. In this regard, Table 8.2 reports on the reported internet use locations per women and men farmers in rural Kenya. The figures in column A reports on these respective groups that do not have a computer at home, whilst the opposite is reported in column B (i.e. individuals report having a computer at home).

When there is no computer at home, both women and men farmers report that they mainly use the internet from their mobile phone or at a community centre (Column A, Table 8.2). There are however reported differences between genders. A larger proportion of men farmers report using the internet from a mobile phone or a cyber café, compared to women farmers. On the other hand, a larger proportion of women farmers' report using internet services from a community centre, compared to men farmers.

[136] Out of these female farmers, approximately 1.5% declare using the internet from the seven different location points, to 2.3% of male farmers.

Table 8.2: Internet use locations per gender for individuals who reported working on the family agricultural holding in rural Kenya in 2009.

Internet use location	**A: Individuals not having a computer at home but using the internet**		**B: Individuals having a computer at home and using the internet**	
	Women farmers	***Men farmers***	***Women farmers***	***Men farmers***
Community centre	5,986 (22%)	3,699 (17%)	476 (7%)	540 (6%)
Cyber café	3,358 (13%)	3,685 (16%)	2,377 (35%)	4,185 (43%)
Educational centre	720 (3%)	382 (2%)	533 (8%)	507 (5%)
Friend's house	2,877 (11%)	1,812 (8%)	331 (5%)	472 (5%)
Mobile phone	6,911 (26%)	7,458 (33%)	1,212 (18%)	1,763 (18%)
Workplace	1,206 (5%)	1,077 (5%)	659 (10%)	1,263 (13%)
Own house*	5,647 (21%)	4,298 (19%)	1,113 (17%)	1,000 (10%)

*Internet use from the 'own house' implies that women and men farmers report using the internet from home. The census does not enquire about from what devices/how the internet is used at respective internet use location (for instance, via the mobile phone, a neighbour that lends a computer). Source: PHC special data processing.

The scenario changes somewhat for individuals who reported having a computer at home (Column B, Table 8.2). A larger proportion of women and men farmers reported using internet services from a cyber café. Interestingly, the number of individuals who reported using the internet from home decreases in both scenarios, compared to individuals who not have a computer at home. This is especially true for men farmers, as the data show in Table 8.2. It was indeed expected that internet use at home would increase for individuals who reported having a computer at home. I suspect that these two internet use locations (i.e. internet use from the own house or from the cyber café) are confounding factors. This point will be further discussed in Section 8.3 (p. 209-210). There are furthermore reported differences between women and men farmers. Proportionately, a larger number of women farmers reported using the internet from their own house and educational centres, compared to men. A larger proportion of men farmers reported using internet services from cyber cafés.

Table 8.2 provides evidence that community centres are an important point whence women start to use internet services. Cyber cafés are said to be main points for men farmers' use of the internet. It is therefore necessary to get a deeper understanding of possible differences between women and men, and if the levels of education and intra-household status influence the place from which the internet is used. This allows us to get an understanding of whether collective spaces could be used as a forum for farmers to enter into use of ICT platforms, and to access the services these devices have to offer.

8.2.2. Collective spaces to use the internet are key to women farmers but differ in respect to levels of education

This Section shows that there are large variances in internet use locations between different sub-groups of women and men farmers in Kenya. It presents the reported internet use locations per proportion of women and men farmers at three main educational levels: (1) never attended school (Figure 8.1), (2) previously attended school (Figure 8.2), and (3) currently attending school (Figure 8.3). These Figures report on the individuals who say they have a computer at home and those who do not have such devices at home.

Figure 8.1 shows that a larger proportion of both women and men farmers who have never attended school and do not have a computer at home reported using the internet from a community centre. This is especially the case for this sub-group of women farmers. It is possible to observe even larger dissimilarities between women and men farmers who report having a computer at home. Here, a larger proportion of women farmers still report using the internet from a community centre (19.5%), whilst a larger proportion of men farmers report using the internet from a cyber café (30%) or the mobile phone (26%). We see that whether women farmers who never attended school have a computer at home or not, a majority report attending a community centre to use the internet. The results show that these collective points are especially important to women farmers with no education. These findings can be merged with the results from the interviews with the women farmers in Machakos county (n=26), that provide evidence of the importance of groups to exchange knowledge. The importance to women of cognitive resources in collective spaces have been studied by authors in other contexts (Agarwal 2000; Fischer & Qaim 2014), and supports the findings from the census data. Such collective points can thus be considered by ICT platforms as places to invest in, to reach this specific sub-group with services and technical content.

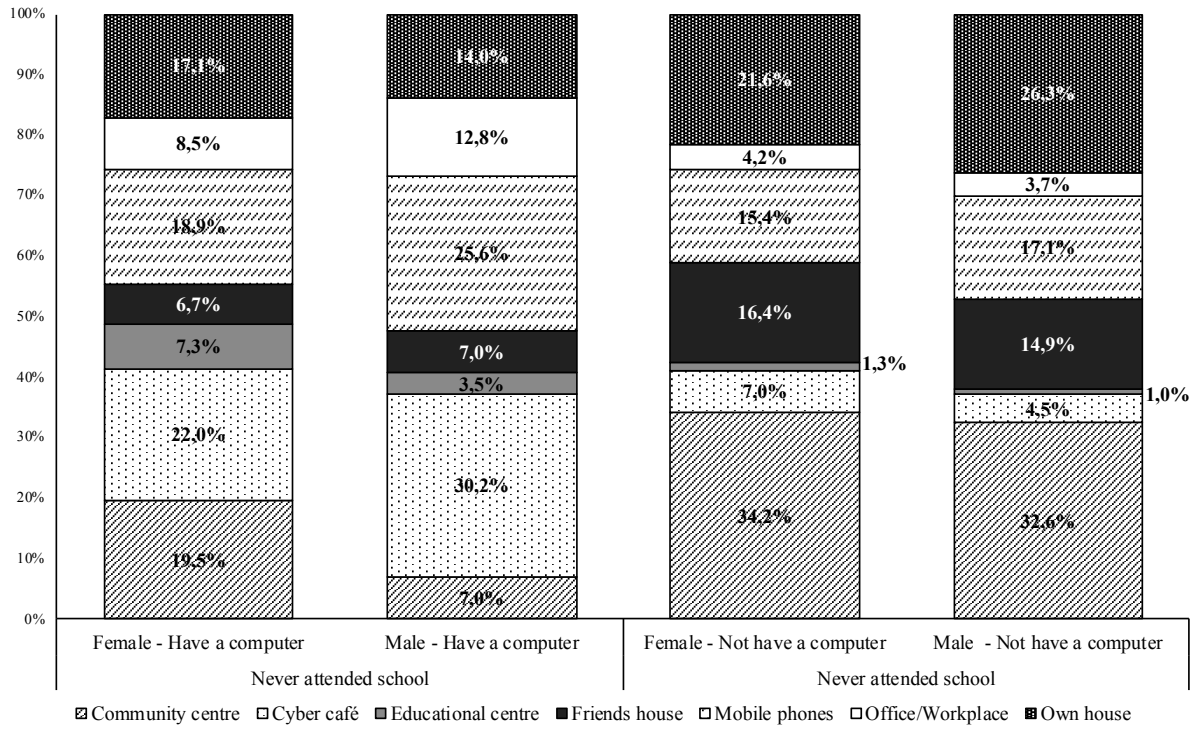

Figure 8.1: Internet use location in rural Kenya in 2009 for women and men farmers over or equal to 18 years of age who have never attended school. For households that have a computer: n_{women}=164; n_{men}=86 and for households that do not have a computer: n_{women}=6,401; n_{men}=3,103 (Source: PHC special data processing).

The scenario is somewhat different for women and men farmers who report using the internet at different locations and who previously attended school, as shown in Figure 8.2. For individuals who report not having a computer at home, a larger proportion of women and men farmers report using the mobile phone to access the internet. A larger proportion of women farmers report using the internet from a community centre (18.9%) compared to men farmers (14.1%). On the other hand, a larger proportion of agricultural workers (women and men), report using the internet from a cyber café, when a computer is present in the household.

Differences between genders are not obvious in either of the two sub-groups (i.e. computer at home or not), apart from the fact that a larger proportion of women farmers report attending community centres compared to men farmers. Thus, the aforementioned point put forward with regard to the importance of collective points to women who have never received an education, compared to men farmers, still stands.

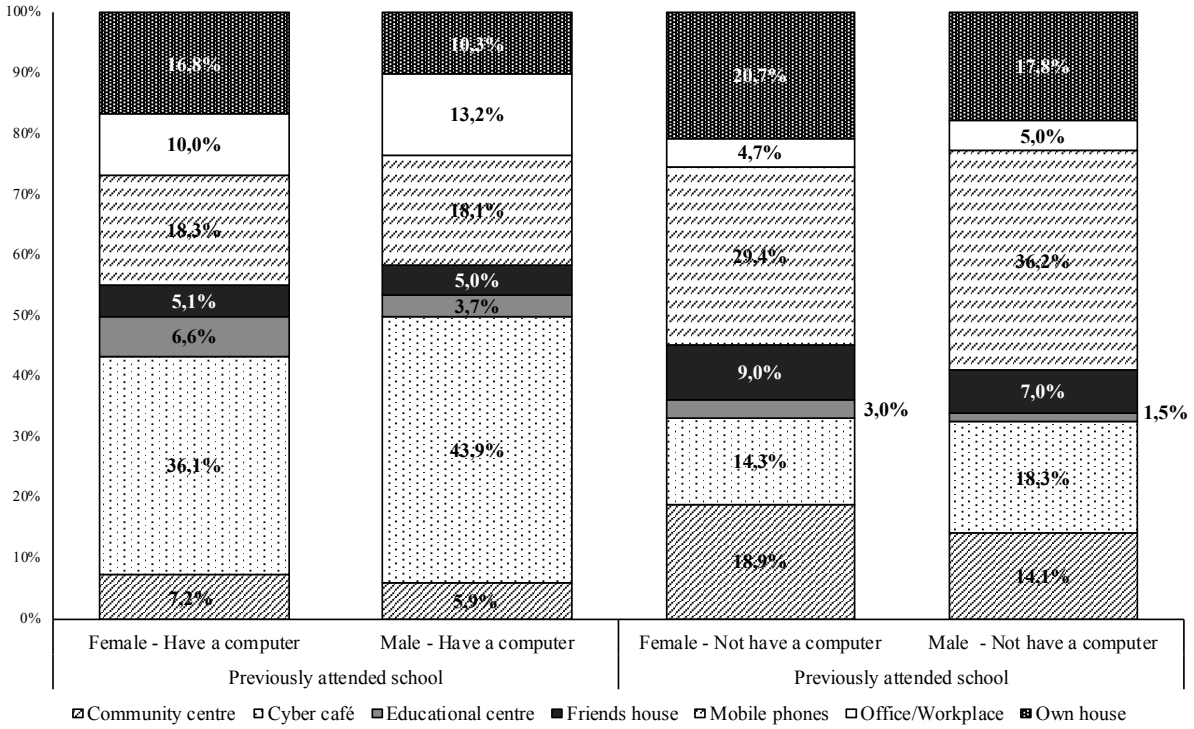

Figure 8.2: Internet use location in rural Kenya in 2009 for women and men farmers over or equal to 18 years of age who have previously attended school. For households that have a computer: n_{women}=6,093; n_{men}=8,825 and for households that do not have a computer: n_{women}=19,585; n_{men}=18,556 (Source: PHC special data processing).

Figure 8.3 presents the reported internet use locations per number and proportion of women and men farmers currently attending school in rural Kenya. For individuals who declare having a computer in the home, the internet use location that corresponds to the largest proportion of women and men farmers are cyber cafés. Entering into use with the internet from home or the mobile phone especially concerns women and men farmers who report not having a computer a home. Moreover, the declared levels of internet use from an educational centre have largely increased in Figure 8.3 compared to the reported data presented in Figure 8.1 and 8.2. It is especially the case for women farmers, currently attending school and who declare having a computer in the household.

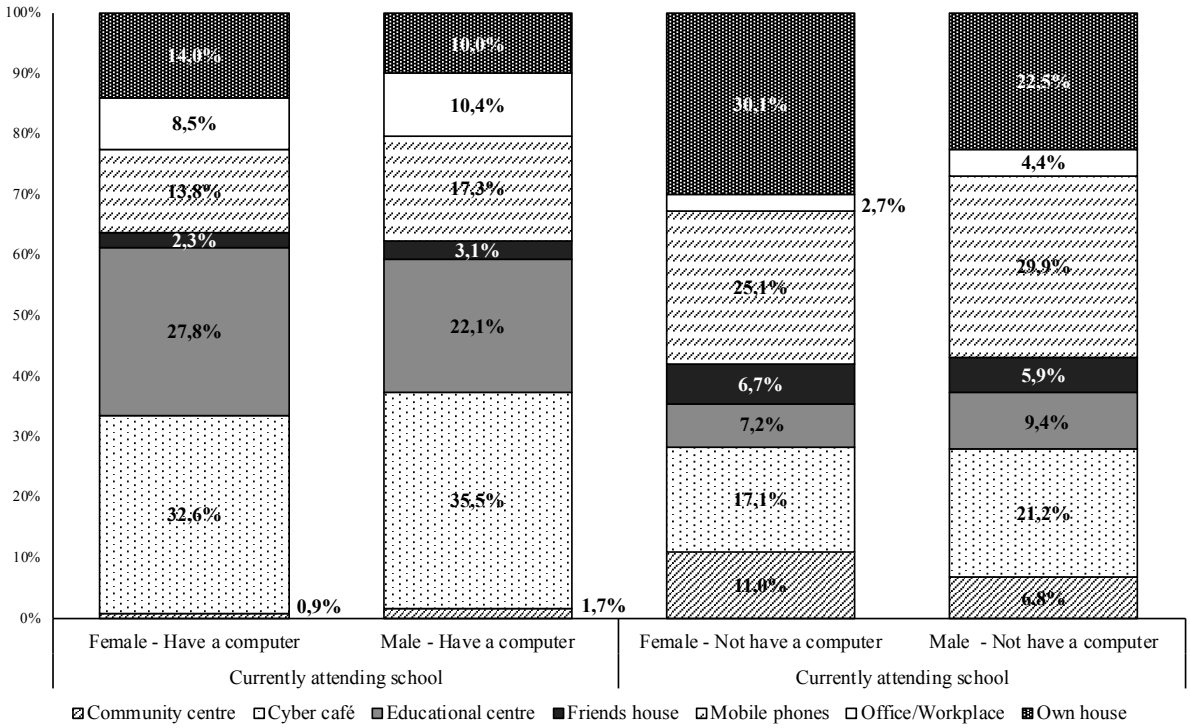

Figure 8.3: Internet use location in rural Kenya in 2009 for women and men farmers over or equal to 18 years of age currently attending school. For households that have a computer: n_{women}=453; n_{men}=811 and for household that do not have a computer: n_{women}=625; n_{men}=680 (Source: PHC special data processing).

All in all, educational status, combined with having a computer at home, influences the reported internet use locations of women and men farmers. The findings show that there are differences between genders, where attending different collective points to use the internet is important to women farmers. It is especially interesting to analyse this sub-group of women farmers more in depth since the census results show that they attend different internet use locations in respect to educational status. To women farmers who never attended school, attending a community centre seem to remain de prevalent choice (irrespective if there is a computer at home or not), which is different compared to men farmers. This particular educational status, with respect to internet use location, also differ from the other educational statuses as the three scenarios show. To prove this case, the coming Section demonstrates a correlation between levels of education and reported internet use locations.

8.2.3. Attending community centres to use internet services: Innovative practices by women farmers who never attended school

This Section examines the levels of education for women farmers and per marital status[137]. It was a deliberate choice to add this Section to provide evidence in the importance of community centres to enable women with no education to use internet services. Figures 8.4, 8.5 and 8.6 present the three main educational levels: (1) never attended school, (2) previously attended school, and (3) currently attending school, with respect to the reported internet use locations and the three main marital statuses (married monogamous, polygamous, and widowed).

Figure 8.4 shows that irrespective of marital status, a higher number of females who never attended any type of schooling system in rural Kenya, prioritise the use of internet services at community centres. The figures are slightly higher for the widows (35% to 33% women married monogamously and 31% of women married polygamously).

On the other hand, among female farmers who previously attended any type of educational system (Figure 8.5), even though going to community centres remains a prevalent choice, using internet services via the mobile phone has greatly increased (regardless of marital status). Another internet use location that is increasing among females who previously attended school are cyber cafés.

Figure 8.6 presents the internet use location for women over or equal to 18 years of age, working at the agricultural holding and currently attending school in rural Kenya in 2009. Proportionately and irrespective of marital status, the preferred location for internet use is via the mobile phone. Nevertheless, what has greatly changed for women in this particular category, is the prioritised use of internet services at educational centres.

These figures reveal that the levels of education are related to certain reported internet use location points for women farmers in rural Kenya. Figure 8.4 shows, and corroborates the data presented in Figure 8.1, that women farmers who report having never attended school, also report using the internet from community centres. On the other hand, the marital status of these women does not seem to determine the place or device from which they access the internet[138].

The results tell us that different collective points for accessing internet services, and to enter into use with ICT platforms, differ in respect to these socio-economic groups. One possibility for ICT platforms to be inclusive of women farmers, could be to target different sub-groups of women farmers against their needs to exchange experiences in different types of collective settings. In this regard, the results differ primarily between women farmers currently attending school and those who never attended school. Rather than attending a community centre to use the internet, a higher proportion of women farmers currently attending school report using internet services from the educational centre. These different groups have reported attending

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[137] Possible differences in intra-household social status between women and men farmers in rural Kenya, per internet use location was also explored. Two points emerge from the results of the census data with regard to marital status (cf. Appendix 15 for further information). First, this intra-household social status does not seem to influence differences in internet use locations between women and men farmers. Second, collective points and especially community centres still remain an important forum for female farmers' use of internet services. Indeed, the results show that investing in computers at collective spaces is a way for ICT platforms to be inclusive of women farmers. It was also concluded that the relationship status does not seem to significantly influence the place or device from which women or men farmers report using internet services.

[138] Cf. Appendix 15 for further information.

dissimilar central points to use internet services and other types of cognitive resources they may access from these centres. It is previously mentioned that it requires of policy actions and interventions to be exact in their service modalities and technical content with respect to these different sub-groups of women farmers.

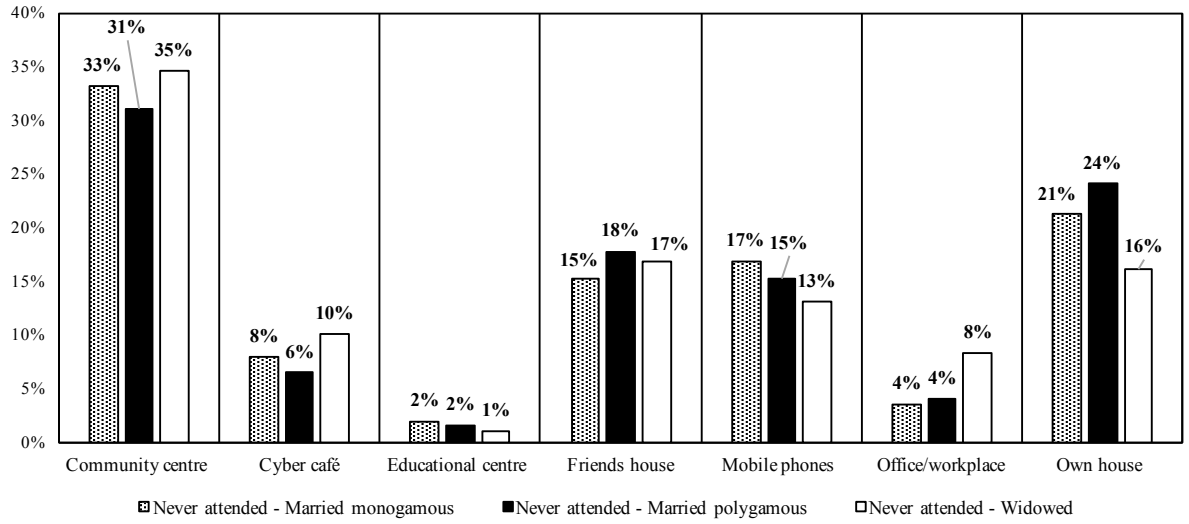

Figure 8.4: Internet use location and levels of education in rural Kenya in 2009 for women over or equal to 18 years working at the agricultural holding never attending school, n_{total}=7,519. (Source: PHC special data processing).

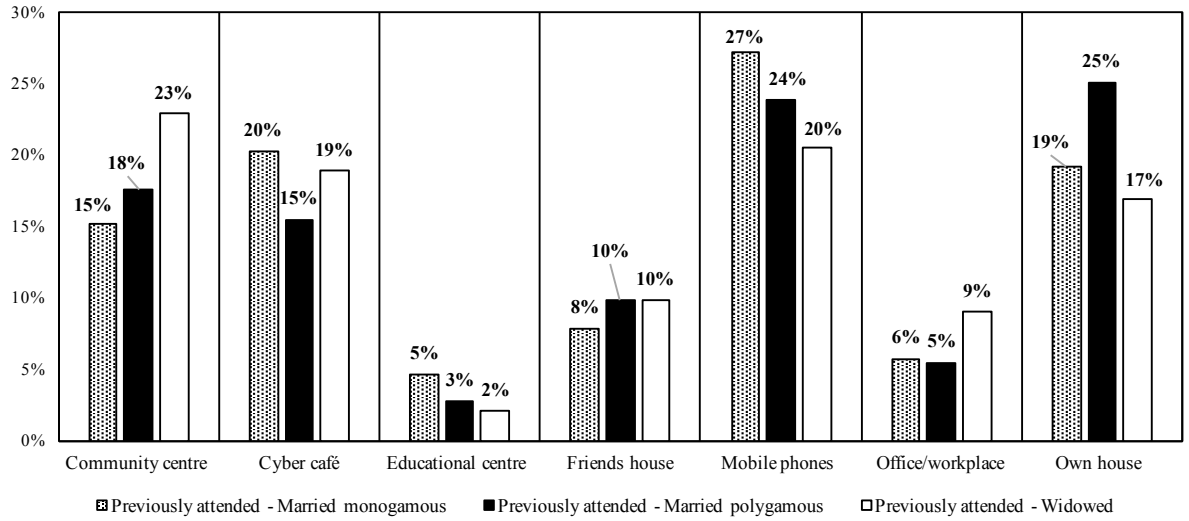

Figure 8.5: Internet use location and levels of education in rural Kenya in 2009 for women over or equal to 18 years working at the agricultural holding previously attended school, n_{total}=27,742. (Source: PHC special data processing).

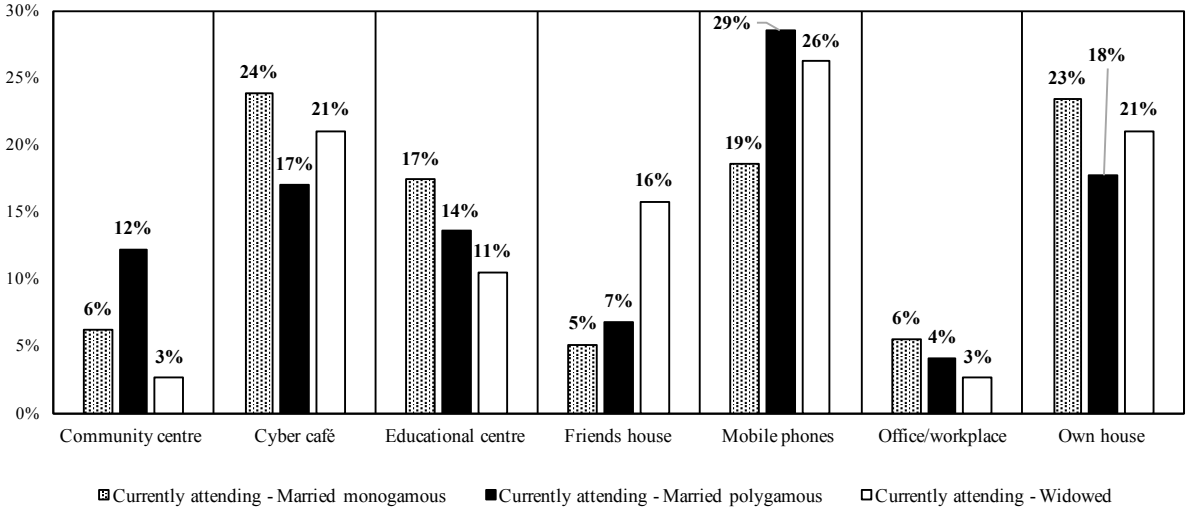

Figure 8.6: Internet use location and levels of education in rural Kenya in 2009 for women over or equal to 18 years working at the agricultural holding currently attending school, n_{total}=1,220. (Source: PHC special data processing).

Such collective spaces could be points for investment (via policy implementation) to reach this group of agricultural workers. Knowledge dissemination through ICTs in groups or other types of collective spaces has been studied is earlier economic literature (Van Campenhout et al. 2017; Van Campenhout 2016; Rodriguez et al. 2015). In these studies, the authors conclude that exchanging knowledge with peers, based on technical content disseminated through ICTs (in this case online agricultural short movies or smartphone applications), leads to successful implementation of farm practices. Conversely, evidence from the census data shows that the importance of these types of spaces is not negligible and should be seriously considered by ICT platforms as means to reach their target groups. Investing in computers (and IT literacy) in collective spaces, via for instance rural ICT development programmes, is another point of concern that needs to be given thoughtful consideration. These results thus provide strong evidence in the fact that it is not enough to invest in cyber cafés (or internet kiosks as emphasised in the paper by (Goyal 2010)) in rural areas to enable access to internet services for the farming population. Collective points to enter into use with internet services and ICT platforms (e.g. at community centres or via farm groups) is a particular phenomenon that has been given little attention in the economic and sociological literature. On the other hand, there is a vast literature on the importance of groups for women to access services and exchange ideas (Taukobong et al. 2016; Sanyal 2009; Harcourt et al. 2002; Agarwal 2000).

To strengthen these results, relationships between different socio-economic variables and internet use locations among women and men farmers in rural Kenya can be cross-verified with regression analyses. These are presented in the next Section.

8.3. Differences in reported internet use locations between sub-groups of farmers: the importance of collective spaces for women still stands

Previous sections strongly indicate the importance of collective points for Kenyan female farmers to access services and acquire knowledge. The question is whether the collective dimension also matters for male farmers, and if there are effectively gendered differences in the use of the internet and ICT platforms. Here, the marginal effects of the seven internet use locations among women above or equal to 18 years of age who reported working at the own family agricultural holding in rural Kenya is shown in Table 8.3. The same data is shown for men in Table 8.4 (cf. Box 8.1 in-depth elaborations of the R^2 per internet use location).

Table 8.3: Interrelation between internet use location and socio-economic variables for women farmers above or equal to 18 years of age, in rural Kenya. Marginal effects reported (dy/dx).

Variables	Community centre	Cyber café	Educational centre	Friend's house	Mobile phone	Office	Own house
Age[139]	0.001*** (0.0002)	0.0003* (0.0002)	-0.001*** (0.0001)	0.0002* (0.0001)	-0.002*** (0.0002)	0.001*** (0.001)	0.0005*** (0.0002)
Divorced	0.057** (0.025) (ref1)	0.008 (0.027) (ref1)	-0.018 (0.018) (ref1)	0.013 (0.019) (ref1)	-0.019 (0.032) (ref1)	0.015 (0.146) (ref1)	-0.066** (0.029) (ref1)
Married polygamous	0.004 (0.006) (ref1)	-0.02*** (0.007) (ref1)	-0.007* (0.004) (ref1)	0.007 (0.005) (ref1)	0.008 (0.007) (ref1)	-0.003 (0.038) (ref1)	0.006 (0.007) (ref1)
Never married	-0.021 (0.014) (ref1)	0.045*** (0.012) (ref1)	0.003 (0.006) (ref1)	-0.006 (0.011) (ref1)	-0.0001 (0.014) (ref1)	0.012 (0.07) (ref1)	-0.058*** (0.014) (ref1)
Separated	0.026 (0.024) (ref1)	0.021 (0.023) (ref1)	-0.009 (0.014) (ref1)	-0.009 (0.02) (ref1)	-0.012 (0.028) (ref1)	0.021 (0.125) (ref1)	-0.040 (0.026) (ref1)
Widowed	0.029*** (0.008) (ref1)	-0.003 (0.009) (ref1)	-0.013 (0.006) (ref1)	0.001 (0.006) (ref1)	-0.004 (0.01) (ref1)	0.008* (0.047) (ref1)	-0.037*** (0.009) (ref1)
Currently attending school	-0.14 (0.017) (ref2)	0.06*** (0.013) (ref2)	0.049*** (0.006) (ref2)	-0.07*** (0.012) (ref2)	-0.026* (0.015) (ref2)	0.007 (0.079) (ref2)	0.060*** (0.014) (ref2)
Previously attended school	-0.03*** (0.006) (ref2)	0.054*** (0.007) (ref2)	0.002 (0.004) (ref2)	-0.03*** (0.005) (ref2)	0.019** (0.008) (ref2)	0.016*** (0.04) (ref2)	0.011 (0.007) (ref2)
Relationship status	0.001 (0.504)	0.004 (0.005)	-0.001 (0.003)	-0.02*** (0.004)	0.009* (0.005)	0.0003 (0.029)	0.012** (0.005)
Computer at home	-0.11*** (0.006)	0.147*** (0.004)	0.034*** (0.002)	-0.04*** (0.005)	-0.144*** (0.006)	0.040*** (0.027)	-0.026*** (0.006)
Mobile phone	-0.16*** (0.005)	0.031*** (0.005)	-0.006** (0.003)	-0.04*** (0.004)	0.226*** (0.006)	-0.001 (0.031)	0.009 (0.005)
Small scale farmer	0.036*** (0.007)	0.013** (0.007)	0.002 (0.003)	-0.02*** (0.005)	0.035*** (0.007)	-0.010*** (0.037)	-0.060*** (0.007)
Informal sector	-0.014** (0.007)	0.007 (0.007)	-0.003 (0.004)	0.001 (0.005)	0.004 (0.008)	-0.006 (0.038)	0.010 (0.007)
Pseudo R^2 (McFadden)	0.1089	0.0882	0.0816	0.0538	0.0943	0.0505	0.0707
Ref1: married monogamous; Ref2: no education; Relationship status: 0=household head; 1=spouse							
Number of observations = 33,213. ***p < 0.01 **p < 0.05 *p < 0.1 Controlling for 44 counties in Kenya. Standard error in brackets							

Source: PHC special data processing.

[139] Cf. appendix 14 on boxplot distributions of education, age and internet use locations of women farmers.

Table 8.4: Interrelation between internet use location and socio-economic variables for men farmers above or equal to 18 years of age, in rural Kenya. Marginal effects reported (dy/dx).

Variables	Community centre	Cyber café	Educational centre	Friend's house	Mobile phone	Office	Own house
Age	0.0008*** (0.00013)	0.0007*** (0.00018)	-0.0005*** (0.000079)	0.00004 (0.0001)	- 0.003*** (0.00019)	0.0013*** (0.0001)	0.0009*** (0.0001)
Divorced	-0.0019 (0.02288) (ref1)	0.015 (0.03132) (ref1)	0.006 (0.0129 (ref1)	0.035** (0.017) (ref1)	-0.05 (0.035) (ref1)	0.01 (0.018) (ref1)	-0.022 (0.028) (ref1)
Married polygamous	-0.00198 (0.0061) (ref1)	-0.0203** (0.0086) (ref1)	-0.0003 (0.0036) (ref1)	-0.0076 (0.0048) (ref1)	0.022*** (0.0087) (ref1)	-0.015*** (0.005) (ref1)	0.017*** (0.007) (ref1)
Never married	-0.016* (0.00847) (ref1)	0.0078 (0.00953) (ref1)	0.011*** (0.0031) (ref1)	0.01 (0.0026) (ref1)	0.029*** (0.0099) (ref1)	-0.04*** (0.0075) (ref1)	-0.04*** (0.009) (ref1)
Separated	0.044*** (0.0145) (ref1)	0.0098 (0.02166) (ref1)	-0.00048 (0.00936) (ref1)	0.0098 (0.0127) (ref1)	-0.044* (0.0235) (ref1)	-0.0046 (0.014) (ref1)	-0.023 (0.02) (ref1)
Widowed	0.007 (0.014) (ref1)	-0.0095 (0.021) (ref1)	0.00098 (0.0097) (ref1)	0.0172 (0.0114) (ref1)	0.027 (0.022) (ref1)	-0.0065 (0.012) (ref1)	-0.04** (0.0183) (ref1)
Currently attending school	-0.11*** (0.013) (ref2)	0.11*** (0.0163) (ref2)	0.051*** (0.0055) (ref2)	-0.06*** (0.0094) (ref2)	-0.037** (0.0159) (ref2)	0.029*** (0.009) (ref2)	0.02 (0.013) (ref2)
Previously attended school	-0.03*** (0.0067) (ref2)	0.13*** (0.0127) (ref2)	0.0043 (0.0049) (ref2)	-0.03*** (0.0053) (ref2)	0.0257** (0.011) (ref2)	0.026*** (0.007) (ref2)	-0.014* (0.0078) (ref2)
Relationship status	-0.004 (0.0176)	-0.021 (0.023)	0.014** (0.0068)	0.041*** (0.012)	-0.0152 (0.023)	-0.0002 (0.014)	-0.03 (0.019)
Computer at home	-0.065*** (0.0047)	0.185*** (0.0045)	0.024*** (0.00199)	-0.01*** (0.0035)	-0.197*** (0.0052)	0.068*** (0.0031)	-0.062*** (0.005)
Mobile phone	-0.149*** (0.0044)	0.093*** (0.0081)	-0.0032 (0.00305)	-0.05*** (0.0038)	0.30*** (0.0082)	-0.005 (0.0047)	-0.043*** (0.0056)
Small scale farmer	0.0166*** (0.00535)	0.03*** (0.007)	-0.0015 (0.0027)	-0.01*** (0.004)	0.038*** (0.0073)	-0.016*** 0.0042	-0.053*** (0.0057)
Informal sector	-0.0153*** (0.0059)	0.018** (0.0076)	0.00031 (0.00294)	-0.00066 (0.0045)	0.0028 (0.008)	-0.01** (0.0046)	0.0058 (0.0062)
Pseudo R^2 (McFadden)	0.1253	0.1064	0.1131	0.0491	0.1095	0.0609	0.0784
Ref1: married monogamous; Ref2: no education; Relationship status: 0=household head; 1=spouse							
Number of observations = 31,974. ***p < 0.01 **p < 0.05 *p < 0.1 Controlling for 44 counties in Kenya. Standard error in brackets							

Source: PHC special data processing.

Box 8.1: Explanation of the R^2 from Table 8.3 and 8.4 presenting the interrelation between internet use location and socio-economic variables for women and men farmers.

For the analysis I used a Probit regression (Stata 13). I considered the following set of exogenous variables: (1) Individual variables: age [continuous variable], education [currently attending school, previously attended school, never attended school], main employer [small scale farmer, informal sector][1]; (2) Family variables: marital status [married monogamous, married polygamous, widowed, never married, separated, divorced], relationship status [household head, spouse]; (3) ICT variables at individual use level (can be used to access the internet): presence of a computer at home [yes, no], presence of a mobile phone at home [yes, no]; (4) Control variables to stabilise the dataset: 44 counties in Kenya (cf. Ch.3 for further details). These coefficients were not reported, for convenience. All the regressions control for the specific location unobservables.

R^2 varies, depending on internet use location from Table 8.3 and Table 8.4. R^2 is satisfactory at 11% and 12.5% for the reported internet use at a community centre by women and men farmers respectively, although it shows that there are missing data. In the case of women farmers, using the internet at a cyber café has a moderate R^2 at 9%. When it comes to men farmers, the R^2 for this internet location is at 10.6%. Missing variables are suspected in both cases however. The R^2 for internet use at educational centres is relatively weak for women farmers, i.e. at 8%, showing that the dataset in not complete. It is higher in respect of men farmers, at 11.3%. Internet use at a friend's house is a relational and random variable, which may explain the low R^2 result at 5.4% for women farmers and 4.9% for men farmers (e.g. the chances of having a friend and with internet connection at home, the age of that friend may not be a main contributing factor, etc.). Thus, missing variable bias is suspected. R^2 is acceptable at 9.4% for female farmers and 10.9% for male farmers for internet use via the mobile phone but it shows that there are missing variables in the dataset in both cases. In situations where R^2 is weak, it is highly likely that certain important variables are omitted, but for different reasons. The R^2 for internet use at the office is particularly weak: 5% when it comes to women farmers' and 6% for men farmers, showing an omitted variable bias in both scenarios. In such cases, the low R^2 could partly be impacted by absent geographical locations of the dataset (a higher number of offices are in urban areas). The R^2 for internet use at own house is also low in both cases (7% for female farmers and 7.8% for male farmers). Verification of the data show that there are absent variables in both datasets. Similar to internet use at a friend's house, using internet at home is relational and stochastic, which may explain the weak R^2 result.

For this analysis, I have decided to turn to the internet use locations showing an R^2 above or equal to 8%. It discusses the most relevant exogenous variables in the dataset in regards to differences in internet use location between sub-groups of women and men farmers that came out as especially relevant in the descriptive statistics Section. These differences particularly relates to the reported use of internet services at the community centre, the cyber café and from the mobile phone.

8.3.1. Community centres

Attending a community centre comes out as a key to women farmers in Kenya, and especially to this group of women who report not have attended school. Let us now explore more closely who these women might be. The presence of less educated, older[140] and widowed women is associated with a higher probability of attending a community centre to use internet services. The widowers' variable shows a significant positive relationship to this dependent variable, and increases the probability of internet use at the community centre by 3%. The only educational coefficient that is reported as (negatively) significant for this internet use location is 'having previously attended school' in the case of women who have no education. Thus, if interpreted correctly, this means that women who previously attended school have a decreased likelihood by 3% in attending a community centre to use the internet, compared to women with no education. Moreover, the coefficient for women currently attending school is not significant for this internet use location. This suggests that community centres are key locations for using the internet and perhaps for women farmers of a certain age, having had limited access to education, to access other services[141]. With regard to men farmers, there is a higher probability that older

[140] As emphasized in Chapter 7, a more important age coefficient was expected. I therefore deduce that it is rather socio-economic variables and in particular having attended school or not that impact the internet use locations of women and men farmers (cf. Appendix 14 for further information).

[141] It is worthy of not to stress that the sub-group of farmers who report using the internet from educational centres differ from the sub-group of farmers using the internet from community centres. As the results from the descriptive statistics analysis shows, a higher proportion of women and men farmers currently attending school report using

separated males, having never attended school, will attend a community centre. There is decreased likelihood by 11% and 6.5% of female and male farmers respectively having a computer at home and accessing internet from this location. Moreover, there is a decreased likelihood by 16% of women farmers and by 15% of men farmers with mobile phone, attending a community centre to use the internet. Finally, the important variables that are correlated with internet use at a community centre are not that different between genders (apart from marital status). These results are consistent with the census data from Section 8.2.2. Interpretations of such evidence combined, are that platform developers and their financiers/donors should take into consideration investing in computer equipment and internet connection at community centres so that this group of women and men farmers can access services and technical content.

8.3.2. Cyber cafés

The profiles of the female and male farmers frequenting a cyber café to use the internet seem to differ from those going to a community centre. Women farmers who are not married, report having or currently receiving an education and accessing ICT devices (computer and/or phone), augment the likelihood of them frequenting a cyber café. Results from the dataset show a significant positive relationship of these particular variables, with coefficients above 3%. When it comes to men farmers, the education coefficients differ from those of women farmers. They report twice as high numbers compared to women farmers (i.e. 11% for men farmers currently attending school and 13% for those who previously attended school), and thus a stronger correlation between these variables and internet use. If we turn to the descriptive statistics Section (8.2.2.1), it is also possible to see that a higher proportion of men farmers report frequenting a cyber café compared to women farmers (especially for households that have a computer). Hence, interpretations show that gender disparities in the levels of education could exacerbate the digital divide for this internet use location. Results reveal however that equal access to education is not the 'one and only solution' since the education coefficients for women farmers are still positive and significant, though lower compared to those of men farmers.

It is worth noting the quite unexpectedly high (and significantly positive) ICT coefficients for women and men farmers who report using the internet at a cyber café. Again, this is especially the case for men farmers. The coefficient for mobile phones is at 3% and 9.3% for female and male farmers respectively. The computer coefficient is particularly high, at almost 15% for women farmers and 18.5% for men farmers. This could suggest that individuals having access to a computer at home may still prioritise using internet services offered from a cyber café[142]. Indeed, results from this Section and the previous one (Section 8.2) indicate that it is highly plausible that there is a confounding factor between cyber café and internet use from home,

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the internet from educational centres. Age has a negative relationship to internet use at educational centres (but the coefficients are small at 0.1% in the case of female farmers and 0.05% for male farmers). Currently attending school increases the likelihood of using the internet at educational centres by 4.9% compared to women who do not have an education (significantly positive). The scenario is similar for men farmers: the coefficient is positive at 5.1%. The probability of using the internet at this location is increased if women and men have access to a computer at home (coefficient at 3.4% and 2.4% respectively, significantly positive).

[142] Reported internet use from home shows a statistically significant negative relationship with the 'computer at home' variable in both cases (cf. Table 8.3 and 8.4). The coefficients are moreover moderate at 2.6% for women farmers and 6.2% for men farmers. Data interpretations tell us that having a computer at home decreases the probability of using the internet from home, given that these groups of women and men use the internet. Initially, the inverse pattern for this particular case was expected, namely, that individuals would use the internet from home on a computer, thus showing a positive relationship. Findings also show that having a computer at home has a significantly positive relationship with internet use from a cyber café (high coefficient at 15% and 18.5% for female and male farmers correspondingly).

related to socio-economic status. Individuals who can afford a computer and can use the internet from home with this device still prefer using the internet from a cyber café, and paying for this service. Reasons for this may vary (faster internet, more efficient devices, moment to take time out and be alone, possibly even using their own computer at the cyber café). Such findings could indicate that computer ownership is related to levels of income and a socio-economic group that is financially better off.

8.3.3. The mobile phone

Accessing the internet from a mobile phone has a strong relationship to the reported main employer type. More interestingly, this internet use location type is related less to the levels of education. This could suggest that mobile phones are easier to use for any individual, with or without education, compared the use of a computer. Women who report being small-scale farmers increase the likelihood of using the internet from the mobile phone by approximately 4% (significantly positive). The likelihood that small-scale men farmers use the mobile phone to access the internet is increased by 3.8%. Owning or accessing a mobile phone significantly increases the probability of using the internet by 23% for female farmers and 30% for male farmers. The coefficient is very high, but as expected for this particular internet use location. It is therefore highly likely that individuals whose first choice is to use the internet from a mobile phone, do actually own a mobile phone and use the internet from this device. On the other hand, having a computer at home decreases the probability of accessing the internet from the mobile phone by 14% and 19.7% for women and men farmers, respectively. An age increase by one year decreases the likelihood of using internet services from the mobile phone by 0.2% when it comes to female farmers and 0.3% for male farmers. Hence, it appears that younger, small-scale female and male farmers mainly use the internet from their mobile phone.

8.3.4. Equal access to education cannot alone solve a digital gender gap

Results from these different sections provide evidence that having collective points for internet use is essential for these different groups of women farmers. There are also differences between women and men in this regard, where the unequal access to education between genders appears as a key discriminating factor. The results show however that equal access to education cannot unaccompanied solve a digital gender gap. Collective spaces are important to women farmers for other reasons as well. Indeed, the analysis also show that women farmers are using innovative practices to access internet services one way or another, and it is especially interesting when it comes to women farmers who report never having attending school.

The results show which groups of women and men farmers report going to these different locations to use internet services. Analysis of the census data also reveal that there are clear gender differences, and variances between women farmers. Hence, from a public policy perspective, one way to reach different sub-groups of women farmers might be to invest in ICTs, and especially computers, at different collective points. Finally, the previous Sections demonstrate that the aspects of groups and collective needs to be given consideration when designing platforms and accompanying services. They equally provide evidence of women farmers interest in using internet services and thus in the possibility to enter in contact with platforms, even the least educated of them. Hence, performing a micro-level analysis clearly reveals what is happening on the ground. It would now be of relevance to move up one level, and analyse possible organisational aspects around the collective dimension of internet platforms. It places us at the ‘upper level’ of services relations developed by Gadrey (1990) (cf. Chapter 2). This allows to elaborate upon the means of manoeuvre brought by agricultural

advisers in acting as mediators to support women farmers to access technical content in knowledge-based platforms.

8.4. The role of advisors: mediators between platforms and farmers

Results from the 2009 census data provide evidence of the importance of collective points to access internet services to women farmers. It presently becomes relevant to analyse at an organisational level how the collective dimension can be taken into consideration in ICT platform development.

If we go back to the literature review presented in Chapter 1, Roling & Maarleveld (1999) and Steins & Edwards (1999), started elaborating upon organisational aspects of platforms, and how these common resource pools could be organised. The authors emphasise on the importance of having focal platform individuals that disseminates platform services and knowledge to community members. Connections can be made to the thesis findings, where, at an organisational level, farm advisors could be given a new role in the organisational features of ICT platforms in Kenya. They could serve as mediators between women farmers and platforms. The question is thus under what conditions.
Data sources for this analysis are based upon:

(1) Interviews with agricultural extension staff from the Ministry of Agriculture (national and Machakos county level) (n=12). Cf. Chapter 3 – Table 3.3 for interviewee numbers.
(2) Interview of small-scale women farmers in Machakos county (n=26)
(3) National level administrative documents (the National Agricultural Sector Extension Policy – Nasep, and the Agricultural Sector Development Strategy – ASDS)

The front-office (Section 8.4.1) and back-office modalities (Section 8.4.2) serve as a foundation to examine the conditions for advisors to act as mediators between platforms and female farmers. This analysis provide evidence in two main points: (1) there is a broader reflection upon how ICT platforms can be linked to the farm advisory system, and extension workers role in this emerging system, and (2) questions are developing when it comes to material means provided to agricultural extensionists to support farmers with services and knowledge from ICT platforms.

8.4.1. The social relations between Kenyan women farmers and extension officers

Table 8.5 presents the front-office conditions for extension workers to be given a mediating role between internet platforms and women farmers in Kenya.

Policy objectives and national action programmes[143] have set the main target group for the agricultural extension system to be small-scale women and men farmers in Kenya (cf. Table 8.5 (A)). The interviewees confirmed working with these target groups. All 12 of them confirmed that they mostly meet and train female farmers.

[143] The Nasep and the ASDS.

Table 8.5: Front-office conditions for farm advisors to be given a mediating role between women farmers and ICT platforms.

Front-office activities	**Findings from interviews with agricultural extension officers in Kenya (n=12)**
(A) Types of target groups	- All 12 confirm targeting any type of farmer, but mostly and mainly the small-scale farmer. - All 12 target both female and male farmers, however, all interviewees confirm that they mostly meet and train female farmers.
(B) Knowledge facilitation procedures and how knowledge is produced	- The extension officers go to meet the farmers individually if requested, for a specific demand (12/12). - 6 out of 12 experienced an increase in the levels of interaction following the switch from individual meetings at the farm to interacting with farmers in groups. - All 12 confirm an increased number of external stakeholders' present in the area, i.e. the stakeholders involve the officers to get in contact with the farmers. - As a result, the most common approach to disseminate technical knowledge is via groups (12/12). - 10 out of 12 confirm that there is co-production of knowledge together with farmers in some cases.
(C) Consideration of groups	- All 12 confirm meeting farmers on a weekly basis via the group approach. - 9 out of 12 believe that the group method is the best alternative to cover as many farmers as possible since devolution and the large budget cuts in extension. - 6 out 12 mentioned that the knowledge that is disseminated during the farmer group meetings can be quite general and not always based upon specific needs. - All 12 confirm interacting with female farmers in these groups. - The disadvantage with the groups is that the officer does not interact individually with each farmer and does not visit individual farms (10 out 12). Hence, the updated knowledge is based on a general demand from the group.
(D) Use of ICTs to share knowledge with women farmers	- 10 out of 12 use ICT devices and services: they share specific content with their assigned farmers during group trainings. - 10 out of 12 use internet services and ICT platforms to complete their agricultural knowledge, i.e. directly in the field with the farmer and sometimes from a cyber café or at home, and then call the farmer to update her or him. - 1 out of 12 have 'WhatsApp' groups with some farmers, communicating on different agricultural issues. - 10 out of 12 confirm mainly using SMS or phone call (to transmit a short message, confirm a meeting or a knowledge uncertainty). - 4 out of 12 connect farmer groups to agricultural TV shows.

Furthermore, there are reduced means for the extension officers to meet the farmers individually. This is as a result of demand-driven services (12/12) (Table 8.5 (B)). Consequently, the farmer either needs to call or to visit the offices. For the farmer it is not always feasible to travel to the offices because of the geographical distance, and it is time consuming. Hence, due to reduced facilitation, the extension officers are not able to travel to the farmers (cf. Box 8.2)[144]. So, even if the face-to-face method is a demand from women

[144] The extension officers confirm that the budget cuts in the public extension services sector, and delayed payments, have a negative impact upon their ability to deliver advice to farmers (12/12).

farmers, such concerns cannot be adequately addressed by the farm advisors, due to the limited financial means (12/12). As a result, all the interviewed farm advisors confirm an increased number of external actors' present in the area. These agents involve the officers, in order to make contact with the farmers, and the usual method is then meeting women farmers in groups. The extension officers could not tell if platform developers are part of these actors.

Box 8.2: Concerns related to material conditions and the means available to supply services to women farmers.

"Now when we were at the national Government, there were funds which used to be, to flow from the national Government to the sub-counties, to the wards and that they used for fuel. You know extension is working by going to the field to meet the farmers, because farmers cannot come to the offices. Although extension nowadays is demand driven, we find it very difficult for the farmers to come here and it becomes mandatory for you to move to the field. And then you cannot move without means for transport. So, there was money which was used for fuel for servicing of motorbikes although they are Government motorbikes. Then maybe if there's a vehicle, then that one used to do that work. Nowadays that is not the case, we're just here in the office. So, the few farmers who come and see us, we just serve them but now we don't reach the farmers the way we used to do… We don't go out most of the time, not unless when now we have stakeholders [who provides financial support to go out a meet the farmers]." (Source: Interview extension officer, no. 13).

This statement indicates that, due to reduced facilitation, farm advisors are not able to travel to the farmers. The interviewee also mentions that one consequence of demand-driven farm advisory services is that all types of farmers can no longer be reached, especially on remote farms. Given that the extension system is demand-driven, one may well wonder what the implications are for the co-construction of knowledge. Results from the interviews show that farm knowledge is disseminated via farm groups rather than being exchanged. In some instances, however, farmers do share specific concerns experienced at their farm, or a new type of knowledge (e.g. indigenous knowledge). It is then discussed in the group (at times, the officer transfers this knowledge to research and government institutes but it is not a formal procedure).

The interviewed farm advisors confirm having an increased focus on the group approach[145] (12/12) (cf. Table 8.5 (C)). Previously, it used to be via individual visits to the farm. The interviewees do not all have the same experience as regards the change from individual farm encounters to groups, and how they presently can address women farmers' demands. Citations 1 to 3 from Box 8.3 show that half of the interviewees feel that there is limited co-construction of knowledge via these groups. As a result, the officers are experiencing a decrease in the levels of interaction and adapted advice to each woman farmer (6/12). The other half is of the opposite opinion, having experienced an increase in the levels of interaction. There is also a general belief that the group approach is the most effective method to reach the farmers, given the budgetary constraints (cf. Citation 3, Box 8.3).

[145] The officers essentially meet women farmers through groups, and meet on a weekly basis, but not always the same farmers (12/12). Nonetheless, the highest rating for establishing relations with the farmers is through individual meetings at the farm (12/12). Conversely, since the government budget cuts, these interactions at a personal level have decreased. 11 out of 12 confirm that this decrease has a negative impact on the officer to farmer relationship (i.e. not being able to travel to the farmers, not showing up at the convened time, not always accessible, not being able to follow farmers' agricultural projects, etc.).

Box 8.3: Farm advisors experiences with the group approach.

[Citation 1]: *"I would say, you know, the objective is to meet farmers in groups because of the understaffing. In the past, it was different because the staff were many. The staff were many but currently because of the understaffing, we tend to use the group approach." (Source: Interview extension officer, no. 16).*

[Citation 2]: *"Because there are farmers who have special needs and when you meet them in a group, you address them generally. You give them general information. There are farmers who need specific information." (Source: Interview extension officer, no. 15).*

[Citation 3]: *"The group approach, because we are very few and the farmers are so many, and then the ratio between the farmers and the extension staff, you can see…because here we're handling wards. One extension staff versus about one thousand farmers. So, you cannot go individually. And the other thing, we have no facilitation so actually we approach farmers in groups so that you can access, you can reach so many of them, at the same time, with the minimal resources that we have. Yeah, so we use the group approach." (Source: Interview extension officer, no. 13).*

It is a stated objective in the Nasep that both public and private farm advisors are increasingly expected take on the role as liaison officers between ICTs and women and men farmers (Table 8.5 (D)). This could be: (1) to update their own knowledge base, and (2) to disseminate/share the technical knowledge within ICTs with farmers unable to access them. It concerns marginalised social groups and farmers based in remote geographical locations in Kenya, especially women farmers (11/12). In this regard, 11 out of 12 interviewees report that they increasingly use ICTs to reach out to their assigned women farmers and update their knowledge base (cf. Table 8.5 (D)). Most of the extension officers (10/12) visit online platforms or portals to acquire additional knowledge on a question/topic raised by a farmer in the field. In this regard, the advisors confirm either knowing of Nafis (7/12) or using the platform occasionally (5/12). Nine of the 12 advisors confirm using the 'WhatsApp' application to communicate with their assigned farmers, on both organisational information and technical knowledge content. One of the advisors took the example of a woman farmer who sent pictures via a 'WhatsApp' group to share a concern about her vegetable production. She then received advice, not only from the advisor but also from other farmers, on this specific issue. The interviewed advisors also confirm using SMS technologies to send information (e.g. upcoming weather event, market prices) to their farmers (12/12). Most of the interviewees (9/12) report that they advise their fellow farmers about agricultural and livestock TV shows, to update their knowledge base[146].

In sum, there is evidence that ICTs and platforms, are used by the officers. A point of concern is however the level of standardisation with this approach, where it is acknowledged that there is limited co-production of knowledge between advisors and farmers in these groups. These findings are consistent with evidence from economics of services studies conducted in other contexts (Labarthe & Laurent 2011) or sectors (Gadrey & De Bandt 1994). This situation stems from the limited funding, according to the interviewees. The extension officers therefore meet farmers in large numbers and not necessarily the same farmers nor on a constant basis. Therefore, even if the extension officers have certain means available to access technical content in ICT platforms, the knowledge therein may not be co-constructed and adapted to each farmer through the group approach.

[146] An example of one TV show in Kenya is called 'Shamba Shape Up' (https://shambashapeup.com/). The show broadcasts weekly on different agriculture or livestock themes (e.g. caring for cows, irrigation, bee rearing). The videos are also available online to watch for free, on the Shamba Shape Up website.

The results show that farm advisors are disseminating knowledge and information via ICTs, such as platforms. The interviewed advisors have however indicated that certain conditions need to be met if they are to be able to make more effective use of ICT platforms in farmer groups. The first condition relates to the fact that an ICT-based advisory services system requires resources, and more particularly their access to material means (computers/tablets, internet, vehicles to travel to meet the farmers). The second condition corresponds first to farm advisors' role as co-producers of knowledge, with farmers, and second to their ability to give feedback to the platform designers, to update their knowledge base and disseminate more customised content to their farmers when meeting in groups.

With regard to the latter point, the interviews provide evidence of the advisors' interest in collaborating with research institutes (e.g. the Kenya Agriculture and Livestock Research Organization) and platform developers to improve the services and content of these ICTs. This brings us to the extension workers' potential role in the back-office dimension.

8.4.2. Farm advisors' role in innovative back-office activities

In farm advisory intervention, back-office activities are inherently related to front-office activities (Labarthe & Laurent 2013b). For farm advisors to be able to effectively serve as mediators between women and the ICT-based advisory service system, they must have access to robust knowledge. Hence, farm advisors in the Kenyan extension system can also have a new role in the back-office activities of ICT platforms. Namely: (1) to contribute to updating knowledge-based platform databases built on observations from the field with farmers, and (2) to connect with research institutes to improve on these databases. The back-office modalities that should be considered by agricultural extension services intervention to effectively deliver services to female farmers based on ICT platform back-office support is presented in Table 8.6.

Table 8.6: Back-office conditions for farm advisors to be given a mediating role between women farmers and ICT platforms.

Back-office activities	**Findings from the interviews with agricultural extension officers (n=12)**
(A) Involvement of research organisations and dialogue with actors involved in knowledge production processes	- Some trainings and/or workshops are being conducted in collaboration with the Kenya Agriculture and Livestock Research Organization (KALRO) (10/12). - 10 out of 12 confirm that after the trainings, the officers disseminate the knowledge to farmers. If there is any question related to the knowledge, the training institute is re-contacted. - 10 out of 12 mentioned that the agricultural extension unit is not always involved, i.e. KALRO carries out projects directly with selected farmers. - 6 out of 12 confirm that they transmit the knowledge outcomes from the farmers to 'liaison officers' attached to KALRO. - 11 out of 12 mentioned that little knowledge is being developed by the agriculture extension officers in partnership with different organisations. The officers are invited to participate in trainings on a pre-decided thematic area and teach the farmer the same. - Based on the group trainings and discussions, the officers develop and update knowledge content for the coming intervention (10 out of 12).
(B) Access and use of the internet and ICTs	- 10 out of 12 use ICT devices to access and complement and update their knowledge on agricultural techniques and on current market prices. - Interviewees confirm using the internet as complementary source of knowledge (11/12).

	- 6 out of 12 watch TV shows to update their agricultural knowledge. - 10 out of 12 confirm listening regularly to agriculture talks on the radio. The main problem with radio talks and TV shows is the lack of possibility for interaction. - All 12 use SMS and phone on a daily basis to communicate with farmers.
(C) Access to cognitive resources	- All 12 prefer physical trainings and/or workshops. - Most trainings are organised through external actors (12/12). Most trainings are provided by international NGOs or intergovernmental organisations. - 10 out of 12 confirm that there is generally a gender equality focus in the trainings they receive. - 12 out of 12 complained about the reduction in the number of trainings they receive annually.
(D) Types of means to carry out R&D activities	- The interviewees do not key data based on field observations into a specific database (all12).

Table 8.6 (A) presents the involvement of public research institutions in back-office activities and the established dialogues between stakeholders involved in knowledge production processes. The interviewees confirm that certain trainings are conducted in collaboration with the Kenya Agriculture and Livestock Research Organization (KALRO). After the trainings, the farm advisors are expected to disseminate the knowledge to the assigned farmers. If there is any problem with the knowledge (e.g. missing information or the appearance of an emerging issue meanwhile), KALRO should be re-contacted by the advisor. At times, however, the interviewees confirm a lack of involvement in the dissemination of knowledge (for example, KALRO carries out projects directly with selected farmers). According to some of the interviewees, this is not the standard procedure (10/12). As stressed earlier, however, the interviewees presented a real interest in becoming increasingly involved in the back-office work of platforms, through potential collaboration with KALRO.

Eleven out of 12 confirm that limited knowledge is being developed by the agriculture extension officers, in partnership with different organisations. Generally, the advisors receive technical knowledge via trainings by external actors, on a pre-determined thematic area. In turn, they teach their assigned farmers the same knowledge. All interviewees stress that they do not receive enough resources to attend training courses to update their knowledge base. The advisors have noticed this since they are asked questions by farmers that they are unable to answer. This is where, according to the farm advisors, ICTs in agriculture play a key role (10/12).

Ten out of 12 confirm using ICT devices to access, complement and update their knowledge-base on agricultural techniques and on market prices of agricultural products (Table 8.6 (B)). The interviewees however highlight the fact that they had not received adequate training in the use of these tools, for instance in the use of ICT platforms. As previously mentioned, all interviewees had heard of the Nafis platform but few used it to complete their knowledge base (although aware of the platform), and none knew about the APF platform. In this regard, Box 8.4 presents citations from the interviews with extension workers and their experience in using ICT platforms to enrich their knowledge base. The quotations have been organised into two main themes: (1) interaction and co-production of knowledge between farm advisors and ICT platform developers, and (2) local adequacy of technical content of ICT platforms.

Box 8.4: Extension workers experience when entering into use with platforms. A demand for involvement in co-production of content and for services to be adjusted to local conditions.

THEME 1: Knowledge co-production between advisors and platform developers

[Citation 1]: *"You know, during the training I was not trained, so you know when you are not trained, and it does not come [i.e. going from theory to practice]. Or maybe I could have done it without knowing that this is [Nafis]. What you do, you just want to Google, if it is marketing or something, maybe you just want to know a certain crop but you do not know whether now it is the [Nafis]. You know Nafis now it is like a platform that you really, maybe there is a procedure or something in the application that you have to… But that is, I do it personally, like you want to know a specimen of maize, where you can sell, how much it is… selling, etc. but you may not know that it is, it is not what or that is expected of Nafis [i.e. that such services are expected of the platform]. You are doing, just Google on a general computer." (Source: interview extension officer, no. 12).*

[Citation 2]: *"I feel they [the platform developers of Nafis] have not exhausted the knowledge. You know, agriculture is dynamic. So, I feel, if I get other information from other platforms, it would even mould me better. You know before they publish the knowledge in the platform, the stage before, do you feel that you think that it would be nice to involve us, because we can share the challenges we are facing, because for example, you know, some years back, farmers where not plating watermelon. So, after production, the farmers implemented the practices. So, it was important for us, the extension to have the knowledge. So, as I am saying it is dynamic, if another crop comes up, then we will need knowledge." (Source: interview extension officer, no. 16).*

THEME 2: Local adequacy of technical content of ICT platforms

[Citation 3]: *"[Nafis] is a bit outdated, but it used to be updated. But now, right now, I do not think it is very useful because it is just dealing with issues and national level. Unless now it is implemented at county level." (Source: interview extension officer, no. 9).*

[Citation 4]: *"In my view, the platforms are going to be extremely useful, but in my view again, they need to be made more relevant to the situation on the ground. You know if it is a national platform, then it may not be able to focus on the local issues within a certain locality within a county. So, if it is possible that you are able to get data from most persons of the county then that would make it very useful so that you can even tailor the message that is there. And you understand the challenge for instance of giving farmers advice, some farmers are in western Kenya, they have planted a different variety, others on a mountain top, others in the low lands. It is not easy; you cannot perhaps give general information. But you could have local chapters. Based in the counties, operated by the field extension officers, within those localities. Then I think it might be able to, be able to be much more relevant to the stakeholders on the ground." (Source: interview extension officer, no. 3).*

Citation 1, Box 8.4, indicates that the low levels of use of the platforms is not only related to the fact that the extension workers have not been trained. In this first quote, which relates to interaction and knowledge co-production, the interviewee stresses that there is a need for increased involvement in the content development of platforms, in order to make it more relevant. Equally, in the second quote, the interviewee emphasises the importance of co-production of knowledge between extension officers and ICT platform developers, to adjust the technical content to their needs. Furthermore, some of the advisors feel that the knowledge content within the platforms is not adequately adapted to their own demands or to the farmers' different situations (citation 3 to 4, Box 8.4). The fourth citation reveals that the service supply of platforms to farm advisors needs to be adjusted to local conditions if it is to become applicable.

The interviews with the extension workers show that receiving new knowledge through training and/or workshops is the preferred option of these advisors (cf. Table 8.6 (C) and Box 8.5, citation 1 and 2). It is their preferred source of knowledge, because it is interactive and the extension workers are able to ask questions on issues that are not fully understood. These types of trainings are generally organised by international NGOs or intergovernmental organisations. Most often, there is some technical content on how to integrate gender equality and women farmers' demands in services the advisors supply (10/12). However, all interviewees complained about the reduction in the number of physical trainings they received per year (one to two trainings annually). They consequently increase their knowledge base via the internet and online platforms instead. One of the interviewees (Box 8.5, citation 1) however stressed that online platform services are based on standardised recommendations, whilst the extension workers demand more interactive trainings/advice.

Box 8.5: Statements from extension officers on the access to different sources of knowledge. Internet services and technical content of platforms may act as complements.

[Citation 1]: *"Yes, we have trainings. We were given some trainings mostly by NGOs like [World Vision]. Let's say maybe two in a year. We need more trainings because you know, things pop up every day and we have new diseases that come every day, we have new crops that come, you know…So yes, we need these trainings. Mainly, at least two per quarter and yes, we need the classroom trainings. You know, in classroom trainings, there is some clarification, where you do not understand. You know, internet you just read, and some of the things that you read you do not even understand what they are saying, so yeah, we need those physical trainings where you can do some clarification and maybe place some issues that are under, you know, in these particular areas there are these issues that are, that only affect this particular area. So, we need to handle those issues…I guess it can be a bit broad sometimes what you find on the internet." (Source: interview extension officer, no. 14).*

[Citation 2]: *"I have been attending several trainings, workshops. You will find that we have several stakeholders who have been funding the trainings. For example, this year, I have attended once. There was that e-subsidy. There was a workshop on e-subsidy fertilizer. We had another one last year and this year I have had one. Last year, we had others like the ones organised by the FAO for this conservation agriculture funded training. There are very few. It started from 2014. Before that 2014, there were many." (Source: interview extension officer, no. 17).*

There are no particular means to carry out R&D activities (e.g. scientific monitoring) and for databases to key in observations for feedback (12/12) (cf. Table 8.6 (D)). This is confirmed at national as well as at county level (cf. Box 8.6). In this regard, the interviewee cited in Box 8.6 confirmed that the establishment and continued implementation of a monitoring and evaluation system is very expensive and that there is not enough public funding.

Box 8.6: Experiences of the establishment of a system for monitoring and evaluation of agricultural extension services intervention.

"We do not have, as of now, we do not have a national mechanism for being able to monitor exactly what is happening in the different counties. However, the Ministry is working hard trying to establish a better unit because it has been felt not just in extension but also in other aspects such as food and crop extension, reports on food insecurity and many others that the Government has been having challenges. So, jointly between the national Government and the county governments we are working on that and I believe it's going to be sorted out. But right now, we do not have that capacity." (Source: interview extension officer, no. 3).

Specific monitoring and evaluation objectives have been set in both the Nasep and the ASDS for the agricultural extension services system (Ministry of Agriculture of Kenya 2012; The Government of Kenya 2010). Yet, its implementation is very costly and as a result difficult to maintain. This is consistent with some of the conclusions in Chapter 4. Due to limited financial means, the Government seeks to build partnerships to construct these types of databases (Ministry of Agriculture of Kenya 2012). It is already on the agenda as quote 1 and 2 in Box 8.7 reveal. The question of having an independent back-office system based on partnerships with the agro-industry becomes a concern. Studies from the economic literature reveal that influences and strong lobbying from the private sector for a certain technology (Abdelnour & Saeed 2014) or ICT service (Meagher 2017) can create exclusions for certain social groups and inequalities.

On the other hand, given that the Kenyan Government is still developing its ICT-based farm advisory services system, an opportunity opens up to build an autonomous back-office system. In this regard, a new back-office role could be given to extension officers, to act as central points in such an ICT-based coordination system, i.e. between ICT developers and research organisations (e.g. KALRO), and farmers (cf. Figure 4.2, Chapter 4). Citation 3 and 4 (cf. Box 8.7) reveals this interest on behalf of the interviewed extension workers.

Box 8.7: The construction of an ICT-based back-office system and the role of farm advisors in the back-office activities of ICTs.

THEME 1: The construction of a back-office system based on partnerships with the agro-industry, where extension workers have a new mediating role.

[Citation 1]: *"…the Ministry actually wanted to leverage on these developments in the ICT sub-sector. And also on the innovations that have come from the different players, both Government and private sector to be able to reach farmers in a much faster, more efficient way in terms of time, in terms of the resources that are required." (Source: interview extension officer no. 3).*

[Citation 2]: *"There are also partnerships with other non-state actors. Because they are non-state actors, they have the funds and they have very sensible programmes. You find that their capital outlay is quite good but they are very thin on professionals. You find now that they are relying more on the field staff. That way the field staff is able to keep abreast on the emerging technologies and also cover farmers that we will not necessarily be able to cover on Government budget." (Source: interview extension officer, no. 9).*

THEME 2: The role of extension workers in the ICT-based advisory services system.

[Citation 3]: *"With the use of ICT perhaps, it might be able to, you might be able to reach many more farmers. Just to give an example, as I am sitting here in the office, I can send short-term messages to 1,000 farmers. I can send emails to 500 farmers within a certain area. Maybe there is an outbreak of a pest or a disease, I can even perhaps, if it is an email it is much more versatile because you could even perhaps send some pictures or a video, you could provide the information that is required. That basically tells you that ICT could be much more efficient than the individual farmer approach or even the group approach. So, I was just trying to emphasise that the use of ICT, the diversification of ICT would be much more efficient and therefore much better with fewer number of staff, that were now being experienced in the Ministry." (Source: interview extension officer, no. 3).*

[Citation 4 is an excerpt of a dialogue between interviewer and interviewee]:
"Interviewer: What do you think the role of ICTs should be in extension services?

Interviewee: I would say, I think it will be more effective compared to the way we are doing it manually. Because you know, you can advise so many farmers in an instant. So, I think it is more effective.
Interviewer: Do you mean that instead of having the extension officer, you would have ICTs directly reaching the farmer?
Interviewee: No, the middle because it is not good to eliminate the extension officer. He should be the intermediary. I think our farmers have not reached a level where they can use the ICT entirely. Because of some of the features, it's about illiteracy, most of the farmers are not used to ICT so much. So, if you use ICT alone, you may find that you are not communicating well with the farmers. But with the extension…, because we are…, the farmers are used to us, you can easily introduce that and grow with the farmers." (Source: interview extension officer, no. 16).

In sum, findings show that the means for the advisors to access and make use of the available cognitive resources (such as platforms) that they need to address the demands of women and men farmers are still limited. They confirm that the integration of gender equality goals in the back-office dimension of the ICT-based advisory system is also still limited. These different back-office activities are nonetheless considered essential to the interviewed farm advisors, to provide relevant advice to farmers.

Hence, an extension pattern is appearing between platforms and agricultural extension officers**,** as a new type of Agricultural Knowledge and Information System (AKIS) (Touzard et al. 2015; Knierim et al. 2015; Labarthe 2009; Engel & van den Bor 1995). The results how that advisors can act as knowledge brokers, as emphasised in previous literature (Klerkx & Leeuwis 2008; Klerkx & Proctor 2013; Kilelu et al. 2011). Indeed, Kenyan farm advisors can have a new innovative role in acting as a bridge between female farmers and ICT platforms. For the front-office dimension, results show that the interviewed extension workers are already filling this new role. They demand however to be part of the co-construction of technical content of platforms, in order to supply their farmer groups with relevant and locally adapted knowledge. Since meeting at collective points is a priority to farmers, and especially women farmers, they can become forums where extension workers and farmers discuss the technical content offered by ICT platforms. There is however an important investment factor that needs to be given consideration (with regard to purchase of ICTs and maintenance costs) for such a type of system to work. The extension officers in the Kenyan advisory system can also be given a larger role in the organisation of the back-office activities of these instruments. Results from the interviews with the extension workers demonstrate that they have a real interest in being part of the back-office work of this ICT-based system, first in research and development, as well as in monitoring and evaluation activities, and second in institutional coordination processes. In this way, the integration of female and male farmers' demands in ICT platforms have a larger chance in being fully considered.

8.5. *Conclusively:* How can platforms be inclusive of women farmers?

The purpose of this chapter was to provide evidence on the ways in which female farmers in Kenya innovate to access the internet and consequently ICT platforms. These can be turned into levers of action, that could enable ICT platforms to be inclusive of women farmers and their demands.

The first one concerns the collective access to computers, beyond economic motivations. In developing countries, a limited number of people can afford the cost of a computer. The results provide evidence of women farmers' unequal access to such devices, as is highlighted in the literature (Hafkin & Huyer 2008). Therefore, from a micro-economic standpoint, shared access

can be considered as a potentially viable means to develop this computer and internet use (Kaushik & Singh 2004). However, what is equally at stake is the importance of interactions with peers for knowledge generation. On multiple occasions in this chapter, there is a particular emphasis on the importance of investing in ICTs, and especially computers, at collective points. These types of forums can either be community centres, educational centres, cyber cafés, or farmer groups. Such different collective settings also need to be equipped with reliable internet access. In their review of the literature, Aker et al. (2016) discuss how 'human-computer interaction' (HCI) may support rural and low-literate populations in developing countries to access technical knowledge. In this context, Wyche & Steinfield (2016) studied farmers' interactions with a mobile based platform in Kenya. The authors come to the conclusion that for these technologies and their content to be relevant to small-scale farmers, discussing content in groups with technical experts should be considered. Hence, there is strong evidence, based on the results from the thesis data, which can be completed with findings from the scientific literature, that computer access via collective points could be one way for farmers to enter into use with ICT platforms.

The second lever of action relates to the mediating role of farm advisors both in front- and back-office activities of ICT platforms. The results show that the levels of internet use are still low (even though they are increasing). Women farmers are especially concerned here as evidence shows in Chapter 7. Indeed, the results from the census data point towards a digital divide between rural women and men farmers in Kenya. Another point of concern here is that 'computer investment programmes at collective spaces' may not work as a standalone. Both the qualitative and quantitative data show that: (1) part of the female population is still low-literate and IT-illiterate, and (2) there is a constant demand for co-production of knowledge. This is therefore where the role of extension workers comes in. The results from the interviews with farm advisors show that extension workers are already disseminating knowledge from platforms to the farmers they meet in groups. ICT information channels are also being used for organisational and exchange of technical content purposes. These results echo findings by Mabe & Oladele (2012), studying the use of ICTs among extension workers in South Africa to disseminate knowledge to farmers. It is emphasised in their study that extension workers could become a central point of connection between ICTs and farmers. Furthermore, the results confirm a real interest by the interviewed extension officers in being part of the back-office work of ICT platforms. The advisors' manifest an appeal for collaborating with research organisations and platform designers. This could to be supported by policy works of the Kenyan Government. Against this background, in the conceptual paper by Kozma (2005), the author posits that social inequalities in rural areas in developing countries is related to women farmers' unequal access to knowledge and information. To bridge this inequality gap, ICT infrastructure investments could be made in rural areas (e.g. community technology centres), including where agricultural extension services could have their base/offices (*ibid.*). Collective points could also be used for the coordination of the front- and back-office services.

ICT development is moreover a novel area of public intervention. Innovative practices may be invented and there is a risk for overlooking the variety of individual and collective behaviours if statistical data are not analysed with sufficient knowledge of the concrete conditions of women farmers' activities. The example of the importance to female farmers of groups, for knowledge sharing and exchange, is especially articulate in this context. Hence, the third and last lever of action concerns the type of data available for the analysis. In this regard, evidence from this thesis shows that it is essential to complement quantitative approaches with qualitative analyses, to bring out the mechanisms that help or hinder ICT adoption in the field, and with in-depth investigations on social innovations. This would, for instance, avoid misinterpretation

of who these women farmers are and their actual demands. While certain studies emphasise women farmers' role as main food providers (Quisumbing et al. 1995; Doss et al. 2011), this is actually just one side of the coin as the results attest.

Ignoring the different characteristics of female farmers' demands presented throughout the results chapters of this thesis could turn these ICT knowledge-based platforms into a new vector of exclusion via a substantial digital gender divide. Recognising them and taking them into account, on the other hand, could provide powerful levers for improving their efficiency, with regard to inclusiveness and innovation. The results from Chapters 4 to 8 hence provide evidence in certain critical points that can allow Kenyan women farmers to access and make use of services and technical knowledge in these ICT policy instruments.

CHAPTER 9 - Discussion and Conclusions – 'Gender relations': a fundamental social relation to ICT policy instruments in agriculture

The review of the literature on knowledge-based platform development show that whilst these technologies are increasing in importance worldwide, they can contribute to a digital gender divide. Thus, this thesis aimed at responding to the following research question: Are knowledge-based platforms in agriculture inclusive of women farmers? The answer to the question is yes, under certain conditions however. The following Chapter shows several critical points for the inclusion of women farmers, and how economic theoretical approaches made some contributions in this regard.

9.1. Critical points for the inclusion of gender equality in ICT platforms

The analysis of policy documents confirms that gender equality is a fundamental guiding principle to the Kenyan Government. Analysing 'gender relations' from an institutional economics perspective allowed me to analyse how this fundamental social relation is considered in the emerging ICT-based farm advisory system in Kenya.

Gender relations are a product of social construction, which is perceived and inherently defined within a society based on a set of values specific to a culture (Section 2.2.2, Chapter 2). The notion is thus context bound. The research was based on four foundations, with the aim of understanding how this social relations interrelate with technological innovations in public policy work: (1) the ways in which gender relations are articulated in ICT platforms in the public policy sphere, with the support of gender principles (i.e. gender mainstreaming and affirmative action); (2), the ways in which gender and equality are dimensions of knowledge-based platforms (referring to the institutional analysis of platforms); (3) how access to services via knowledge-based platforms can be assured for women farmers; and (4) how women are considered in ICT platform services supply. These four foundations of the 'gender relations framework' developed in the state of the art (i.e. Chapter 2), structured the analysis.

9.1.1. The integration of the gender dimension in ICT platforms in public policy

Empirical evidence shows that knowledge-based platforms in agriculture are increasing in importance worldwide and in Kenya. Findings from the literature review on knowledge-based platform development presented in Chapter 1 also confirm this.

The idea of an eventual substitution of traditional forms of advisory services with ICT platforms is developed by intergovernmental agencies such as the FAO or the World Bank (The Food and Agriculture Organisation 2014; George et al. 2011). The hypothesis that platforms can provide farm advisory services and knowledge more effectively compared to traditional advisory intervention is put forward by several authors (Karippacheril et al. 2013; Courtois & Subervie 2015; Nakasone et al. 2014). The literature review reveals however that there is limited empirical evidence to support such arguments. Besides, very few papers analyse institutional aspects of platforms, or provide evidence of factors of social inclusion/exclusion. There is therefore a huge need to provide empirically-based studies, and this thesis contributes to meeting that need.

Chapter 4 demonstrates that the Government of Kenya considers that ICT platforms can be inclusive of gender equality objectives. Results from the analysis of policy documents in this chapter provide evidence that ICT platforms are considered as tools for gender inclusion in the

advisory services system. They are considered as one main solution to reach women farmers with services and technical knowledge. It is emphasised in the Nasep, the ASDS and the ICT policy of the Kenyan Government, that ICTs (such as platforms[147]) have the potential to provide services more rapidly to wide-spread vulnerable groups, such as female farmers in rural Kenya.

Based on empirical evidence from Chapter 4, it makes sense to consider these platforms as policy instruments. Studies of policy instruments by Lascoumes & Le Gales (2007) emphasise that such tools organise social relations between a government and the governed. I especially refer to the central role given to platforms (both public and PPP-based platforms) in the integration process of gender equality objectives in the emerging ICT-based advisory services system in Kenya. It is expected of these devices to supply women farmers either directly or indirectly (i.e. going via service providers) with technical content.

As mentioned in Chapter 1 and shown in Chapter 4, however, ICT platforms used in farm advisory intervention are not neutral devices. The policy document analysis clearly indicates that knowledge-based platforms are more than technical tools, since they are used as instruments for the integration of gender equality objectives and thus of women. Results also show however that ICT platforms are inserted into networks that are constituted of complex multi-actor partnerships. There are both economic and political incentives behind the development of these ICT instruments. Hence, even though a considerable effort is made to include rural women farmers via policy work by the Kenyan Government, this does not guarantee their inclusion.

In this regard, gender principles (i.e. gender mainstreaming and/or affirmative action) are used to address gender inequality at policy level (Moser 2005). Here, defining 'gender relations' as a fundamental social relation highlighted evidence of the challenges of implementing gender equality objectives through the use of gender principles, and the fact that such objectives must be adjusted to the local context. The question is however on what conditions these principles can support the effective integration of gender equality in the emerging farm advisory coordination structure, with a central place given to ICTs. As previously emphasised by feminist economists, gender relations differ according to socio-economic conditions and are hence context bound (Ferber & Nelson 2003). Analyses are non-transposable from one context to another. It was therefore expected that gender equality policy objectives achieved via policy instruments (i.e. ICT platforms) would be context related.

Results from Chapter 4 (policy level) and Chapter 5 and 6 (platform level) show that the integration of gender equality objectives are supposed to be ensured via the implementation of specific measures based on the use of gender principles (gender mainstreaming and/or affirmative action). In the case of the Kenyan Government, the analysis shows that to ensure gender equality, policy instruments are coupled with gender principles. This has occurred in other situations as reported in the papers by Gillard et al. (2008); King (2007) and Walby (2005:2011). Empirical evidence from Chapter 5 and Chapter 6 reveal that these ICT policy instruments, similar to gender principles, should be bound to the context of Kenyan women and men farmers. A concrete example is the demand for knowledge co-production and interactive knowledge exchange by Kenyan women farmers, as the results reported in Chapter 6 attest. Findings from the census data moreover show that a larger proportion of rural Kenyan women farmers report that they attend collective spaces use internet services.

[147] For example, the Nasep refers to the Nafis platform and its potential in reaching farmers in remote areas in Kenya (Ministry of Agriculture of Kenya 2012).

This implies that gender equality objectives present in ICT policy instruments, via the use of gender principles, must be context-bound. Gender studies reveal however that the use of gender mainstreaming at policy level is not a sufficient condition the achieve gender equality across sectors (Moser & Moser 2005; Bock 2015; Shortall 2015). In this sense, applying too general strategic gender equality actions for social inclusion may not be enough for an appropriate integration of gender equality objectives at policy level.

Hence, the analysis show that there is a need to be precise in the construction of ICT services, to ensure that women farmers gain from farm advisory services policy intervention. Two critical points of inclusion have been identified for the integration of gender equality goals in the Kenyan ICT-based farm advisory services coordination system:

(1) The first one concerns the need for the implementation of gender equality objectives (based on the use of gender principles) to be specific and context-related, so that they include the needs and demands of different social-groups, and in this case Kenyan women farmers. An eloquent example here is their specific demands to exchange knowledge in groups. Hence, for ICT platforms that use gender mainstreaming as a guiding principle, there is a need for their services to be context specific.

(2) The second point corresponds to the availability of resources for: (a) R&D, data collection and data analysis [back-office]; (b) the monitoring and evaluation of ICT advisory services [back-office]; (c) the co-construction of knowledge between farmers and extension workers [front-office]; and (d) institutional coordination processes, that connect the front- and back-office dimensions. PPPs could present a solution to this second point, even though complex partnership patterns raise questions about the integration of social dimensions. This brings us to the next Section.

9.1.2. The ability of complex partnership patterns in ICT platforms to supply services to women farmers

Various policy tools have been developed to ensure a sustainable access to agricultural extension services for farmers. ASDS[148] and ICT policy[149] documents have given actors other than the Kenyan Government, via different partnership set-ups, the mandate to implement ICT platforms. The analysis shows that all of the analysed knowledge-based platforms presented in this work are being developed through public-private types of partnership, with the exception of the Nafis platform. The Kenyan Government therefore has good reason to develop multi-

[148] For example, to increase farm productivity in Kenya, the Government has established an Innovation Fund for Agriculture and Agribusiness. *"An essential component of the ASDS is to enhance the capacity of the private and public sectors in agriculture through supporting innovative private sector activities or public–private partnerships that promote market-driven production, processing and marketing initiatives. This support will be actualized through the establishment of an Innovation Fund for Agriculture and agribusiness (IFAA). The objective of the Fund will be to foster ASDS's central objective of commercializing agriculture by catalyzing private sector participation in market-oriented production and service delivery, promoting productivity and profitability or commercial viability of sector activities at all levels of the wider agricultural sector value chains. The Fund will target the semi-commercial agribusiness or transitory level actors: farmers, traders, processors, traders, agribusiness service providers. For purposes of the fund, semi- commercial enterprise is defined as 'a business enterprise that is producing or offering a product or service for sale and fully for profit and or is at below the desired or optimum level of operation, but at the same time is neither capable of injecting all of the required additional resources / capital from own sources nor has the capacity to acquire required additional resources / capital from commercial sources."* (The Government of Kenya 2010, p.89).

[149] The ICT policy of the Kenyan Government states that: *"There is need for an enabling environment for Public-Private Partnerships (PPP) in ICT development."* (Ministry of Information and Communications 2006, p.6).

actor partnerships, such as PPPs, to test the potential of ICT platforms and knowledge databases for back-office activities. Implementing ICT platforms via PPPs are thus a possible solution, given the high costs of maintaining an ICT-based extension system.

The analysis from Chapter 5 reveals nevertheless that if ICT platforms are to replace traditional forms of advisory services, they cannot be proposed as a general and standardised solution to a very multifaceted reality. In this context, other technologies have been advocated as universal solutions in response to a highly complex reality in previous cases, as Abdelnour & Saeed (2014) have emphasised in their research. Their empirically-based findings show how fuel-efficient stoves are promoted and considered as viable solutions for reducing rape in refugee camps in Dadaab (Kenya) and Darfur (Sudan). The authors stress that the technology on its own does not have the ability to solve such complex problems. It is further shown that technological innovations must be adjusted to the local cultural and social context in order to resolve such large social issues effectively. Thus, in the case of this research, there is a need for the analysis to genuinely go into the details of the implementation of gender principles and policy tools, and to ensure that they are adjusted to the local conditions. Here, one could thus expect that it is a solution where supply and demand are coupled (for instance, in co-producing knowledge between extension workers and women farmers in groups).

On the other hand, findings from the results in Chapters 5 and 6 raise the question of whether pluri-actor partnership platforms could be supportive of gender equality objectives. In this regard, the studies by Gurumurthy (2006); Khanom (2009) and Akyeampong (2009) stress that PPPs can contribute to certain exclusion mechanisms for women and girls, which mainly relate to their institutional nature. In the case of this thesis, two main reflections around the integration of the civic dimension in multi-actor partnerships of platforms derive.

The first reflection concerns the fact that financial performance rationales could be prioritised over civic performance rationales in the case of PPP-based platforms. Hence, since it is not the role of such types of ICT platforms to support the civic dimension, what requires further analysis are the consequences upon the farming population. To continue on this path, given that the financial dimension is prioritised by PPP types of platforms, and that a return on investment is expected, the poorest part of the population is perhaps not the main client base. Yet, it is recognised that small-scale women farmers in low-income countries are part of this demographic cluster.

The second reflection is the nature of the commitment of partners in these PPP-based ICT projects and the fact that they vary considerably, which challenges the coherence of this system (cf. Chapter 5). Such phenomena are also reported by other economic literature on PPP development (Murphy et al. 2014; McGoey 2016). Hence, while the state is always there and cannot opt out of societal issues, other partners may choose to leave the scene and stop funding a program after a given period of time. Blowfield & Dolan (2014) come to similar conclusions based on a number of case studies from African countries. In this sense, and as results attest (Chapter 5), there could be long-term sustainability issues with PPP-based platforms when they are not controlled by public partners. Conversely, research from various sectors demonstrates that PPP models better serve the profitability of industry investment rather than serving societal issues (Sclar 2015; Miraftab 2004). Moreover, Mann's (2017) study suggests the need to precisely describe the organisational and financial structures of ICTs, such as platforms, in order to understand the motivations of the partners involved, and to discuss the scope for public intervention. The results from the platform typology framework developed in Chapter 5 show

that we have to ask ourselves these types of questions, found in this part of the economic literature.

9.1.2.1. The heuristic value of the platform typology framework

Kenyan women farmers' demands for co-production of knowledge and interactive advice incite service suppliers to be precise in their methods. The results demonstrate however that platform suppliers' vision differs from the type of services demanded by this group of women, namely for interactive advice, and knowledge co-produced in groups. It raises questions about the representations that platform designers (and financiers) have of the role of women in agriculture, and if these could possibly reinforce gender discriminatory patterns. The foundation for such questions lies in the findings that emanated from the platform typology analysis.

In this context, for the platforms where the use of gender principles could be identified (i.e. 4 out of 9, cf. Table 5.4, Chapter 5), gender mainstreaming seems to guide the interventions. Even so, the gender-targeted services and knowledge content in the devices may be subject to partiality, due to the lithe structure of the principle, as emphasised by Shortall (2015). What could also occur is that that the most influential actors may have a dominant and consequently prescribed view of gender equality in platforms. This depends essentially on how gender equality is valued by actors, as previously emphasised, and is equally valid for the unintended gender dimension in the services and technical content of platforms. The results therefore corroborate what is emphasised in the literature, namely that the use of gender mainstreaming does not guarantee the inclusion of gender equality dimensions (Bock 2015; Lombardo 2005; Lombardo & Meier 2006). In the case of foreign-based PPP-based platforms, this could therefore imply that non-context related (and consequently non-relevant) services and technical knowledge are disseminated to Kenyan women farmers.

The results also show that the notion of 'knowledge-based platforms accessible via the internet' masks a vast diversity of goals and partnership patterns. They show that it is expected of the analysed platforms to benefit investors and serve the strategic objectives of relevant NGOs and/or foundations. The platform typology analysis moreover provides evidence that there is a need to specify the characteristics of platforms, and to assess their potential contribution to public policy objectives. It also shows that a technology and related services that may seem quite similar to end users, serve very different interests and development agendas. Here, Meagher (2017) provides evidence in the disempowering effects upon local operators of cost-effective mobile-based technologies. The author also shows the empowering effect for multi-national corporations (MNCs), both economically and politically. In this context, several studies make explicit the intentions and economic interests of multi-national corporations (MNCs) when providing financial support to governments in developing countries (Blowfield & Dolan 2014; Murphy & Carmody 2015; Barral 2015). McGoey (2016) lays out MNCs' economic interests, based on the example of the partnership between the Gates Foundation and two MNCs (Monsanto and Coca-Cola) in selling their products in developing markets. McGoey shows how the knowledge content provided through internet-based ICTs are used as a means to advertise for the MNCs products. Consequently, it could be that the most influential actors in complex partnership set-ups of platforms are the ones imposing the type of services and technical content. The latter confirms evidence in potential conflicts of interest between different actors that invest in ICT platform development. Hence, could this contribute to a technological lock-in situation? This will be further discussed in Section 9.2.2.2. For now, the main points that emanate from the implementation of gender principles to integrate gender equality in platforms are presented.

9.1.2.2. Lessons learned from gender equality integration in two platforms

Analysis from Chapter 6 provides evidence in different implicit representations of women farmers in ICT platforms. The differences between the Nafis and the APF platforms are presented as examples below.

Nafis adheres to the representations of women and their respective demands described in the analysed administrative documents from Chapter 4. In administrative documents at national level, Kenyan women farmers are portrayed as having different demands, needs and concerns than men farmers. The results also show that the integration of gender equality is part of the strategic process of Nafis. The types of demands are nonetheless not specified in the platform content. Yet, there is evidence that female farmers' demands can be specified. As emphasised in Chapter 6, and revealed in Figure 6.1, women have specific demands because they are embedded in precise social relations, which also corroborates findings in the feminist social and economic literature (Ferber & Nelson 2003; Barker & Feiner 2004; Harcourt 2016; Risman 2004). As a consequence, women famers use resources for other reasons compared to men farmers and it is due to such specific social situations that women farmers' demands are different and diverse. Hence, coming back to Nafis, even though the platform develops content based on what is considered to be an accurate representation of the 'Kenyan woman farmer' per the Kenyan Gender Policy (Ministry of Gender of Kenya 2011), the demands of female farmers are not very specific. Furthermore, Nafis does not at present have evaluation tools measuring the performance of its gender-targeted knowledge content and activities. There is thus no real measure of the effectiveness of Nafis services, with respect to gender equality integration. As emphasised in the results of Chapter 6, this is an acknowledged concern by the Nafis platform staff and public extension staff working at national level. There is however no immediate solution to such problems, given the high implementation and maintenance costs of a monitoring and evaluation system.

2.) The way in which the APF platform develops gender knowledge content and perceives the woman farmer in developing countries differs from that of the Nafis platform. Two research findings show that it is strongly related to the complex partnerships of the APF platform.

First, the integration of gender equality activities in the APF via the use of gender mainstreaming is a demand from the Government of the Netherlands (i.e. main donor of the platform). From this perspective, the gender equality work of the APF and thus the application/implementation of the gender principle could become an issue since it will be based upon the implicit representation that this donor has of women farmers, and in this case in Kenya. One such example is the 'gender in value chains' knowledge base of the APF platform. It appears as if this knowledge base was developed to respond to the demands of APFs main donor and is not a mandatory knowledge base in the different countries in which the APF operates. Therefore, the question is whether the use of gender mainstreaming in the APF platform is not purely rhetoric (with isolated actions, e.g. 'the gender in value chains' knowledge based, the gender coaching track), rather than an actual implementation of the principle.

Second, the APF platform aims at changing its financial strategy, increasingly relying on revenues from paying members. The objective is to become less financially dependent on the Government of the Netherlands. This type of strategic direction could also imply a decreased focus on gender equality integration in the platform activities. Furthermore, it is with the paying members that the APF co-develops services and further knowledge content. Hence, the gender-

targeted knowledge content is based upon the vision that the paying members of APF and the technical staff of the platform have of female farmers. These values are however not easily transposed from one context to another (Agarwal 1997). Ferber & Nelson (2003) likewise highlight that gender is a dynamic social construct, based on power relations between women and men, valued differently based on cultures and norms within a country. Findings from this research are in line with evidence from this economic literature. Results equally reveal that implicit representations of women farmers in the services and knowledge content disseminated via the APF may not always reflect the priorities of Kenyan female farmers. This is something that is recognised by the platform in their 2018 report on gender: *'Making gender work – Cultivating diversity'*: *"It is not easy to integrate a gender perspective into a programme. Partners accuse you of imposing Western values, women are not allowed to participate, colleagues don't take the issue seriously, and so on."* (AgriProFocus 2018, p.9). Hence, this could suggest that the types of services that are developed and the knowledge disseminated via the platform could be based standard representations of the Kenyan female farmer, and that it is not necessarily the correct one.

In conclusion, findings point towards different critical points in the ability of multi-actor partnership platforms to supply relevant and reliable services to Kenyan women farmers. The in-depth study of two platforms raises questions about the integration of gender equality in ICT policy instruments when using gender mainstreaming. Analysis also shows that the platforms, in addition to the applied gender principles, should be context related to become relevant to the women farmers. Yet, to date, very few of the platforms presented in the platform typology are bound to the Kenyan context[150]. As emphasised in Chapters 5 and 6, civic performance (and gender equality) can become deprioritised, to the benefit of financial performance. Questions are raised concerning private-sector involvement in farm advisory services platforms, in particular. This, since their strategic priorities are not necessarily aligned with the priorities of the Kenyan Government, and in this case with gender equality policy objectives, that ensure women farmers access to adequate and free knowledge.

9.1.3. How access to ICT platform services can be assured for women farmers

Agricultural platforms could offer technical support to female farmers having restricted or no access to extension officers. Knowledge-based platforms are considered a solution to compensate for the decreased supply of public services in farm advisory interventions (Lele & Goswami 2017). Findings show that ICT platforms are increasing in numbers. Such results are consistent with the economic literature (Aker et al. 2016[151]). In addition, Karippacheril et al. (2013) are of the opinion that ICT platforms are inclusive tools allowing female farmers in having more rapid access to available knowledge. The authors from the 2011 World Bank report make the assumption moreover that ICTs present better solutions to support female farmers in increasing farm productivity.

Such points of view are however highly debated and questioned. Evidence from gender studies on the digital divide assume that a lower proportion of female farmers have access to ICT tools in agriculture (Antonio & Tuffley 2014; Scheerder et al. 2017). Such unequal access could lead to a new digital gender divide. Findings reported in Chapter 7 provide evidence of this. The 2009 population and housing census data demonstrate a low use of internet services for women farmers in rural Kenya. This economic group of women is the most disadvantaged group for

[150] I.e. Nafis and iCow, and the latter have foreign-based donors and financiers.

[151] Also cf. Appendix 1.

accessing and using internet services, irrespective of economic activity or social status. The regression results and descriptive statistics analysis from Chapter 7 show that women in rural Kenya appear to be more disadvantaged for accessing the internet, compared to men. Interpretations from the econometric results for women farmers in rural Kenya suggest, precisely, that being a woman and a farmer, especially small-scale, and not educated, are exclusion factors for ICT access. It is however important to stress that the results also show that education / attending school is not enough to reduce inequality and a digital divide (cf. Section 7.3.2). Other critical points to be considered that emanate from the analysis is on the hand material ICT investments and, on the other, from where different sub-groups of women farmers report using the internet.

Although some findings from the literature show that this gender gap is caused by intra-household barriers (Anderson et al. 2017), this is not necessarily the case, as shown in Chapter 7. Evidence from the census data shows that the discrepancy is related to women's economic status as farmers. In this context, even though a lower proportion of Kenyan women farmers report that they use the internet, this does not necessarily mean that they are less likely to enter into contact with its services. Two critical findings from the thesis provide evidence in this regard.

First, certain difficulties in accessing the internet that are reported by women farmers seem to stem from the fact that ICT devices (e.g. computers) enabling internet access are not considered as devices that could be used in a forum important to them. Findings from the interviews with women farmers provide evidence of the importance of groups for accessing knowledge (cf. Section 8.1). All of the interviewed women belonged to at least one group, in which they participate on a weekly basis. The main rationale for joining groups is to meet family, friends, colleagues and external actors to exchange knowledge, information and at times other resources. According to the interviewed farmers, it is important to be a member of these groups, since they constitute a major mean for accessing agricultural knowledge, and provide a forum for discussing the adoption of new practices.

The census data also show that a higher proportion of women farmers report using internet services in collective spaces in general. Thus, the 2009 census data presented in Chapter 8 show that 45% of women farmers and 44% of men farmers reported that their foremost channels for using internet services were cyber cafés, educational or community centres. Most female farmers use internet services at community and educational centres, whilst male farmers tend to prefer cyber cafés. Thereupon, findings from quantitative data provide strong evidence on the importance of collective spaces among women farmers in Kenya for accessing internet services. There are however differences between sub-groups of women that require some emphasis. Results from Chapter 8 show that attending community centres to use internet services is especially important to women farmers who report never having attended school. These findings re-joins and strengthens some conclusions made in Chapter 7, stressing that education is not enough to reduce the digital gender divide. What can be concluded here is that there is a need to target sub-groups of women and men farmers with different types of services and at dissimilar collective points.

Against this background, collective points, such as community centres, could equally be spaces where female farmers exchange technical knowledge. Parallels can be drawn to the empirical study by Hudson et al. (2017), who show that enabled access to platform technologies among

women farmers in sub-Saharan Africa[152] does not guarantee adoption. They suggest complementing technological innovations with interactive types of methods. One explanation for the omission of such solutions could relate to the fact that internet use is considered an individual activity, as disclosed in certain reports and statistics analysis (International Telecommunication Union 2018a; George et al. 2011). Yet, the research provides strong evidence that internet use, and entering into contact with ICT platforms, could be seen as an activity performed in collective spaces.

Second, the interviewed women farmers seem to manifest a real interest in using the internet and platform services (cf. Chapter 6). However, as previously emphasised, the 2009 census data show that there is a critical education factor (cf. Chapter 7). Proportionately, a more educated (and also younger) part of the female farming population reports using internet services. Here, this could imply that the national education schemes of the Kenyan Government specifically targeting girls and young women in rural areas since in the early 1990s have had a positive impact (Ministry of Education of Kenya 2012).

Hence, a possible point of action that emanates from this analysis is to look into the importance of collective aspects and how women farmers can access ICT platform services in collective spaces (e.g. a community centre), using a computer. There are however other dimensions that matter, as the results show, not only related to access. The issue of interaction and co-production of knowledge came out as specific demands by the interviewed women farmers, which takes us to the last critical point.

9.1.4. The consideration of women in ICT platform services supply: co-production and interaction

In order to have relevant technical content to meet women farmers' demands, the results show that co-production of knowledge and interaction between farmers and extension workers are fundamental. These findings corroborate analyses from studies in the institutional economics of services, providing evidence of the importance of social relations for farm advisory services to be effective (Faure & Compagnone 2011; Davis 2008; Labarthe & Laurent 2011).

Results from Chapter 6 show a discrepancy between the strategy of platforms to design the content of services provided through platforms, and the demands for knowledge co-production by women farmers. In the case of the two platforms that were analysed more in depth, Nafis and APF, there is indeed limited co-construction of services and interaction with respective target groups. Answers from Kenyan women farmer interviewees show nevertheless that the interviewees consider sharing and exchanging knowledge as an economically important resource. Co-production of knowledge through interactive advice is a specific demand (as shown in Chapter 6). The interviewees report that these exchanges most often take place when they attend different types of collective spaces. Moreover, the individual interviews show that women farmers are keen on building interactions with peers. Such organisational patterns could be a specific gate to enter into interactions with knowledge-based platforms. The results from Chapter 8, which provide evidence of the weight of attending collective spaces to use internet services, can further be related to (and strengthen) the findings from section Chapter 6. In this regard, the importance of adequate ICT services and consequently technical content based on women's needs is testified in other research (Somolu 2007; Olatokun 2008). As such, the results support previous research. Furthermore, interviewees at national and Machakos county level

[152] The countries in question are Burkina Faso, Ghana, Tanzania and Uganda.

and platform level confirm that knowledge co-production is important, but there is still limited emphasis on this point in administrative documents[153] and in the two analysed platforms (Nafis and APF). The results from the innovations platform performance rationale analysis show that there is still a source of progress when it comes to gender equality objectives in the types of services and technical content of platforms (cf. Table 6.2, Chapter 6). This essentially concerns the front-office activities of the platforms, and more particularly Kenyan women farmers' demands for interactive advice in groups. There are moreover paths for improvement that especially relate to the back-office work of the two analysed platforms (i.e. Nafis and APF).

In conclusion, connecting to Chapter 2 (the state of the art), the importance of taking into account collective action and shared identities (through values, norms) for economic growth is analysed by regulationists (Jessop & Sum 2006; Boyer 1986). These authors' findings echo results from this thesis, and the fact that this idea can actually be applied in the 'gender relations research framework'. More concretely, it means the qualitative and quantitative evidence that supports the importance of collective spaces for accessing services and exchanging with peers on type of technical content. This is reported by rural Kenyan women farmers (cf. results from the Kenyan census data), and by the interviewed female farmers in Machakos county (n=26). Conclusions therefore point towards the fact that such dimensions should be considered for the construction of relevant advice for women in ICT platforms. Therefore, a point of action for platform designers and investor could be to couple supply and demand, focusing on both the front- and back-office dimension in knowledge-based platforms (i.e. to be inclusive of women farmers' specific demands for knowledge co-construction and interactive advice in collective forums, and possible service modalities).

Section 9.1 outlined certain key conditions for platforms to be inclusive of gender equality objectives. As presented, these correspond to the consideration of gender equality and women farmers' specific demands in service relations. Likewise, the results provide evidence of the fact that ICT development is a new area of public intervention, where innovative practices may be invented. There is however a risk of overlooking the diversity of individual and collective behaviours if statistical data are not analysed with enough knowledge of the actual conditions of the individuals' activities . For this research, it was therefore fundamental to complement quantitative approaches with qualitative analyses to reveal the mechanisms that support or hamper ICT adoption by women farmers in Kenya. Such types of in-depth investigation were also required for social innovations that could support the development of emerging technological paths.

9.2. Theoretical contributions

9.2.1. Advancement of the State of the Art

A number of authors who founded their research on neo-classical economic approaches considered that market-based substitution mechanisms in state intervention in farm advisory services could be inclusive of different socio-economic groups (Baxter 1987; Carney 1995; Dinar 1996; Umali-Deininger & Schwartz 1994). As a result, in the 1990s, governments began to try out various farm advisory approaches (e.g. participatory processes) in partnership with private actors, through mechanisms of decentralisation, privatisation, cost sharing, pluralism, commercialisation, and forms of contracting. However, as later shown by feminist economists

[153] For instance, per the Cooperative Societies Act, the National Agricultural Sector Extension Policy and the Agricultural Sector Development Strategy.

who studied the gendered effects of the structural adjustment programmes[154], these macro-economic changes increased the labour burden weighing on rural women farmers (Ongile 1999; Beneria 1995). Furthermore, results from Elson (1995) show that the economic models underpinning the adjustment policies were based on an implicit gendered structure, and thus disregarded the invisible part of women's work. This therefore led to discriminatory gender patterns.

Hence, had this thesis would been based on neo-classic economics theory, it is likely that the implicit yet present gender dimensions in platforms would have gone unnoticed (for instance, when it comes to: the difference between putting into action concrete gender principles rather than being based on a rhetoric level the institutional dimension of platforms and interplay among actors therein; the importance of collective spaces for knowledge exchange; the fact that equal access to education is not the 'one and only solution' to reduce the gender digital divide). So, combining different heterodox economic approaches reveals insights about the consideration of institutions and institutional forms.

Combining institutional economic approaches allowed us to analyse how institutional developments affect the inclusion of gender equality objectives in policy work. First, regulationists emphasise historically contingent economic and 'extra-economic' mechanisms (Jessop 1995; Jessop & Sum 2006). Extra-economic mechanisms are for instance collective identities and common values. Researchers from this approach analyse the combination of different mechanisms in institutional change that lead economic agents to take a decision at a certain point in time (Petit 2008). Together, these decisions lead to a critical mass of similar opinions, finally having an impact on contemporary structures or showing the need for new institutional developments. Examples are the development of farm advisory models, based on technological innovations that integrate aspects of co-production in collective spaces. In this regard, both quantitative and qualitative findings from this dissertation, especially from Chapters 6 and 8, provide evidence in the importance of these dimensions to female farmers in Kenya.

Second, and as put forward in Chapter 2, there is an inherent link between the economic concepts provided by the regulation approach, and the presentation of gender relations by feminist economists. Defining gender relations as fundamental social relations and shaping economic behaviours would not have been possible without using theoretical concepts and empirical evidence from both feminist economist and regulationist scholars. This step has equally been central to bringing out the implicit gender dimensions in platforms. The examination of the integration of gender equality in ICT policy instruments of the Kenyan Government actually show that this social relation is a type of institution that underpins the organisation of economic activities of this Government. A point of reflection is thus the heuristic value of considering 'gender relations' as a fundamental social relation and as a key institutional form. Per Chapter 2, p. 11): 'Institutions' remains a relatively extensive term, going from habitus and conventions to fundamental constitutional orders, including through laws (Petit 2008). The difficulty is how to navigate through this entanglement of institutions in order to understand how fundamental social relations determine economic structures. Combining this definition with that of 'gender relations' from feminist economists, allowed to actually define 'gender relations' as a key social relation, and consequently to decrypt an intricate reality, and shed light in the implicit gender dimension in ICT policy instruments. As a result, this research demonstrates the inherent link between the economic concepts suggested by the regulation

[154] Which economic models where essentially founded upon mainstreaming economic arguments.

approach and the definition of 'gender relations' developed by feminist economists. Drawing from both economic schools of thought was thus a necessary step in this process.

Three, the results provide evidence in the fact that (a) gender equality objectives are present throughout the administrative framework of the Kenyan Government, and (b) this Government elaborates upon how to achieve gender equality with new institutional developments, i.e. ICT platforms based on multi-actor partnerships. Therefore, based on the results from this thesis, it makes sense to suggest that gender relations should become a major structural form of the regulation research programme. As initially presented in Chapter 2, a structural form is defined as any codification of one or more fundamental social relations (Boyer 1986). This point of reflection converges with the work by the feminist sociologist Barbara Risman (2004[155]), who suggests that gender be conceptualised as a social structure. Risman stresses that such processes would enable the study of how gender is embedded in the individual, interactional and institutional dimensions of society. According to this author, if gender can be conceptualised and thus defined as a social structure, it can be placed at the same level of general social significance as the economy and the polity.

Fourth, results from this thesis show how gender relations are present in technological innovations and services relations in ICT platforms, whether it is explicit or not. Results from the platform performance rationale analysis provide evidence in the importance of conducting an integrated analysis of the five performance registers of services initially developed by (Gadrey & Gallouj 1998; Gallouj et al. 1999) and later by (Labarthe 2006). It reveals on the one hand that performance dimensions are prioritised differently depending on the platform type. On the other hand, this analysis shows that if gender equality objectives are to be implemented in the long-term, actions must go beyond the display of gender equality performance rationales. In this regard, the analysis provides evidence that technological and organisational innovations should be considered jointly to avoid gender inequality. There are two interrelated key points that emanate from the results in this regard. First, the findings give strong indications for considering mutually investing in IT-infrastructure and IT-literacy in collective spaces, which may allow for women farmers to enter into use with ICT platforms. Such arguments corroborate earlier gender studies, namely that gender-bound budgeting, allocated gender equality financial means, and gender equality financial planning are required to put gender principles into action (Moser & Moser 2005; Waal 2010; Woodford-Berger 2004; Debusscher 2011; Bock 2015; Shortall 2015). Second, the interviewed Kenyan women farmers have a specific demand for interaction with peers in groups. With respect to such particular demand, extension workers could be given a key role in both the front- and back-office activities of this emerging advisory system, developed around ICTs. In sum, the evidence brought forward in this research with regard to co-production of technical knowledge and co-construction of advice, followed by farmers' demands for interaction in collective spaces, corroborate previous research in economics of services studies, focusing either on ICT development in farm advisory services (Hudson et al. 2017), on advisory services in general (Labarthe & Laurent 2013a; Prager et al. 2016), or on the tertiary sector (Gadrey 1990; Gadrey & De Bandt 1994; Gadrey & Gallouj 1998; Kuusisto & Viljamaa 2004).

In conclusion, the way in which the articulation of gender relations in the policy work of the Kenyan Government is presented, indicates that this social relation is fundamental. We also see that even though the Kenyan Government has a liberal political economic agenda, they are still

[155] Cited 1,094 times.

‘keeping a controlling hand’ when it comes to certain critical points in this gender-inclusive ICT farm advisory services system. These can also be turned into levers of action.

9.2.2. Levers of action

Section 9.1 reveals four critical points for the inclusion of gender equality dimensions, and women farmers. Consequently, three levers of action for the integration of gender equality in ICT-based farm advisory services[156] have been identified.

At macro-level, the main lever of action concerns the institutional coordination framework in place to ensure that gender equality objectives are integrated into ICT policy instruments and thus into policy work. Undeniably, institutional coordination mechanisms are key when public policy objectives are at stake. A coordination framework allows us to adjust the supply of knowledge in farm advisory services, methods and devices to farmers’ demands, as reported in other studies (Poulton et al. 2010; Laurent et al. 2006). In this regard, front-office and back-office work take place in coordination bodies (as demonstrated in Chapter 5 and 6). In this context, the results show the importance of an institutional coordination framework of ICT development for the inclusion of gender equality objectives. The establishment of a coordination structure in farm advisory services, to build relevant advice, is acknowledged in policies of the Kenyan Government. Figure 4.1 (Chapter 4) provides evidence that the Kenyan Government makes substantial efforts to include gender equality objectives in the institutional farm advisory services coordination system. The role of these coordination structures is to ensure that farmers receive access to services and adequate technical knowledge, and therefore to ensure continuous interaction between public extension officers and farmers. Figure 4.2 (Chapter 4) shows that the Kenyan Government elaborates on how to organise and finance institutional coordination structures and a large network of farm advisors in this emerging ICT-based services system. I could however not find evidence of the role of respective stakeholders in this process (and at these levels). Can there thus be a risk for an emerging knowledge gap for women farmers if gender equality objectives are not integrated throughout the entire coordination process? Parallels could be drawn with the conceptual paper by Borrás & Edquist (2013), who analyse the effects of ill-planned knowledge-based dissemination systems via ICTs. The authors are of the point of view that poorly outlined coordination structures in back-office activities can lead to unexpected outcomes, creating knowledge gaps in certain communities. One assumption made by the authors is that it creates socio-economic disparities among different target groups. Against this background, analyses reveal the importance of having a space of intervention and coordination in this emerging farm advisory system, if it is to be inclusive of gender equality goals.

The meso-level, or platform level, concerns on the one hand the ‘upper level’ of service relations and on the other, the ‘lower level’ of services relations (cf. Chapter 2 on the presentation of Gadrey's (1990) model). The ‘upper level’ refers to the integration of gender equality in knowledge-based platforms supported by public policies and the ‘lower level’ to the consideration of women in the technical content of knowledge-based platforms. At this stage, there are two points of action that are closely interlinked, namely the coupling of front- and back-office activities for the integration of gender equality goals, and strategic actions in the ICT advisory services system. The analysis of the platform performance rationale analysis shows that gender equality objectives are present to some extent in the services of the two

[156] The research analysis is based on four conceptual foundations, and has revealed specific levers of action for each foundation.

platforms analysed more in depth[157,158]. At this level moreover, an important and interwoven point of action that has been raised throughout this research concerns the financial structures of platforms and assured financial means to guarantee the long-term sustainability of this new ICT system. This should however not be done at the expense of the civic performance rationale of a farm advisory system primarily using ICTs as a main service structure.

At farmer level, a lever for action that may enable women farmers to access knowledge-based platform services is the mediating role that could be given to extension workers. Analyses show that farm advisors could be given this new role in the ICT-based extension system in Kenya. The interviewed extension workers demand to be part of the co-construction of technical content of platforms, and to supply farmers with knowledge through an interactive dialogue. Collective points could become forums where extension workers and farmers discuss of the technical content offered by platforms. Results from Chapter 8 show furthermore that the investment in computers at collective points may allow women farmers to use platform services. Hence, and as emphasised at policy level, there is an important investment factor. The extension officers in the Kenyan advisory system can also be given a larger role in the organisation of back-office activities of these instruments, which joins the lever of action at 'upper level' of service relations.

9.2.3. Avenues for future research

9.2.3.1. Institutional economic approaches allow us to analyse how institutional developments affect the inclusion of gender equality goals

As previously emphasised, 'gender relations' are context bound. The integration of gender equality dimensions in policy work depends on how a government values gender equality. This thesis explored the robustness of conceptualising 'gender relations' as major fundamental social relations, and finally an institutional form, inspired by the definition of a structural form by the regulation research programme. Thus, taking it one step further would be to carry out comparative studies between two (or more) developing nations having different political and economic systems, for instance, Kenya and Tanzania. Kenya has since the 1980s applied a rather liberal agenda and adopted quite a number of economic instruments proposed via the Washington Consensus (based on a self-regulating market model). On the other hand, Tanzania first adopted a more protectionist political and economic agenda, but which is now also based on liberalised ideas. Even so, the socio-economic context and how the intimal political-economic agenda has shaped Tanzanian society may differ from that of the Kenyan society.

It would thus be of relevance to compare the integration of gender equality in the extension services system between two nations having different political and economic systems in place. This could be done in four successive phases: first, by determining the role of the state in the farm advisory system (e.g. if the state opts for a disengagement from national funding and management of advisory services or the opposite; promotion PPPs or not, etc.); second, by providing evidence of the historic changes of farm advisory services and thus of their transformation, based on policy analysis (i.e. regarding front- and back-office activities, the use of ICTs, etc.); third, by considering how the demands of women and men farmers are taken into

[157] For example, the Nafis staff confirm cooperating with the Ministry of Gender on questions of gender equality integration in platform activities and technical content.
[158] For instance, the APF platform has gender-bound financial reporting procedures for the knowledge base that is gender specific.

consideration with respect to the role of the government in this system. As a last step, it would be relevant to conduct a comparative analysis of the impacts upon the economic performance of a state when objectives of gender equality are inadequately considered. Coming back to Risman's (2004) hypothesis, this would allow the insertion of gender equality objectives and concrete points of action in the interactional and institutional dimensions of society to be analysed. In that sense, conducting such types of analysis would contribute to the state of the art in both feminist (social and economic) theories and institutional economic regulation theory, and thus to pluridisciplinary research. Moreover, such type of analysis could allow to identify: (a) the mechanisms of inclusion/exclusion, and in turn understand the economic and political behaviour of different actors; followed by (b) the modes of action.

9.2.3.2. Can ICT platforms contribute to a technological lock-in situation?

Access to knowledge-based platforms can be solutions for providing technical support to farmers. I have analysed platform development in Kenya. Findings show that for some of the analysed platforms, the civic performance rationales (and thus gender equality objectives) could become deprioritised over financial performance rationales. As a result, they could be sources of gender inequality. This is partly because platforms must benefit investors. Such actors may provide services via platforms on the basis of economic models where costs of services are integrated into product prices. If so, the interests at stake have effects on the type of technical content in farm advisory services. This implies that ICT platforms based on multi-actor partnerships might enforce dependency patterns of certain agricultural inputs manufactured by international actors, for instance agrochemicals and chemical fertilizers. Hence, are emerging ICT devices, used to disseminate agricultural knowledge in farm advisory services, contributing to a technological 'lock-in' situation?

Findings show that there are political and economic stakes with regard to the reduction of agrochemicals in developing countries. The dissemination of knowledge via ICTs (and the internet) present increased opportunities for the agroindustry to promote their products, through agricultural extension services. They can also do so via outsourced public extension staff or internally developed services, which implies that the agricultural service is integrated into the agricultural good. Thus, after a first stage of investigation where I identified and analysed different institutional patterns of platforms, an interesting research project could be to understand how these patterns will impact the content of the knowledge that is made available to users. It would be based on the hypothesis that there are implicit properties within these ICT policy tools, which reflect the economic priorities of involved stakeholders, thus contributing to a technological lock-in situation. Such research could be based on a comparative case study between different institutional platform types present in Kenya. It would thus analyse the aspect of technical content lock-in favoured by ICT platforms from an institutional economics standpoint, and based on the hypothesis that multi-actor partnerships could enforce a lock-in into a high level input agricultural development models. More concretely, one could conduct such study firstly examining the economic models of platforms economic, followed by an analysis of the link between technical content and platforms' economic models.

9.3. *To conclude:* ICT platforms in advisory services intervention are always gendered

Finally, whether deliberate or not, the examined ICT knowledge-based platforms and their relations therein comprehend a gendered structure, i.e. in the sense that everything is about gender relations. For instance, if we go back to the performance rationale analysis in Chapter 6, the services and technical content of the examined ICT platforms have been designed according to the types of gender relations that designers and donors have in mind. Thus, applying an institutional approach allowed us to identify the conditions for knowledge-based platforms to be inclusive of gender equality objectives and thus of women farmers' demands in Kenya. All in all, ignoring these particularities may exclude female farmers from benefiting from the opportunities that knowledge-based platforms could generate. On another note, taking them into account via policy work could turn ICT platforms in advisory services intervention into a vector of inclusion to this group of agricultural producers.

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Appendix 1: Systematic review of the economic literature on knowledge-based platform development

Research questions

Research question 1
Are internet knowledge-based platforms inclusive?

Research question 2
Are ICT-based technologies in agriculture and in particular knowledge-based platforms inclusive?

Research question 3
Are ICT-based technologies and in particular knowledge-based platforms supplying any type of service, inclusive?

Research question 4
Are ICT-based technologies and in particular knowledge-based platforms used in farm advisory services intervention, inclusive?

Research question 5
Are ICT-based technologies in agriculture and in particular knowledge-based platforms producing a new divide between farm women and men?

Scientific databases

EconLit
EconLit is the main database that I used for the systematic review given that my research is in economics. I classified each word composition as "in abstract". Only scientific articles have been selected.

Web of Science
The Web of Science (WOS) database was used as complementary database. I obtained some articles from the WOS database because it is a pluridisciplinary database. I classified each word composition as "in topic". With this said, a high number of the papers are not relevant in the context of this research (e.g. biology, engineering, chemistry). Hence, for research query 1, 2, 3 and 4, papers in WOS have not been considered. Only scientific articles have been selected.

Google Scholar
Any grey literature esteemed necessary to complete this review of the literature comes from the Google Scholar database.

Inclusion criteria

Research fields	Relevant	Not relevant
R1		

Type of platform	Papers defining or conceptualising a knowledge-based platform as a device that ensures access to knowledge content and provide different functions for a given sector. These functions are (i) a shared repository for various types of cognitive resources; (ii) a virtual space or forum where (a) knowledge suppliers and users can interact and (b) criteria for assessing the knowledge quality may be discussed, stored, and disseminated. In complement, it can also be used as a gateway, providing access to other types of resources, including links to other websites and services.	Papers defining or conceptualising knowledge-based platforms as a portal and not supplying services or knowledge. Any paper that analyses any other type of "platform" (e.g. oil platforms, train platforms, electoral platforms, export platforms, military platform, etc.) or papers that examine platform development from an engineering point of view (e.g. programming, computing, software development, etc.). Any paper that defines platforms as innovation platforms that are not internet / online based.
Target groups of platforms	Papers examining the potential of platforms in including different social groups, conducted at individual level.	Papers examining the potential of platforms in addressing the needs of organisations.
R2		
Agriculture or farm	Papers emphasising on the question of knowledge content with focus on agriculture (e.g. advice and knowledge on different agricultural value chains, agricultural practices or crop systems, livestock systems).	Papers that do not target the agricultural sector.
R3		
Advice or service	Papers that examine the question of service activities whose objective is to accompany changes among different social groups in society through the production of knowledge by establishing relationships between advisors and individuals in need of the service.	Papers that does not study the question of service provision.
R4		
Advice or service	Papers that examine the question of service activities whose objective is to accompany technical changes in farmers' practices or production systems through the production of knowledge by establishing relationships between advisors and farmers.	Papers that does not study the question of service provision in the agricultural sector.
Target groups of platforms	Papers examining the potential of platforms in including different social groups at individual level working in the agricultural sector.	Papers examining the potential of platforms at addressing the needs of organisations in the agricultural sector.
R5		

Gender	Papers that are examining if gender is in any way related to/impacted by ICTs and especially knowledge-based platform development in agriculture and vice versa. Papers that analyses if ICTs and especially knowledge-based platforms in agriculture are: (1) Contributing to the digital gender divide. (2) Altering the profession of female and male farmers.	Papers that do not comprehend a gender dimension.

Quality criteria for the selected articles

Quality criteria for conceptual papers

1. Is/are the research question(s) clearly stated/written out in regards to the title of the article?
2. Does the article fulfil its stated aim/objective? For instance, does the findings concur with the stated aim/objective?
3. If it is a paper conducting a literature review, is the review thoroughly conducted and replicable?
4. Is the methodology adapted to the article objective and title?
5. Are the results clearly, meticulously and objectively presented?
6. Are the conclusions validated and come back to the state of the art?
7. Is the impact of the article considerable within this field of reflection?
8. If the findings and conclusions in the paper could appear as biased, has the paper been peer reviewed by a third party to cross-verify results and conclusions?

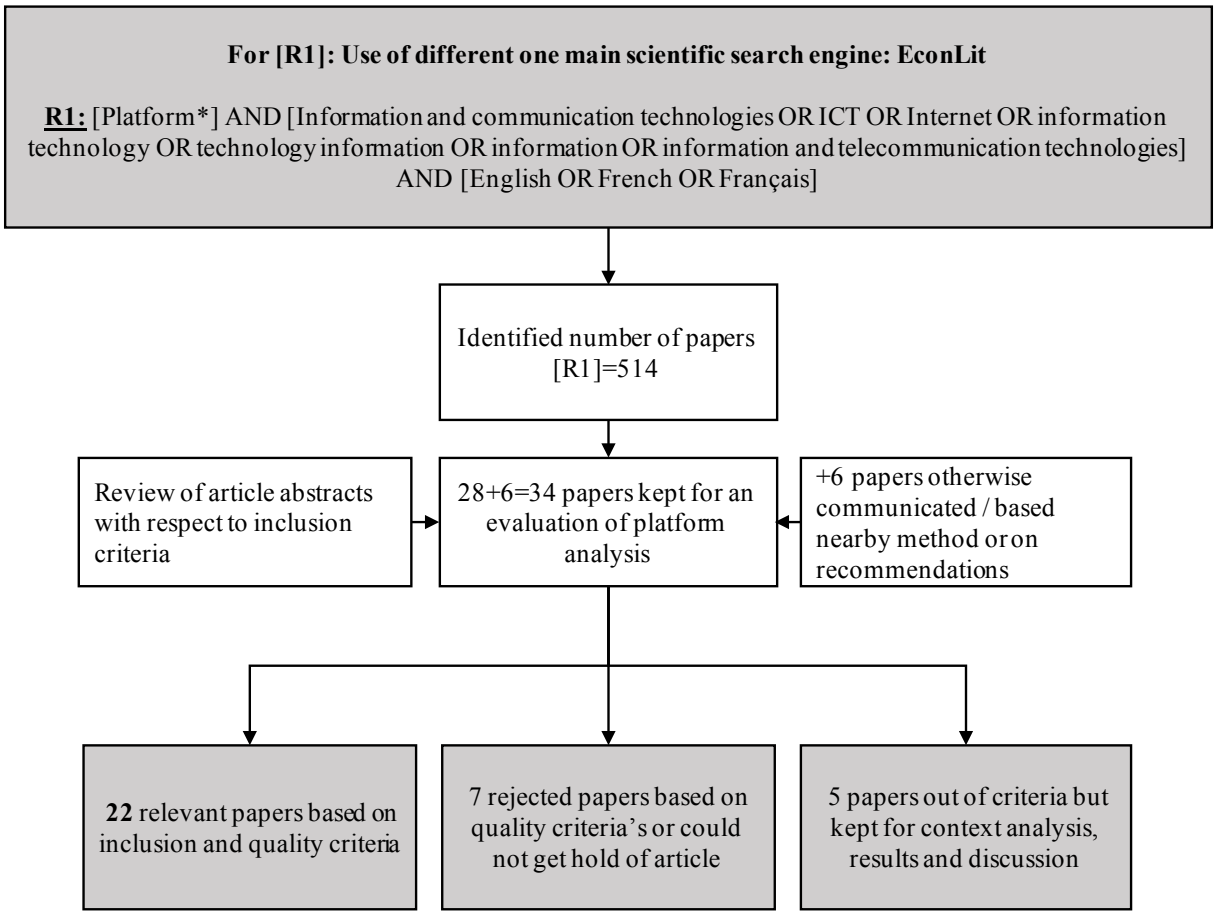
Quality criteria for empirically based papers

1. Is/are the research question(s) clearly stated/written out in regards to the title of the article?
2. Does the article fulfil its stated aim/objective? For instance, does the findings concur with the stated aim/objective?
3. Is the review of the literature thoroughly conducted, transparent and replicable?
4. Is the methodology adapted to the article objective and title?
    a. If adequate, is the sampled group clearly identified?
    b. If adequate, is the control group clearly identified?
    c. If adequate, is the sample size adapted to the study?
    d. If adequate, are the analysed variables clearly identified?
    e. If adequate, is the choice of variables consistent with/adapted to the objective?
    f. If adequate, are the statistical methods appropriate?
5. Are the results clearly, meticulously and objectively presented?
6. Are the conclusions validated and come back to the state of the art?
7. Is the impact of the article considerable within this field of reflection?
8. If the findings and conclusions in the paper could appear as biased, has the paper been peer reviewed by a third party to cross-verify results and conclusions?

Articles kept for reading

Research query 1

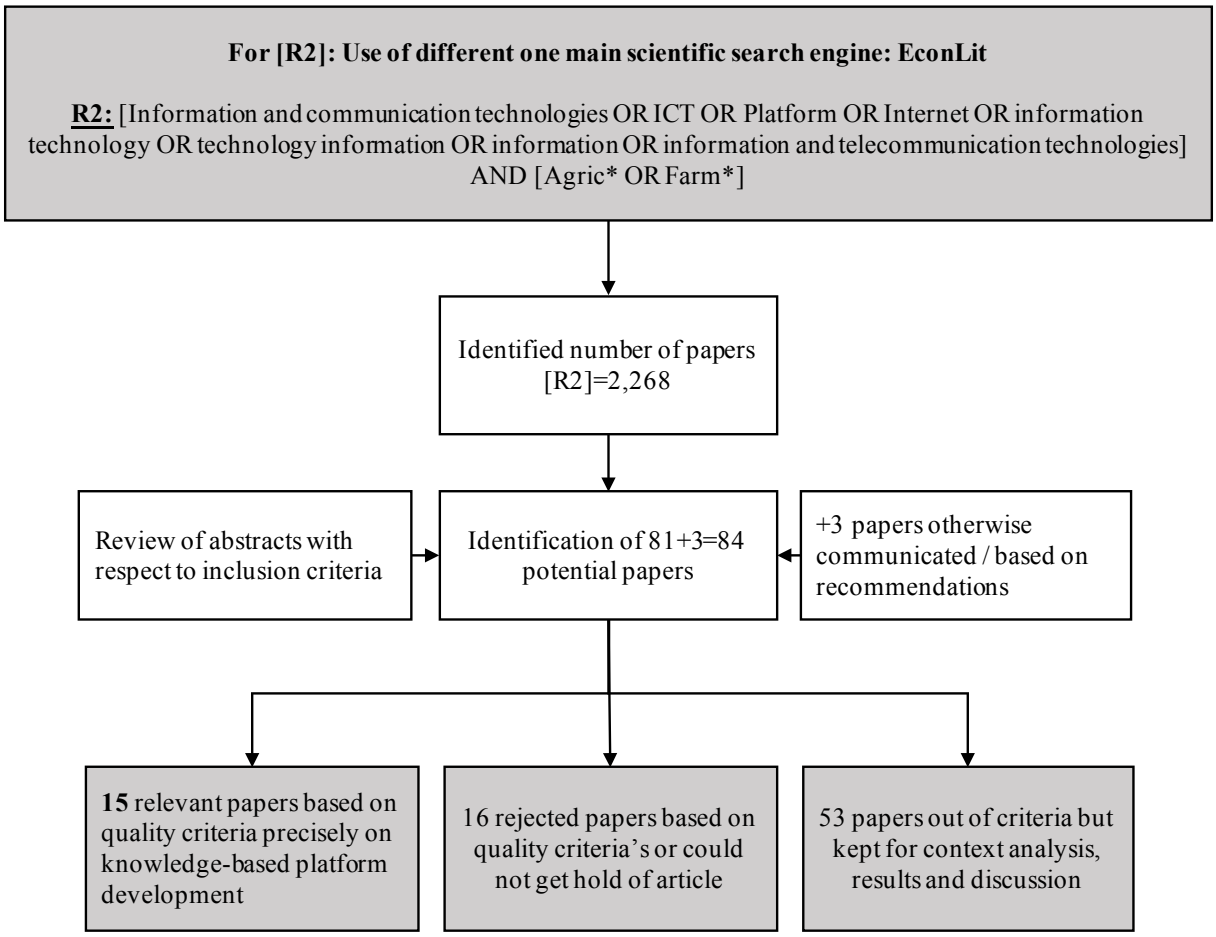
Based on research question 1, the inclusion and quality criteria, 22 publications in research query [R1] are considered relevant and have thus been selected. The following figure summarises the different steps of the selection process (Figure 1). In total, the 22 documents that answers to the inclusion and quality criteria are scientific. 5 papers have been kept as relevant but out of criteria.



Appendix 1 Figure 1: Selection process for [R1].

Research query 2

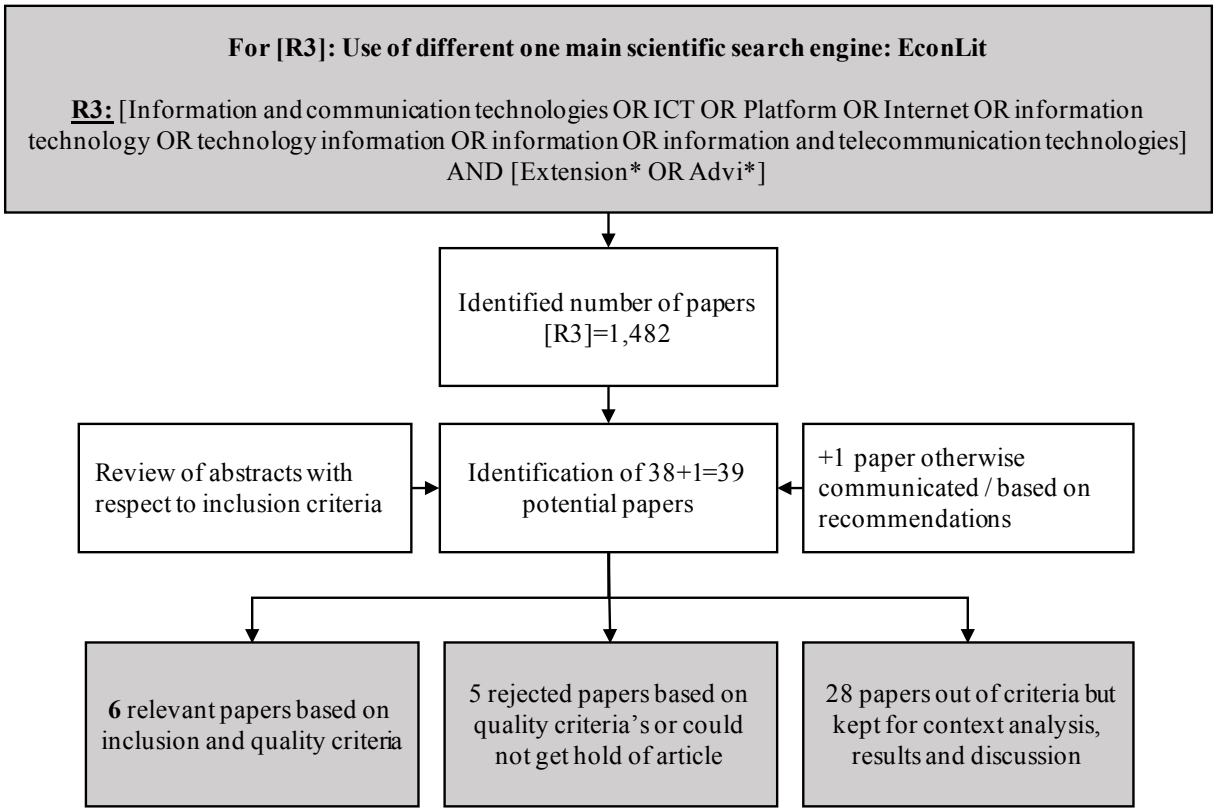
Based on research question 2, the inclusion and quality criteria, 15 publications in research query [R2] are considered relevant and have thus been selected. Figure 2 summarises the different steps of the selection process. In total, 13 documents that answers to the inclusion and quality criteria are scientific and 2 papers are considered as grey literature. 53 papers have been kept as relevant although out of criteria.



Appendix 1 Figure 2: Selection process for [R2].

Research query 3

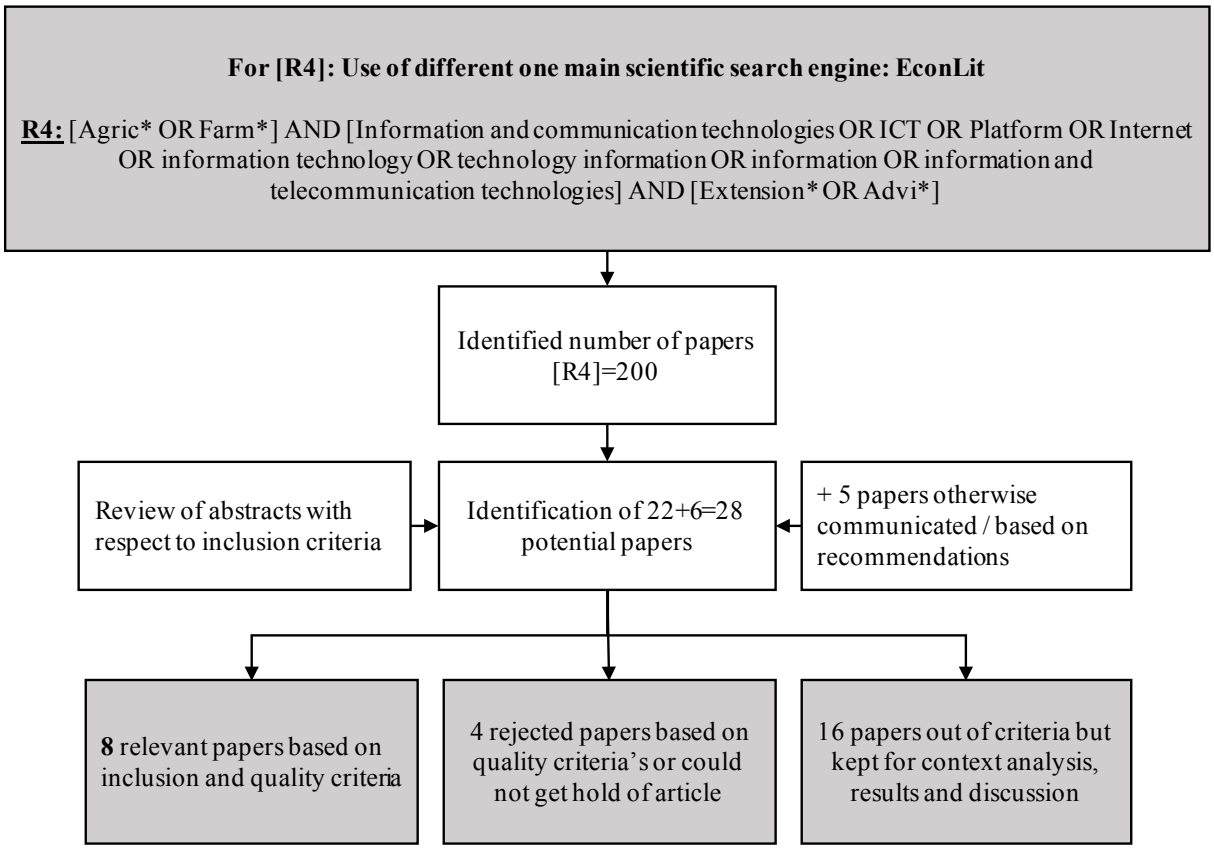
Based on research question 3, the inclusion and quality criteria, 6 publications in research query [R3] are considered relevant and have thus been selected. Figure 3 summarises the different steps of the selection process. All 6 documents that answer to the inclusion and quality criteria are scientific. 28 papers have been kept as relevant although out of criteria.



Appendix 1 Figure 3: Selection process for [R3].

Research query 4

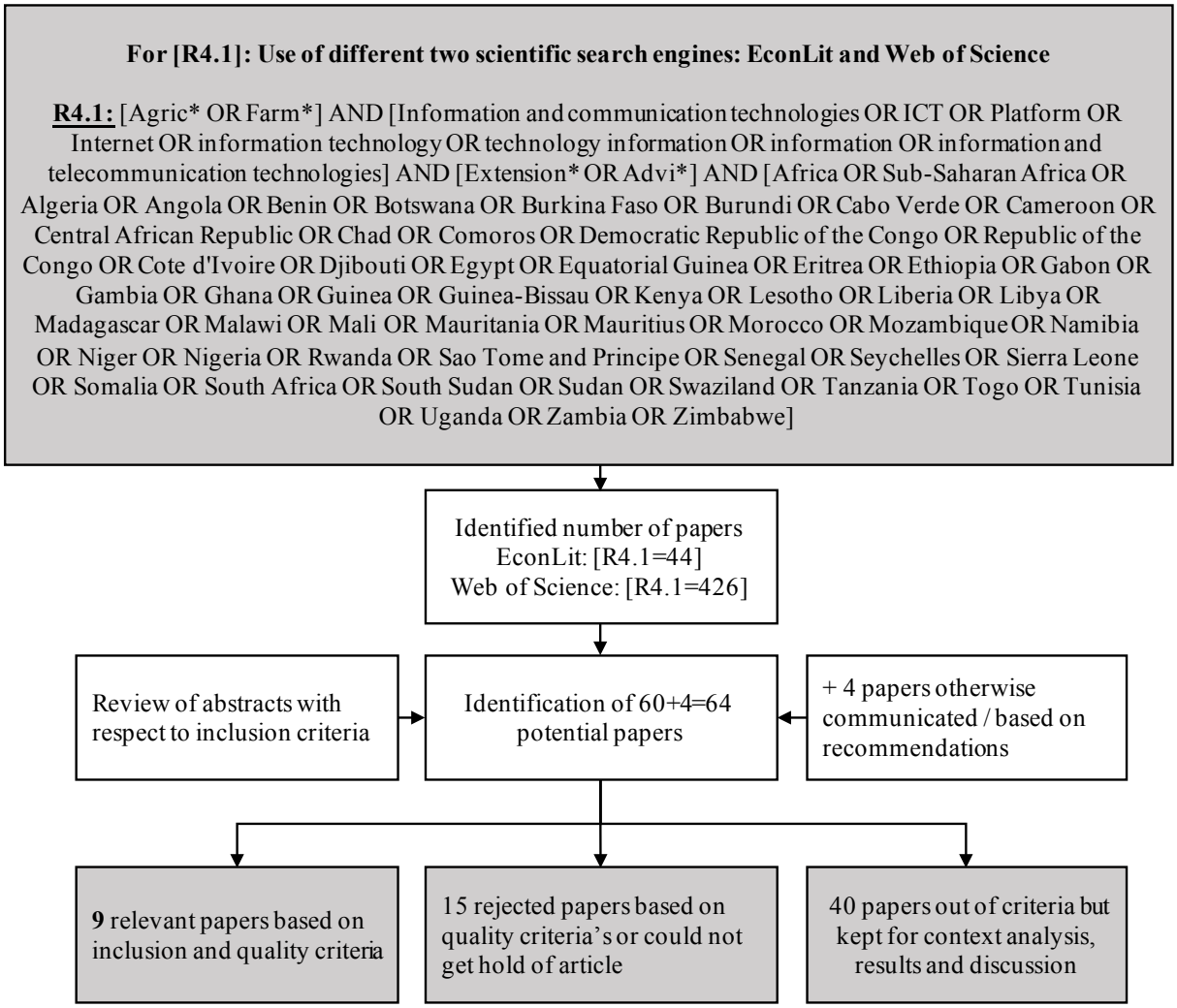
Based on research question 4, the inclusion and quality criteria, 8 publications in research query [R4] are considered relevant and have thus been selected. Figure 4 summarises the different steps of the selection process. In total, 6 documents that answer to the inclusion and quality criteria are scientific and 2 papers are classified as grey literature. 16 papers have been kept as relevant although out of criteria.



Appendix 1 Figure 4: Selection process for [R4].

Research 4.1

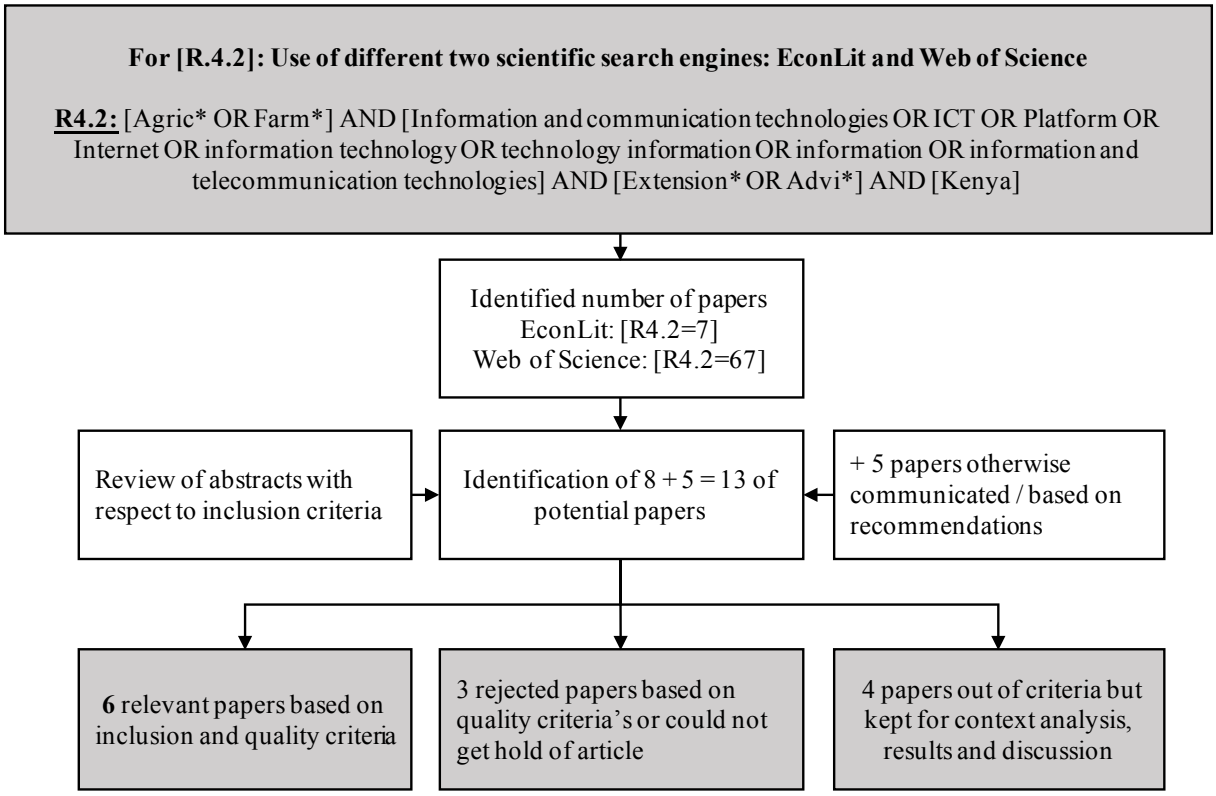
Based on the quality criteria, 9 publications in research areas [R4.1] are considered relevant and have thus been selected. Figure 5 summarises the steps of the selection process. In total, among the 9 documents that answers to the inclusion criteria, 7 are scientific articles and 2 are classified as grey literature. Duplicates from the two databases have been removed. 40 papers have been kept as relevant but out of criteria (i.e. they do not treat of knowledge-based platforms in sub-Saharan Africa or in Kenya).



Appendix 1 Figure 5: Selection process for [R4.1].

Research 4.2

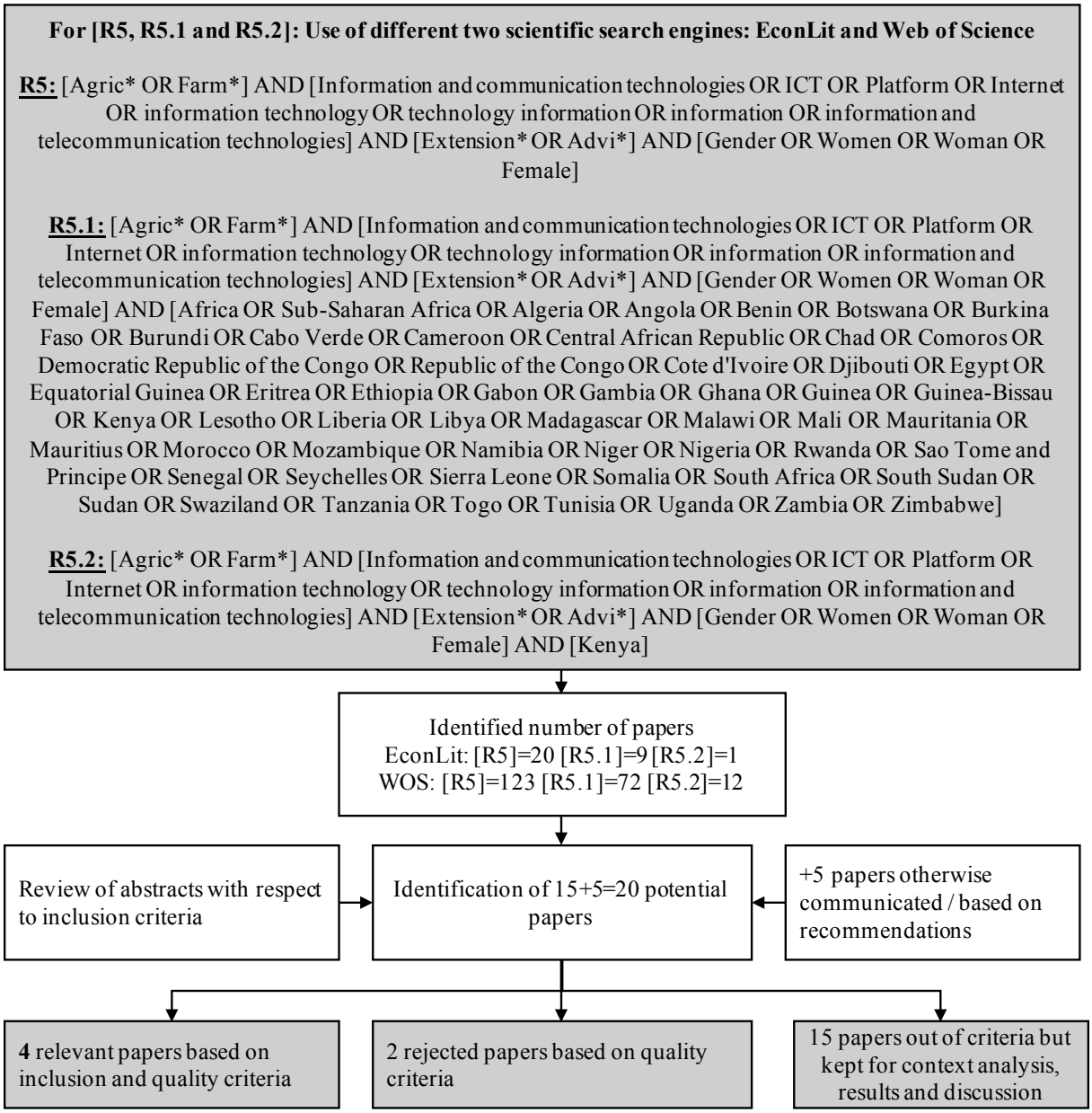
Based on the quality criteria, 6 publications in research areas [R4.2] are considered relevant and have thus been selected. Figure 6 summarises the steps of the selection process. In total, among the 6 documents that answers to the inclusion criteria, 4 are scientific articles and 2 are classified as grey literature. Duplicates have been removed between the two scientific databases. 4 papers have been kept as relevant but out of criteria (i.e. they do not treat of knowledge-based platforms in Kenya).



Appendix 1 Figure 6: Selection process for [R4.2].

Research 5, 5.1 and 5.2

5 publications in research areas [R5], [R5.1] and [R5.2] are considered relevant and have thus been selected based on the quality criteria. The steps of the selection process are summarised in Figure 7. In total, among the 4 scientific articles that answers to the inclusion criteria. Duplicates from [R5], [R.5.1] and [R5.2] have been removed within and between the two scientific databases. 15 papers have been kept as relevant but out of criteria (i.e. they do not treat of knowledge-based platforms and gender).



Appendix 1 Figure 7: Selection process for [R5], [R5.1] and [R5.2].

Research method and identification of references

- Search engines

Main search engine: EconLit
Complementary search engines: Web of Science and Google Scholar (the latter is only for grey literature esteemed highly relevant)

- Research queries

In total, there are five main research queries. Research query number 4 and 5 comprehends two sub-research queries, specifying the papers in platform development in a particular geographical area.

Research 1 (R1)
[Platform*] AND [Information and communication technologies OR ICT OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies OR knowledge OR learn* OR exchang* OR collective] AND [English OR French OR Français]

Research 2 (R2)
[Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Agric* OR Farm*]

Research 3 (R3)
[Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Extension* OR Advi*]

Research 4 (R4)
[Agric* OR Farm*] AND [Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Extension* OR Advi*]

Research 4.1 (R4.1)
[Agric* OR Farm*] AND [Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Extension* OR Advi*] AND [Africa OR Sub-Saharan Africa OR Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cabo Verde OR Cameroon OR Central African Republic OR Chad OR Comoros OR Democratic Republic of the Congo OR Republic of the Congo OR Cote d'Ivoire OR Djibouti OR Egypt OR Equatorial Guinea OR Eritrea OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR Sao Tome and Principe OR Senegal OR

Seychelles OR Sierra Leone OR Somalia OR South Africa OR South Sudan OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR Zambia OR Zimbabwe]

Research 4.2 (R4.2)
[Agric* OR Farm*] AND [Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Extension* OR Advi*] AND [Kenya]

Research 5 (R5)
[Agric* OR Farm*] AND [Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Extension* OR Advi*] AND [Gender OR Women OR Woman OR Female]

Research 5.1 (R5.1)
[Agric* OR Farm*] AND [Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Gender OR Women OR Woman OR Female] AND [Africa OR Sub-Saharan Africa OR Algeria OR Angola OR Benin OR Botswana OR Burkina Faso OR Burundi OR Cabo Verde OR Cameroon OR Central African Republic OR Chad OR Comoros OR Democratic Republic of the Congo OR Republic of the Congo OR Cote d'Ivoire OR Djibouti OR Egypt OR Equatorial Guinea OR Eritrea OR Ethiopia OR Gabon OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR Sao Tome and Principe OR Senegal OR Seychelles OR Sierra Leone OR Somalia OR South Africa OR South Sudan OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR Zambia OR Zimbabwe]

Research 5.2 (R5.2)
[Agric* OR Farm*] AND [Information and communication technologies OR ICT OR Platform OR Internet OR information technology OR technology information OR information OR information and telecommunication technologies] AND [Extension* OR Advi*] AND [Gender OR Women OR Woman OR Female] AND [Kenya]

- Date from where the research queries begin

01/01/1980 to present year

- The most recent database query date

21/01/2018

- Type of papers that have been selected

Papers who treat of knowledge-based platforms as defined in the inclusion criteria table.

- Population types

Individuals who are potential users of knowledge-based platforms.

- Selection of the kept papers

The papers were selected based on the research queries in the summary for EconLit, title and summary for Web of Science and based on the inclusion criteria. Some grey literature was selected from the Google Scholar database, based on the inclusion criteria.

- Exclusion criteria

Papers were rejected for different reasons. In first, papers not treating of knowledge-based platforms was the first and most important exclusion criteria. Nonetheless, a high number of papers are considered relevant for the context analysis, results and discussion of the thesis. In second, papers that was not found to be relevant with regards to the research questions and quality criteria assessment. In third, papers that was not (1) in English, French or Swedish or (2) accessible to the author.

- Results

After removal of duplicates between the different research queries, I was able to gather 40 papers treating of knowledge-based platform development. 38 papers are scientific articles and 2 are classified as grey literature. Among these 40 papers, 30 articles or reports are on analyses in developing countries. 20 and 9 articles either cover or treats of African countries or Kenya respectively. Moreover, all 20 papers on platform development in African countries deal with agriculture (in exception of the paper of Maarleveld & Dabgbégnon (1999) dealing with fishery management). It is also the case for the 9 papers based on Kenya as case study.

With this said, papers in Spanish were rejected and as a result, there are most probably a number of papers on platform development in agriculture that have not been considered from Latin America. The same goes for papers dealing with platform development in Chinese, Russian or any other language. Moreover, the research queries were only conducted in English.

<u>Research query 1 was made using the EconLit research engine.</u>

Research query 1 generated in January 2018 a total of 796 scientific articles.

A total of 22 papers were classified as relevant and kept for the research. All papers are scientific articles.

<u>Research query 2 was made using the EconLit research engine.</u>

Research query 2 generated in January 2018 a total of 2,268 scientific articles.

A total of 15 papers were classified as relevant and kept for the research. 13 of these papers are scientific articles and 2 are classified as grey literature.

<u>Research query 3 was made using the EconLit research engine.</u>

Research query 3 generated in January 2018 a total of 1,482 scientific articles.

A total of 6 papers were classified as relevant and kept for research query 3, whereby all papers are scientific articles.

Research query 4 was made using the EconLit research engine.

Research query 4 generated in January 2018 a total of 200 scientific articles.

A total of 8 papers were classified as relevant and kept for the research. 6 of these papers are scientific articles and 2 are classified as grey literature.

Research query 4.1 was made using the EconLit and Web of Science research engine.

Research query 4.1 generated in January 2018 a total of 44 articles from EconLit and 426 articles from Web of Science.

After removal of duplicates among the two databases, a total of 9 papers were classified as relevant and kept for the research. 7 of these papers are scientific articles and 2 are classified as grey literature.

Research query 4.2 was made using the EconLit and Web of Science research engine.

Research query 4.2 generated in January 2018 a total of 7 articles from EconLit and 67 articles from Web of Science.

After removal of duplicates among these two research queries (although not with respect to research query 1 to 4), a total of 6 papers were classified as relevant and kept for the research. 4 of these papers are scientific articles and 2 are classified as grey literature.

Research query 5, 5.1 and 5.2 was made using the EconLit and Web of Science research engine.

Research query 5 generated in January 2018 a total of 20 articles from EconLit and 123 articles from Web of Science.

Research query 5.1 generated in January 2018 a total of 9 articles from EconLit and 72 articles from Web of Science.

Research query 5.2 generated in January 2018 a total of 1 article from EconLit and 12 articles from Web of Science.

After removal of duplicates among these three research queries, a total of 4 scientific articles were classified as relevant and kept for the research.

List of kept references

Research query 1

In total, 22 references kept as relevant with respect to knowledge-based platform development in research query 1.

1. Aker, J. C., Ghosh, I., & Burrell, J. (2016). The promise (and pitfalls) of ICT for agriculture initiatives. *Agricultural Economics, 47*(S1), 35–48. http://doi.org/10.1111/agec.12301
2. Aulkemeier, F., Paramartha, M. A., Iacob, M.-E., & van Hillegersberg, J. (2016). A Pluggable Service Platform Architecture for E-Commerce. *Information Systems and E-Business Management*, *14*(3), 469–489. Retrieved from http://link.springer.com/journal/volumesAndIssues/10257
3. Blanc, A. K., Glazer, K., Ofomata-Aderemi, U., & Akinfaderin-Agarau, F. (2016). Myths and Misinformation: An Analysis of Text Messages Sent to a Sexual and Reproductive Health Q&A Service in Nigeria. *Studies in Family Planning*, *47*(1), 39–53. Retrieved from http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291728-4465/issues
4. Courtois, P., & Subervie, J. (2015). Farmer Bargaining Power and Market Information Services. *American Journal of Agricultural Economics*, *97*(3), 953–977. Retrieved from http://ajae.oxfordjournals.org/content/by/year
5. Fafchamps, M., & Minten, B. (2012). Impact of SMS-Based Agricultural Information on Indian Farmers. *World Bank Economic Review*, *26*(3), 383–414. Retrieved from http://wber.oxfordjournals.org/content/by/year
6. Goyal, A. (2010). Information, Direct Access to Farmers, and Rural Market Performance in Central India. *American Economic Journal: Applied Economics*, *2*(3), 22–45. Retrieved from http://www.aeaweb.org/aej-applied/
7. Karippacheril, T. G., Nikayin, F., de Reuver, M., & Bouwman, H. (2013). Serving the Poor: Multisided Mobile Service Platforms, Openness, Competition, Collaboration and the Struggle for Leadership. *Telecommunications Policy*, *37*(1), 24–34. Retrieved from http://www.sciencedirect.com/science/journal/03085961
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12. Maarleveld, M., & Dangbegnon, C. (1999). Managing Natural Resources: A Social Learning Perspective. *Agriculture and Human Values*, *16*(3), 267–280. Retrieved from http://link.springer.com/journal/volumesAndIssues/10460
13. Meisel, J. (2007). The Emergence of the Internet to Deliver Video Programming: Economic and Regulatory Issues. *Info*, *9*(1), 52–64. Retrieved from http://www.emeraldinsight.com/journals.htm?issn=1463-6697
14. Ogutu, S. O., Okello, J. J., & Otieno, D. J. (2014). Impact of Information and Communication Technology-Based Market Information Services on Smallholder Farm Input Use and Productivity: The Case of Kenya. *World Development*, *64*, 311–321. Retrieved from http://www.sciencedirect.com/science/journal/0305750X
15. Peters, M. A., & Heraud, R. (2015). Toward a Political Theory of Social Innovation: Collective Intelligence and the Co-creation of Social Goods. *Journal of Self-Governance and Management*

Economics, *3*(3), 7–23. Retrieved from http://www.addletonacademicpublishers.com/contents-jgme
16. Purvis, R. L., Sambamurthy, V., & Zmud, R. W. (2001). The Assimilation of Knowledge Platforms in Organizations. *Organization Science*, *12*(2), 117–135. http://doi.org/10.1287/orsc.12.2.117.10115
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19. Steins, N. A., & Edwards, V. M. (1999a). Platforms for Collective Action in Multiple-Use Common-Pool Resources. *Agriculture and Human Values*, *16*(3), 241–255. Retrieved from http://link.springer.com/journal/volumesAndIssues/10460
20. Steins, N. A., & Edwards, V. M. (1999b). Synthesis: Platforms for Collective Action in Multiple-Use Common-Pool Resources. *Agriculture and Human Values*, *16*(3), 309–315. http://doi.org/10.1023/A:1007591401621
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22. Zack, M. H. (1999). Managing Codified Knowledge. *Sloan Management Review*, *40*(4), 45–58.

Research query 2

In total, 15 references kept as relevant with respect to knowledge-based platform development in research query 2. The 13 scientific papers are:

1. Aker, J. C. (2011). Dial A for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics, 42*(6), 631–647. http://doi.org/10.1111/j.1574-0862.2011.00545.x
2. Aker, J. C., Ghosh, I., & Burrell, J. (2016). The promise (and pitfalls) of ICT for agriculture initiatives. *Agricultural Economics*, *47*(S1), 35–48. http://doi.org/10.1111/agec.12301
3. Courtois, P., & Subervie, J. (2015). Farmer Bargaining Power and Market Information Services. *American Journal of Agricultural Economics*, *97*(3), 953–977. Retrieved from http://ajae.oxfordjournals.org/content/by/year
4. Deichmann, U., Goyal, A., & Mishra, D. (2016). Will digital technologies transform agriculture in developing countries? *Agricultural Economics*, *47*(S1), 21–33. http://doi.org/10.1111/agec.12300
5. Fafchamps, M., & Minten, B. (2012). Impact of SMS-Based Agricultural Information on Indian Farmers. *World Bank Economic Review*, *26*(3), 383–414. Retrieved from http://wber.oxfordjournals.org/content/by/year
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11. Nakasone, E., & Torero, M. (2016). A Text Message Away: ICTs as a Tool to Improve Food Security. *Agricultural Economics*, *47*(S1), 49–59. http://doi.org/10.1111/agec.12314
12. Ogutu, S. O., Okello, J. J., & Otieno, D. J. (2014). Impact of Information and Communication Technology-Based Market Information Services on Smallholder Farm Input Use and Productivity: The Case of Kenya. *World Development*, *64*, 311–321. Retrieved from http://www.sciencedirect.com/science/journal/0305750X
13. Okello, J. J., Kirui, O. K., Gitonga, Z. M., Njiraini, G. W., & Nzuma, J. M. (2014). Determinants of Awareness and Use ICT-Based Market Information Services in Developing-Country Agriculture: The Case of Smallholder Farmers in Kenya. *Quarterly Journal of International Agriculture*, *53*(3), 263–282. Retrieved from http://www.agrar.hu-berlin.de/fakultaet/departments/daoe/publ/qjia/contents/standardseite

The 2 papers classified as grey literature are:

1. George, T., Bagazonzya, H., Ballantyne, P., Belden, C., Birner, R., Castello, R., … Treinen, S. (2011). *ICT in Agriculture. Connecting Smallholders to Knowledge, Networks, and Institutions*. The World Bank. Washington D.C.
2. The Food and Agriculture Organisation. (2014). *The State of Food and Agriculture* (Vol. 34). Rome.

Research query 3

In total, 6 references kept as relevant with respect to knowledge-based platform development in research query 3. The 6 scientific papers are:

1. Aker, J. C. (2011). Dial A for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics, 42*(6), 631–647. http://doi.org/10.1111/j.1574-0862.2011.00545.x
2. Aulkemeier, F., Paramartha, M. A., Iacob, M.-E., & van Hillegersberg, J. (2016). A Pluggable Service Platform Architecture for E-Commerce. *Information Systems and E-Business Management*, *14*(3), 469–489. Retrieved from http://link.springer.com/journal/volumesAndIssues/10257
3. Deichmann, U., Goyal, A., & Mishra, D. (2016). Will digital technologies transform agriculture in developing countries? *Agricultural Economics*, *47*(S1), 21–33. http://doi.org/10.1111/agec.12300
4. Meisel, J. (2007). The Emergence of the Internet to Deliver Video Programming: Economic and Regulatory Issues. *Info*, *9*(1), 52–64. Retrieved from http://www.emeraldinsight.com/journals.htm?issn=1463-6697
5. Nakasone, E., Torero, M., & Minten, B. (2014). The power of information: The ICT revolution in agricultural development. *Annu. Rev. Resour. Econ.*, *6*(1), 533–550.
6. Poetz, K., Haas, R., & Balzarova, M. (2012). Emerging Strategic Corporate Social Responsibility Partnership Initiatives in Agribusiness: The Case of the Sustainable Agriculture Initiative. *Journal on Chain and Network Science*, *12*(2), 151–165. Retrieved from http://wageningenacademic.metapress.com/content/120816

Research query 4

In total, 8 references kept as relevant with respect to knowledge-based platform development in research query 4. The 6 scientific papers are:

1. Aker, J. C. (2011). Dial A for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics, 42*(6), 631–647. http://doi.org/10.1111/j.1574-0862.2011.00545.x
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5. Poetz, K., Haas, R., & Balzarova, M. (2012). Emerging Strategic Corporate Social Responsibility Partnership Initiatives in Agribusiness: The Case of the Sustainable Agriculture Initiative. *Journal on Chain and Network Science*, *12*(2), 151–165. Retrieved from http://wageningenacademic.metapress.com/content/120816
6. Wawire, A. W., Wangia, S. M., & Okello, J. J. (2017). Determinants of Use of Information and Communication Technologies in Agriculture: The Case of Kenya Agricultural Commodity Exchange in Bungoma County, Kenya. *Journal of Agricultural Science*, *9*(3), 128–137. http://doi.org/10.5539/jas.v9n3p128

The 2 papers classified as grey literature are:
1. George, T., Bagazonzya, H., Ballantyne, P., Belden, C., Birner, R., Castello, R., … Treinen, S. (2011). *ICT in Agriculture. Connecting Smallholders to Knowledge, Networks, and Institutions*. The World Bank. Washington D.C.
2. The Food and Agriculture Organisation. (2014). *The State of Food and Agriculture* (Vol. 34). FAO. Rome.

Research query 4.1

In total, 9 references kept as relevant with respect to knowledge-based platform development and sub-Saharan Africa / African countries. The 7 scientific papers are:
1. Aker, J. C. (2011). Dial A for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics, 42*(6), 631–647. http://doi.org/10.1111/j.1574-0862.2011.00545.x
2. Deichmann, U., Goyal, A., & Mishra, D. (2016). Will digital technologies transform agriculture in developing countries? *Agricultural Economics*, *47*(S1), 21–33. http://doi.org/10.1111/agec.12300
3. Hudson, H. E., Leclair, M., Pelletier, B., & Sullivan, B. (2017). Using radio and interactive ICTs to improve food security among smallholder farmers in Sub-Saharan Africa. *Telecommunications Policy*, *41*(7–8, SI), 670–684. http://doi.org/10.1016/j.telpol.2017.05.010
4. Mukhebi, A., & Kundu, J. (2014). Linking farmers to markets in Kenya: The evolving KACE model. *Cah Agric*, *23*, 282–287. http://doi.org/10.1684/agr.2014.0710
5. Munyua, H., Adera, E., & Jensen, M. (2009). Emerging ICTs and their potential in revitalizing small scale agriculture in Africa. *Agricultural Information Worldwide*, *2*(1), 707–717. http://doi.org/10.3233/WOR-141920
6. Rodenburg, J., Le Bourgeois, T., Grard, P., Carara, A., Irakiza, R., Makokha, D. W., … Marnotte, P. (2016). Electronic support tools for identification and management of rice weeds in Africa for better-informed agricultural change agents. *Cahiers Agricultures*, *25*(1). http://doi.org/10.1051/cagri/2016004
7. Tata, J. S., & McNamara, P. E. (2016). Social Factors That Influence Use of ICT in Agricultural Extension in Southern Africa. *Agriculture-Basel*, *6*(2), 15. http://doi.org/10.3390/agriculture6020015

The 2 papers classified as grey literature are:
1. George, T., Bagazonzya, H., Ballantyne, P., Belden, C., Birner, R., Castello, R., … Treinen, S. (2011). *ICT in Agriculture. Connecting Smallholders to Knowledge, Networks, and Institutions*. The World Bank. Washington D.C.
2. The Food and Agriculture Organisation. (2014). *The State of Food and Agriculture* (Vol. 34). FAO. Rome.

Research query 4.2

In total, 6 references kept as relevant with respect to knowledge-based platform development specifically in Kenya. The 4 scientific papers are:

1. Aker, J. C. (2011). Dial A for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics, 42*(6), 631–647. http://doi.org/10.1111/j.1574-0862.2011.00545.x
2. Deichmann, U., Goyal, A., & Mishra, D. (2016). Will digital technologies transform agriculture in developing countries? *Agricultural Economics*, *47*(S1), 21–33. http://doi.org/10.1111/agec.12300
3. Mukhebi, A., & Kundu, J. (2014). Linking farmers to markets in Kenya: The evolving KACE model. *Cah Agric*, *23*, 282–287. http://doi.org/10.1684/agr.2014.0710
4. Wawire, A. W., Wangia, S. M., & Okello, J. J. (2017). Determinants of Use of Information and Communication Technologies in Agriculture: The Case of Kenya Agricultural Commodity Exchange in Bungoma County, Kenya. *Journal of Agricultural Science*, *9*(3), 128–137. http://doi.org/10.5539/jas.v9n3p128

The 2 papers classified as grey literature are:

1. George, T., Bagazonzya, H., Ballantyne, P., Belden, C., Birner, R., Castello, R., … Treinen, S. (2011). *ICT in Agriculture. Connecting Smallholders to Knowledge, Networks, and Institutions*. The World Bank. Washington D.C.
2. The Food and Agriculture Organisation. (2014). *The State of Food and Agriculture* (Vol. 34). FAO. Rome.

Research query 5, 5.1 and 5.2

In total, 4 references kept as relevant with respect to knowledge-based platform development and gender relations, worldwide or sub-Saharan Africa / African countries or specifically Kenya.

1. Hudson, H. E., Leclair, M., Pelletier, B., & Sullivan, B. (2017). Using radio and interactive ICTs to improve food security among smallholder farmers in Sub-Saharan Africa. *Telecommunications Policy*, *41*(7–8, SI), 670–684. http://doi.org/10.1016/j.telpol.2017.05.010
2. Kadiyala, S., Morgan, E. H., Cyriac, S., Margolies, A., & Roopnaraine, T. (2016). Adapting Agriculture Platforms for Nutrition: A Case Study of a Participatory, Video-Based Agricultural Extension Platform in India. *Plos One*, *11*(10). http://doi.org/10.1371/journal.pone.0164002
3. Rodriguez, L., Kulpavaropas, S., Annamalai, D., Wright, J., & Evans, J. F. (2015). Trends in Information Needs and Communication Channel Use Among Rural Women in Africa, Asia, and Latin America, 2000–2012. *Journal of Agricultural & Food Information*, *16*(3), 221–241. http://doi.org/10.1080/10496505.2015.1047496
4. Tata, J. S., & McNamara, P. E. (2016). Social Factors That Influence Use of ICT in Agricultural Extension in Southern Africa. *Agriculture-Basel*, *6*(2), 15. http://doi.org/10.3390/agriculture6020015

Content and analysis of a few selected articles

40 references corresponding to the inclusion criteria presented in chronological order
5 papers presented in the Special Issue of *Agriculture and Human Values* in 1999 1. Maarleveld, M., & Dangbegnon, C. (1999). Managing Natural Resources: A Social Learning Perspective. *Agriculture and Human Values*, *16*(3), 267–280. Retrieved from http://link.springer.com/journal/volumesAndIssues/10460 2. Ravnborg, H. M., & del Pilar Guerrero, M. (1999). Collective Action in Watershed Management—Experiences from the Andean Hillsides. *Agriculture and Human Values*, *16*(3), 257–266. Retrieved from http://link.springer.com/journal/volumesAndIssues/10460 3. Röling, N., & Maarleveld, M. (1999). Facing strategic narratives: An argument for interactive effectiveness. *Agriculture and Human Values*, *16*(3), 295–308. http://doi.org/http://dx.doi.org/10.1023/A:1007595530813 4. Steins, N. A., & Edwards, V. M. (1999a). Platforms for Collective Action in Multiple-Use Common-Pool Resources. *Agriculture and Human Values*, *16*(3), 241–255. Retrieved from http://link.springer.com/journal/volumesAndIssues/10460 5. Steins, N. A., & Edwards, V. M. (1999b). Synthesis: Platforms for Collective Action in Multiple-Use Common-Pool Resources. *Agriculture and Human Values*, *16*(3), 309–315. http://doi.org/10.1023/A:1007591401621 The research topic around platform emergence in agriculture appeared in a special issue of *Agriculture and Human Values* in 1999 (Steins and Edwards 1999b [R1]). The papers from this issue (i.e. Maarleveld and Dabgbégnon 1999; Ravnborg and del Pilar Guerrero 1999; Röling and Maarleveld 1999; Steins and Edwards 1999a [R1]) initiates a debate concerning these new technologies, as possible tools for organising and facilitating collective action in articulating multi-stakeholder interests of common-pool resources (e.g. in the case of water and lake management). Three papers in this special issue are conceptually based articles, and two are empirically based, discussing the potential of platforms in enabling the good governance of common goods. The papers contributing to this special issue are still at an early stage of platforms emergence, since the device is still loosely defined. Further, there is limited elaboration upon the potential effects of the intentions and mandate of actors involved in platform development.
6. Zack, M. H. (1999). Managing Codified Knowledge. *Sloan Management Review*, *40*(4), 45–58. Zack (1999 [R1]) suggests a framework for aligning technical and organisational resources and capabilities to leverage explicit knowledge. The paper provides a framework for configuring a firm's technical and organisational resources and capabilities to leverage its codified knowledge. The author refers to this as 'the knowledge management architecture'. Within the knowledge management architecture, knowledge platforms are given a core role as knowledge structures, providing context for interpreting accumulated content. Zack (1999) perceives platforms as a central knowledge unit, containing different sets of knowledge repositories (e.g. product literature, best sales practices, competitor intelligence). The author presents the knowledge management architecture based on the example of two firms, who are, accordingly, successfully competing on their ability to manage explicit knowledge. The definition of knowledge (i.e. that is can be tacit or explicit; it may be of several types; and it may range from general to specific) and how knowledge is made explicit is highlighted in the paper. The knowledge management architecture framework uses four resources: (i) repositories of explicit knowledge; (ii) refineries for accumulating, refining, managing, and distributing a particular knowledge type; (iii) organisation roles to execute and manage the refining process; and (iv) information technologies to support the established repositories and processes. The author brings out four factors that influence the impact of knowledge management on the performance of an organisation (strategic context, knowledge context, organisational context, and technology context). The framework developed by Zack (1999) is used to define internet knowledge-based platforms in the context of the thesis.
7. Purvis, R. L., Sambamurthy, V., & Zmud, R. W. (2001). The Assimilation of Knowledge Platforms in Organizations. *Organization Science*, *12*(2), 117–135. http://doi.org/10.1287/orsc.12.2.117.10115 Purvis et al. (2001 [R1]) examine the institutional factors that influence the assimilation of knowledge platforms in organisational practice. It is an empirically based paper, investigating the presented research question based on the assimilation of CASE technologies of system development projects in

organisations. According to the authors, CASE is a knowledge-based platform (i.e. an IT-enabled knowledge platforms in organisations). Purvis et al. (2001) gathered data based on a questionnaire survey using a purposive sampling strategy. Such method was deployed for the identification of respondents that had adopted the CASE platform and were actively using the device [obtained 176 responses]. The authors provide evidence in the important role of institutional forces, whom are having an impact upon the assimilation rate of the platform. Namely, that prevalent institutional factors within organisations could establish important inertia and impede the adequate use of the technological innovation.

8. Isard, S. A., Russo, J. M., & DeWolf, E. D. (2006). The Establishment of a National Pest Information Platform for Extension and Education. *Plant Management Network*, 1–4. http://doi.org/10.1094/PHP-2006-0915-01-RV

Isard et al. (2006 [R2]) discuss the value of the Pest Information Platform for Extension and Education (PIPE). The platform was launched in 2006, established to address the soybean rust threat in the US. Under the direction of the US Department of Agriculture (USDA) Regional Integrated Pest Management (IPM) Centres, the PIPE focused on established pests of soybean and other legumes. Accordingly, the platform and its content was built on an existing structure of the regional IPM centres, with contribution from public extension specialists. The IPM centres interact with industry to set regional pest priorities. Specialists input monitoring information into databases and interpret observations and model output. These observations are then documented as 'decision support for pest management guidelines' for agricultural producers and industry. The initial direction and funding of the platform comes from the USDA, but designed to be sustained by the involved private actors. The authors believe that the PIPE enhances the role of extension specialists in IPM. They conclude that the future challenge of PIPE is to ensure its financial sustainability.

9. Jensen, R. (2007). The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector. *The Quarterly Journal of Economics*, *CXXIII*(February), 1–48. http://doi.org/10.1162/003355302753399436

Jensen (2007 [R2]) estimates the effect of mobile phones on agricultural markets in India, more precisely in the fisheries sector in Kerala. In the case of the article, mobile phones are used as network platforms to coordinate sales exchange, market based information, and knowledge among fishermen. A randomised control trial was used, based on [300] sardine fishing units. The author finds that the expansion of mobile phone coverage leads to a reduction in the scattering of fish prices across markets, and a decline in fish waste. The results show that as a result of increased mobile phone use, fishermen's profits increased by 8 percent, consumer prices declined by 4 percent and consumer surplus increased by 6 percent.

10. Meisel, J. (2007). The Emergence of the Internet to Deliver Video Programming: Economic and Regulatory Issues. *Info*, *9*(1), 52–64. Retrieved from http://www.emeraldinsight.com/journals.htm?issn=1463-6697

Meisel (2007 [R3]) investigates the impact of the internet as a video distribution platform and analyses the related economic and legal issues appearing as a consequence. It is a conceptual paper. The author presents the different layers of a digital distribution platform, with a particular focus on the stakes that relates to the dissemination of platform content. Per the author, platforms can strengthen certain already existing unbalanced power relations between stakeholders (e.g. increase in the number of distribution platforms increases the potential audience in both geographic space and time). Meisel (2007) stresses concerns around unbalanced power relations between private versus public actors involved in platform development. Here, the author discusses of the example of commercials aired with content. On the one hand, advertisers are interested in promoting their product to an audience that is prone to buy the product. On the other hand, viewers are interested in watching / reading content that diverts and/or informs them. Revenue for the organisation detaining the video distribution platform is then generated by providing interesting content to attract viewers, and from advertisers' willingness to pay to reach the audience attracted by the content. The content is therefore experienced for 'free' yet, it is supplemented by advertisements by the company itself or third-parties. Regulatory concerns are also highlighted in the paper (e.g. type of regulation on broadband companies, property rights and control of content). The author concludes on the note that intense debates in policy work will arise due to the economic and regulatory stakes emerging with distribution platforms.

11. Lazaric, N., Longhi, C., & Thomas, C. (2008). Gatekeepers of Knowledge versus Platforms of Knowledge: From Potential to Realized Absorptive Capacity. *Regional Studies*, *42*(6), 837–852. Retrieved from http://www.tandfonline.com/loi/cres20

Lazaric et al. (2008 [R1]) aim at showcasing interaction that is occurring in high-technology clusters via online platforms of knowledge. More precisely, the paper illustrates why the development of clusters rests on the creation of local competencies via geographical proximity, cognitive interactions and entrepreneurial initiatives. The authors introduce distinctions among potential and realised 'absorptive capacity'. This, with the aim of discussing the evolution of 'satellite platforms' (i.e. *"a system directed from outside, rich in external connections, but deprived of internal linkages"* p. 843) into platforms of knowledge. The Sophia Antipolis ICT cluster (referred to as the knowledge management platform – KMP), with its physical location in Nice (France), is used as case study. The authors conducted (i) exploratory interviews of potential users; and (ii) semi-directive interviews, ad-hoc committees, committees and open interviews with the pilot users. It is unclear in the paper the number of interviews that were conducted. The authors conclude that the KMP provides an adequate example of the gradual transformation of a satellite platform into a high-technology clusters merging localised capabilities with global innovative networks. Moreover, the distinction between the aptitude to absorb new knowledge and to effectively combine it, is fundamental in successful platform development.

12. Goyal, A. (2010). Information, Direct Access to Farmers, and Rural Market Performance in Central India. *American Economic Journal: Applied Economics*, *2*(3), 22–45. Retrieved from http://www.aeaweb.org/aej-applied/

Goyal (2010 [R1], [R2]) investigates the effect of 'e-choupals' in India (i.e. internet kiosks) on soybean prices. The purpose of the internet kiosks was to provide information upon soybean prices and how to perform quality-testing to soy farmers. Each kiosk was designed to cater to the host village. The kiosks were managed and operated by farmers trained in basic computer usage. These farmers were selected within the village and provided free services to other soy farmers. Each day the prices of soybean, combined with high quality soybean and their location, were posted on a website. Besides, farming techniques and weather updates were made available in local language to farmers through the kiosks (upon which they could interact with specialists and/or other farmers). Findings from this empirical study show that the introduction of the e-choupals had a positive effect on soybean prices (1-3 percent increase in markets located in districts where kiosks were introduced). Such technology also yielded a 19 percent increase in soy production, leading to an overall increase of 33 percent in farmers' net profits. Most of which seems to have come from a redistribution of surpluses away from traders.

13. Jensen, T. (2010). Information, efficiency, and welfare in agricultural markets. *Agricultural Economics, 41*, 203–216. http://doi.org/10.1111/j.1574-0862.2010.00501.x

Jensen (2010 [R2]) performs an analysis of the impact ICTs have on the functioning of agricultural markets in developing countries. Mobile-based platforms are also discussed, their ability in providing market information services to farmers and how this has affected their livelihoods. He conducts a literature review on this issue. Tshe author especially focuses on the effect mobile phones have on welfare, with regards to potential efficiency gains (through improved arbitrage), and welfare transfers among agents in the supply chain (by reduced informational asymmetries and market power). The author bases his analysis on secondary data sources from the International Telecommunication Union and empirical evidence from the literature. Jensen (2010) detects five main impacts: (1) efficient arbitrage; (2) reduced market power; (3) supply responses; (4) reduced use of transportation; and (5) reduced price variability. The author stresses however that these positive impacts should be interpreted with caution (e.g. price dispersion changes alone do not capture the welfare effects, certain welfare gains could emanate from production increases and/or changes in the mix of crops produced; social gains could have taken place even while there is no measurable change in consumer prices or in profits; observations cannot only concentrate on villages that access phones, it must be compared with a control group, i.e. one community may gain while another is worse off).

14. Livingston, M. J. (2010). U.S. Soybean Producer Perceptions and Management of Soybean Rust in the United States under the USDA Pest Information Platform for Extension and Education. *Agricultural and Resource Economics Review*, *39*(3), 547–560. Retrieved from http://ageconsearch.umn.edu/handle/36551

Livingston (2010 [R1]) studies survey data to get a better understanding of the factors that determine beliefs regarding the Pest Information Platform for Extension and Education (PIPE). More precisely, the author examines (i) the relationship between the PIPE website visitation and probability beliefs; (ii) the use of fungicides to control rust; and (iii) whether information found on the platform is more likely to modify the management behaviour of producers who are ambiguous about their chances of experiencing a rust outbreak, relative to producers who have more certain expectations. The paper is based on a case study from the U.S. and is an empirically based paper. The author uses filled in questionnaires from 2006 of [1,884] U.S. soybean farmers. The findings show that the geographical location of the farms is the most significant determinant of a soybean producer's probability beliefs and in using the PIPE website. Livingston (2010) stresses policy action points, namely that of reducing the costs of internet access in southern areas of the U.S. Accordingly, this would increase the aggregate value of the PIPE platform (since it makes it more easily available to the farmers).

15. Aker, J. C. (2011). Dial A for agriculture: a review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics, 42*(6), 631–647. http://doi.org/10.1111/j.1574-0862.2011.00545.x

Aker (2011 [R2], [R4.2]) presents the likely mechanisms by which ICT may facilitate agricultural adoption and the provision of extension services in sub-Saharan Africa (SSA). It is a conceptual paper, based on a review of the current scientific literature. Knowledge-based platforms in agriculture are among the ICTs that are analysed in this regard (e.g. the Infonet Biovision Farmer Information Platform). The author discusses the reason to as of why ICTs are considered a more effective solution in advisory services, based on a historic analysis of the agricultural extension system in SSA. A major argument is the low performance of the traditional public this system in different SSA countries. It is argued that ICTs have the potential to reach a large and vast population with information and knowledge more at a lower cost. Aker (2011) emphasises in the importance of information sharing as central mechanism by which ICT can contribute to an increase in agricultural productivity. It is nonetheless denoted that ICTs is extension may become unsustainable (e.g. irrelevant content, inaccessibility for target groups). The author calls for rigorous impact evaluations of ICTs such as platforms at a micro-level, assessing the demand-side of the service.

16. George, T., Bagazonzya, H., Ballantyne, P., Belden, C., Birner, R., Castello, R., … Treinen, S. (2011). *ICT in Agriculture. Connecting Smallholders to Knowledge, Networks, and Institutions*. The World Bank. Washington D.C.

In 2011, the World Bank published the ICT in Agriculture e-Sourcebook report, in partnership with infoDev and, with substantial contributions from outside experts (George et al., 2011 [R2], [R4], [R4.1], [R4.2]). The report is part of the program on 'Creating Sustainable Businesses in the Knowledge Economy'. The Government of Finland majorly financed the work. The objective of the report is to provide new insights on ICT progress in agriculture in developing countries. Accordingly, the document was designed to support decision-makers, development organisations and practitioners, working at the crossing of agriculture and ICT. Case studies from various developing countries are presented in the report relating to ICT development in agriculture (e.g. different ICT knowledge-based platforms and smartphone applications providing virtual advisory services to farmers, where some of these technologies are especially targeting women farmers). The report is presenting different types of financial models and solutions for ICT devices in agriculture. In particular, public-private partnerships (PPPs), involving international donors, foreign private financiers, NGOs and Governments. Authors from the report have a positive stance towards the capacity of ICTs in agriculture in providing female and male farmers in developing countries with technical knowledge.

17. Fafchamps, M., & Minten, B. (2012). Impact of SMS-Based Agricultural Information on Indian Farmers. *World Bank Economic Review*, *26*(3), 383–414. Retrieved from http://wber.oxfordjournals.org/content/by/year

Fafchamps and Minten (2012 [R1], [R2]) examine the impact of the ICT initiative by the Thomas Reuters company, namely the Reuters Market Light (RML). The RML is a mobile phone-based agricultural information system (based on standardised interaction via SMS). More precisely, the RML content include market information, weather forecast, crop advisory tips, and commodity news. The paper is based on the case of India. The authors use a randomised controlled trial (RCT) to test the effect of RML on the price received by farmers. On average, the authors find no differences in average prices for farmers with RML subscriptions as compared to those without. The authors suggest

that low levels of actual RML usage and the fact that farmers sold mostly to a single local market may have contributed to this finding.

18. Liotard, I. (2012a). Les plateformes d'innovation sur Internet: arrangements contractuels, intermédiation et gestion de la propriété intellectuelle. *Management International*, *16*. Retrieved from https://hal.archives-ouvertes.fr/hal-00680366

Liotard (2012a [R1]) analyses the contractual arrangements of a specific platform (i.e. the 'Innocentive' platform), with regards to intellectual property, technical assistance and support. The author also aims at understanding how platforms respond to information asymmetry and uncertainty inherently embedded in technology transfer. Hence, the author suggests to examine how contractual arrangements of Innocentive can create value and reduce the information gap between seller and buyer of solutions, highlighted in the economic literature. The paper is based upon the Economics of the Internet. Innocentive is a U.S. based platform, developed and detained by the pharmaceutical company, Eli Lily. A number of qualitative interviews were conducted with platforms users (paying clients and non-paying clients) and developers. The author provide evidence in a certain number of opportunities that arise with the use of platforms, e.g. access to the state of the art, speed of the solution, cost reduction, the quality of solutions (filtering), the procedures for signing new licences. However, results also show different constraints surfacing with these technologies. Indeed, transitioning to the platform requires important internal organisation (allowing teams to be involved in the project); good management of intellectual property (e.g. with regards to implicated stakeholders); and an ex-ante reflection on the transfer of contracts.

19. Liotard, I. (2012b). Transferts de connaissances sur internet et innovation: Le role de nouveaux intermediaries. (Knowledge Transfer on the Internet and Innovation: The Role of New Intermediaries. With English summary.). *Innovations*, (39), 49–69. Retrieved from http://riien.univ-littoral.fr/?page_id=39

Liotard (2012b [R1]) studies the role of internet based innovation platforms in acting as intermediaries in knowledge transfer and innovation. The author is more precisely studying the Innocentive platform to prove her case. The objective of the paper is two-fold. In first, the author provides evidence in original ways to manage innovation via 'crowdsourcing' by analysing platform mechanisms. Second, the author presents how platform intellectual property can be managed. Accordingly, Innocentive introduces new contractual arrangements by suggesting intermediation tools, having the ability to attenuate the problems of asymmetry. In sum, Liotard (2012b) illustrates how a knowledge-based platform can serve as intermediary in an innovation relationship (i.e. between a company and an internet user). The author does nonetheless evoke the importance of a thorough management of intellectual property rights (e.g. when it comes to the disclosure of certain types of knowledge content).

20. Poetz, K., Haas, R., & Balzarova, M. (2012). Emerging Strategic Corporate Social Responsibility Partnership Initiatives in Agribusiness: The Case of the Sustainable Agriculture Initiative. *Journal on Chain and Network Science*, *12*(2), 151–165. Retrieved from http://wageningenacademic.metapress.com/content/120816

Poetz et al. (2012 [R3], [R4]) evaluate the Sustainable Agriculture Initiative (SAI) platform from a business management perspective. Accordingly, they are interested in understanding how innovation processes among multi-national companies (MNCs), via platforms, can contribute to sustainable agricultural development. The MCNs in this case are Nestlé, Groupe Danone and Unilever. The intentions of these MNCs for jointly investing in the SAI platform is essentially related to image and reputation.

21. Karippacheril, T. G., Nikayin, F., De Reuver, M., & Bouwman, H. (2013). Serving the poor: Multisided mobile service platforms, openness, competition, collaboration and the struggle for leadership. *Telecommunications Policy*, *37*(1), 24–34. http://doi.org/10.1016/j.telpol.2012.06.001

Karippacheril et al. (2013 [R2]) examine the potential of mobile based platforms to supply services to 'low income people living at the base of the economic pyramid (BOP)'. It is an empirically based paper. The authors assess the capacity of platforms for supplying services to the poor. The theoretical framework is based upon what the authors calls the 'platform theory' comprehending three dimensions; (1) platform openness; (2) platform competition; and (3) platform leadership. Applying this theoretical perspective place the devices at a meso-level, much related to business and

management studies. As such, it is 'only' perceived as a technical tool, whereby the institutional dimension of platforms is overlooked. Hence, emerging economic and political stakes at macro-level and thus policy implications are not studied nor revealed. The findings present different platform models (operator centric platforms, device centric platforms, service provider centric platforms, mobile based platforms). The authors conclude that mobile based platforms may have the largest potential to reach the most marginalised part of the population for different reasons (e.g. cost of device, usability, accessibility, network coverage). It is also highlighted that policy makers will need to revise strategic frameworks to stimulate mobile based platforms. Accordingly, it should be based on public-private partnership models, since these enable openness, collaboration and competition.

22. The Food and Agriculture Organisation. (2014). *The State of Food and Agriculture* (Vol. 34). FAO. Rome.

The 2014 FAO report ([R2], [R4], [R4.1], [R4.2]) examine the role of innovation in family farming in developing countries. It is highlighted in the report that family farms must be supported to innovate in ways that promote sustainable intensification of production and improvements in rural livelihoods. This is accordingly fundamental in ensuring global food security, environmental sustainability and poverty reduction. Innovation is defined as a process through which farmers can improve their production and farm management practices. ICTs are a type of innovation system highlighted as fundamental in supplying farmers with knowledge and information, through effective advisory services and networks. In turn, ICTs will support farmers to increase farm productivity and improve their livelihoods. Case studies from various developing countries are presented in the report relating to the development of ICTs in farm advisory service systems (e.g. cf. page 69-70 in the report of the use of ICTs to enable a better access to farmers to advisory services and knowledge). The content of the report was developed by staff from the FAO and external organisations (essentially composed of researchers and development workers from e.g. Cirad, IFPRI, GFRAS, University of Wageningen, University of Guelph, The World Bank, Oxfam). The report was prepared by two main FAO units (the Agricultural Development Economics Division and the Research and Extension Unit).

23. Nakasone, E., Torero, M., & Minten, B. (2014). The power of information: The ICT revolution in agricultural development. *Annu. Rev. Resour. Econ.*, *6*(1), 533–550.

Nakasone et al. (2014 [R3]) investigate the state and impact of ICTs on agricultural development in selected developing countries. The authors restrict their study to the use of mobile-based ICT platforms by farmers to access and use market information services (MIS). It is a review of the literature and hence a conceptual paper. Findings reveal an overall improved access to agricultural MIS via mobile phones. Yet, impacts at the farmer level vary. There is also still limited evidence regarding the impact of MIS on farm prices. Likewise, the rollout of extension programs via ICTs is at an early stage. Moreover, the paper show that the adapted methods (e.g. via SMS, voice call) and knowledge content provided to farmers must be adapted to the demands of the farmer. Such type of system, based on local content, is however very costly. Moreover, the financial sustainability of ICT-driven extension services is questioned. Here, the authors stress that such systems ought to be less dependent upon donor funding.

24. Ogutu, S. O., Okello, J. J., & Otieno, D. J. (2014). Impact of Information and Communication Technology-Based Market Information Services on Smallholder Farm Input Use and Productivity: The Case of Kenya. *World Development*, *64*, 311–321. Retrieved from http://www.sciencedirect.com/science/journal/0305750X

Ogutu et al. (2014 [R1], [R2]) investigate ICT platforms ability to reduce information asymmetries for farmers in Kenya. The paper evaluates the impact of Kenyan farmers' access to ICT-based market information services (MIS), via an ICT-based project, on the use of fertilizers, pesticides, farm manure and improved seed varieties. The impact of access to ICT-based MIS on land and labour productivity is also examined. The authors analysed data from farmers introduced to the ICT platform, divided into groups of farmers using platform services [144] and those who did not use its services [231]. Ogutu et al. (2014) show that farmers' participation in the ICT-based MIS project has a positive and significant effect on the use of purchased seed, fertilizer, labour and land productivity. On the other hand, it has a negative and significant impact on the use of hired, family, and total labour. The authors recommend to scale up this type of ICT project. Accordingly, it enhances smallholder farmers' participation in agricultural markets, and strengthening their bargaining position as a result of reduced information asymmetries.

25. Okello, J. J., Kirui, O. K., Gitonga, Z. M., Njiraini, G. W., & Nzuma, J. M. (2014). Determinants of Awareness and Use ICT-Based Market Information Services in Developing-Country Agriculture: The Case of Smallholder Farmers in Kenya. *Quarterly Journal of International Agriculture*, *53*(3), 263–282. Retrieved from http://www.agrar.hu-berlin.de/fakultaet/departments/daoe/publ/qjia/contents/standardseite

Okello et al. (2014 [R2]) study the conditions for awareness and use of ICT-based market information services (MIS) by small-scale farmers. It is based on the case of Kenya and is an empirically based paper. To answer to the aim of the article, the authors use a conceptual framework based on institutional economics and theory of the firm, namely the transaction cost (TC) theory. The choice of using the TC theory is well presented in the paper and how this theory can be used to analyse the levels of awareness and use of MIS-types of platforms. Accordingly, farmers that are aware of and use ICT-based MIS face smaller transactions costs. The authors targeted sites where ICT-based projects operate. The project specially aim at connecting small-holder farmers to markets and getting access to knowledge by providing MIS. A total of [397] farmers were sampled in the study at three different sites in Kenya. At each site, there was a control group (i.e. not part of the project) and a sampled group. The authors used the probability proportionate to size sampling method. Findings show that the geographical location of farm households particularly affects the awareness levels of farmers. The levels of income, group membership and access to technological devices (e.g. a phone) affects the use of MIS-platforms. The study is concluded by the fact that such targeted type of intervention has the potential in increasing agricultural yields and improve the livelihoods of smallholders in Kenya.

26. Mukhebi, A., & Kundu, J. (2014). Linking farmers to markets in Kenya: The evolving KACE model. *Cah Agric*, *23*, 282–287. http://doi.org/10.1684/agr.2014.0710

Mukhebi & Kundu (2014 [R4], [R4.1], [R4.2]) describe the different development stages of the Kenya Agricultural Commodity Exchange Limited (KACE) platform model. It is a conceptual paper, describing the historic evolution of a technical device, initiated in 1992 by the Kenyan Government. In the late 1990s, the KACE started using ICTs for the transmission of market prices to Kenyan farmers. Initially established as a PPP (e.g. with the Rockefeller Foundation), certain physical KACE centres in Kenyan counties are presently self-sustaining small enterprises (since the user pays a fee for most services). Certain centres have nevertheless gone bankrupt due to lack of financial support from donors. The authors denote that the KACE platform is experiencing challenges in finding the adequate set of appropriate and affordable platform services. Other difficulties are to (1) develop adequate services, with the right technologies, for farmers, for an efficient management of the device, and (2) ensure financial sustainability of the platform.

27. van der Boor, P., Oliveira, P., & Veloso, F. (2014). Users as Innovators in Developing Countries: The Global Sources of Innovation and Diffusion in Mobile Banking Services. *Research Policy*, *43*(9), 1594–1607. Retrieved from http://www.sciencedirect.com/science/journal/00487333

van der Boor et al. (2014 [R1]) examine the extent to which users in developing countries innovate, the factors that enable these innovations and if such factors are meaningful on a global scale. The authors conduct an empirical investigation into the origin and types of innovations in financial services offered via mobile phone-based platforms. A multi-method longitudinal analysis is used in the paper, encompassing a historical analysis based on primary and secondary sources. In regards to the primary data, the authors used as a baseline, a complete list of financial services available through mobile phones, reported in the Deployment Tracker published by the GSMA. Findings show that user-innovators come from less-developed countries, as a result of a long-standing unfilled need for inexpensive banking services. The authors conclude that there is a need to acknowledge the role of and involve producers when the development of ICT platforms providing financial services. It is also recommended that allocation of resources to innovative activities should be accounted for in innovation policy in developing countries.

28. Courtois, P., & Subervie, J. (2015). Farmer Bargaining Power and Market Information Services. *American Journal of Agricultural Economics*, *97*(3), 953–977. Retrieved from http://ajae.oxfordjournals.org/content/by/year

Courtois & Subervie (2015 [R1], [R2]) evaluate the performance of an ICT-based mobile platform in Northern Ghana. It is called the ESOKO platform (a mobile phone-based market price platform).

Courtois and Subervie (2015) investigate how much an informed farmer would receive in terms of price gain compared with a situation without price information. Assumptions are based upon field observations and from relevant literature describing bargains at the farm gate. Data was also gathered from the Ghana Living Standard Survey. Findings show that farmers who received MIS obtained higher prices for their crops. On the other hand, the authors could not find evidence in the conditions for a continued use of the MIS-based platforms.
29. Peters, M. A., & Heraud, R. (2015). Toward a Political Theory of Social Innovation: Collective Intelligence and the Co-creation of Social Goods. *Journal of Self-Governance and Management Economics*, *3*(3), 7–23. Retrieved from http://www.addletonacademicpublishers.com/contents-jgme Peters & Heraud (2015 [R1]) discuss, based on a review of the literature, recent claims made for the ways in which social innovation can co-create public goods and services through the utilisation of various types of collection intelligence (CI) and CI internet-based platforms. The authors are interested in the application of collective intelligence and associated forms based on awareness generating collective action, in turn delivering a political theory and practice of social innovation. Emerging forms and ways of delivering social goods and services via forms of co-creation and co-production is of particular concern. Internet-based platforms are the devices used as collective forums for knowledge co-creation. The authors conclude that greater attention ought to be paid to the process of collective conceptualisation and learning (e.g. in the co-production via networked engagement in platforms).
30. Rodriguez, L., Kulpavaropas, S., Annamalai, D., Wright, J., & Evans, J. F. (2015). Trends in Information Needs and Communication Channel Use Among Rural Women in Africa, Asia, and Latin America, 2000–2012. *Journal of Agricultural & Food Information*, *16*(3), 221–241. http://doi.org/10.1080/10496505.2015.1047496 Rodriguez et al. (2015 [R5]) examine the information-seeking behaviours of rural women farmers in Africa, Asia and South America. Based on a review of the literature, the authors study the changing needs of rural women and they have satisfied these needs over time. Throughout the years, there is an increased recognition that rural women are responsible for multiple activities, particularly at the farm. As a result, a realisation that there is a need to bring a different lens onto the information and knowledge needs of female farmers. In this regard, findings from the literature review show how emerging ICTs are promoted by development agencies and various donors as solutions for providing services to women farmers. Particularly web-based platforms, given their multi-functional features (direct knowledge source, serve as a portal, access to other ICT devices). Rodriguez et al. (2015) are however questioning this agenda, whereby they ask why platforms are promoted as a universal solution capable of addressing rural women's needs compared to other types of service providers and methods.
31. Aker, J. C., Ghosh, I., & Burrell, J. (2016). The promise (and pitfalls) of ICT for agriculture initiatives. *Agricultural Economics*, *47*(S1), 35–48. http://doi.org/10.1111/agec.12301 Aker et al. (2016 [R2]) perform a multidisciplinary literature review to identify how ICTs perform in the agriculture sector in developing countries (e.g. if they can help overcome information asymmetries in agriculture). Knowledge-based platforms are discussed as a technical device having the ability to increase farmers' knowledge base via e-learning programmes. In turn, this should contribute to an increase in farm productivity if the learned practices are adequately applied by farmers. Accordingly, other types of platforms, more market oriented, have a large potential in supporting remote farmers with more cost-effective access to financial services. The authors aim at finding evidence in the impact of ICTs in agriculture. It is concluded that there should be more efforts put into making ICTs, such as platforms, more adjusted to farmers demands (by performing needs assessments in the field). There is also an important effort that ought to be done in policy intervention, to avoid that ICTs exacerbate the digital divide. The authors recommen that questions relating to trust, quality of information, usability of technology, and heterogeneity of impacts across populations could be integrated on a routine basis into economic studies on ICT platform development.
32. Aulkemeier, F., Paramartha, M. A., Iacob, M.-E., & van Hillegersberg, J. (2016). A Pluggable Service Platform Architecture for E-Commerce. *Information Systems and E-Business Management*, *14*(3), 469–489. Retrieved from http://link.springer.com/journal/volumesAndIssues/10257

Aulkemeier et al. (2016 [R1], [R3]) present a reference architecture for a pluggable service platform for e-commerce. The paper is based on the case of the U.S. The authors suggest an e-commerce platform especially focusing on certain key capabilities of retailers situated in a different value chains, and to then create a partner ecosystem around them. According to the authors, it implies putting in place a buoyant platform architecture including a core e-commerce functionality, which can be extended by other services from third party providers. The authors examine existing online shop platform solutions and the assimilation of these technologies in the market. Further, they develop an architecture of a service-based pluggable platform for online retailers. Conclusively, Aulkemeier et al. (2016) suggest an extended reference model that can improve the ease of integration for service users (e.g. in terms of user interference, interaction). Yet, the introduction of such a component may have consequences regarding the handling of the shared data. While new services can interact directly with the data services, the link leads to a strong dependency between service and platform. Furthermore, the availability of platform compatible e-commerce services will be limited unless the platform is gaining support from service providers. Also, the adoption of the platform requires integration of existing services and therefore a strong commitment and initial (and significant) investment from the e-commerce company.

33. Blanc, A. K., Glazer, K., Ofomata-Aderemi, U., & Akinfaderin-Agarau, F. (2016). Myths and Misinformation: An Analysis of Text Messages Sent to a Sexual and Reproductive Health Q&A Service in Nigeria. *Studies in Family Planning*, *47*(1), 39–53. Retrieved from http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291728-4465/issues

Blanc et al. (2016 [R1]) study a mobile-based platform aiming at providing sexual and reproductive health (SRH) knowledge content to young individuals in Nigeria. It is an empirically based paper, investigating the performance of the 'MyQuestion' platform (a device that allow persons between 10-24 years of age to ask SRH question via SMS). The authors analysed content of 300,000 text messages. The paper provide evidence in dissatisfied needs for elementary SRH information. The authors conclude that SMS-based platform may provide too standardised information in regards to the issue, creating confusion and misunderstanding for the users.

34. Deichmann, U., Goyal, A., & Mishra, D. (2016). Will digital technologies transform agriculture in developing countries? *Agricultural Economics*, *47*(S1), 21–33. http://doi.org/10.1111/agec.12300

Deichmann et al. (2016 [R2], [R3], [R4], [R4.1], [R4.2]) introduce a framework for describing the benefits from emerging ICTs in agriculture in developing countries. The paper presents a literature review on the ability of new ICTs in providing services to small-scale farmers in developing countries. Knowledge-based platforms are among the presented ICTs. The authors find various papers showing positive and significant impacts of ICTs on farm livelihoods. They do, however, highlight that there is a problem of scaling up ICT projects. Two reasons are put forward. One, problem relate to the (long-term) financial sustainability of farm advisory ICT services systems. Two, technology can only address certain, although not all of difficulties faced by small-scale farmers in developing countries. Deichmann et al. (2016) also stress that platform development in agriculture may require some degree of regulation given the number of involved actors and accompanying objectives.

35. Kadiyala, S., Morgan, E. H., Cyriac, S., Margolies, A., & Roopnaraine, T. (2016). Adapting Agriculture Platforms for Nutrition: A Case Study of a Participatory, Video-Based Agricultural Extension Platform in India. *PLoS One*, *11*(10). http://doi.org/10.1371/journal.pone.0164002

Kadiyala et al. (2016 [R5]) explore the feasibility of supplying child nutrition behaviour change communication via an agricultural extension programme serving nutritionally vulnerable groups in rural India. The programme encompasses participatory production of online based videos on nutrition and its dissemination through women groups. The video-based agricultural extension platform initiative is financed and implemented by the Digital Green Foundation, with additional support from USAID. The programme targeted 30 villages in India, proposing 10 locally produced videos containing 10 main practice themes. The women farmers were sampled via village stratification, selected 15 of 30 villages having women's groups active with the Digital Green Programme. The sample purposely included a larger proportion of pregnant and lactating women, and by looking at the prevalence of castes and tribes, followed by remoteness. The paper presents an articulate and replicable methodological framework in the paper. Moreover, the results are organised per the three stated sub-objectives of the paper. In this regard, the findings of the paper reveal that there is a need

to continuously develop adequate content based on the norms, values and traditions at microscale level. The authors also stress the importance in having in place coordination mechanisms with public authorities (e.g. Ministry of Health) on this issue.

36. Nakasone, E., & Torero, M. (2016). A Text Message Away: ICTs as a Tool to Improve Food Security. *Agricultural Economics*, *47*(S1), 49–59. http://doi.org/10.1111/agec.12314

Nakasone & Torero (2016 [R2]) examine, based on the '3C's' model, how to effectively scale up ICTs in developing countries. The authors provide a synopsis of the impact of ICTs on food security in developing countries. They especially emphasise on the case of mobile phones. Mobile-based platforms are also part of the analysis (mobile money platforms such as MPesa). Nakasone and Torero (2016) highlight findings in the current literature that provide insights of the conditions under which ICT projects can have a positive impact on the livelihoods in rural areas. The three C's (or three challenges) are presented to upscale ICT applications for development: (1) connectivity to services; (2) content of the information; and (3) the capacity of farmers to use the information. Findings show that under certain circumstances, services and information provided via mobile phones may improve the livelihoods of farmers. Focus on accessibility is according to the authors fundamental for scaling-up ICT related projects. The authors also reveal that a limited number of studies focus on the aspect of content, yet that such dimension is fundamental to ensure usability and replicability of ICTs. Finally, understanding the local conditions and farmers' ability to internalise technical advice is required to make enhanced use of ICTs in developing countries.

37. Rodenburg, J., Le Bourgeois, T., Grard, P., Carara, A., Irakiza, R., Makokha, D. W., … Marnotte, P. (2016). Electronic support tools for identification and management of rice weeds in Africa for better-informed agricultural change agents. *Cahiers Agricultures*, *25*(1). http://doi.org/10.1051/cagri/2016004

Rodenburg et al. (2016 [R4.1]) developed an online weed identification tool (AFROweeds) and online exchange platform (Weedsbook). The purpose of the development of such system is to support agricultural agents to update their knowledge base and to offer assistance to rice farmers with specific weed problems. The online knowledge system covers 14 sub-Saharan African countries. The aim of the study was to evaluate the performance and usefulness of the platform. A test group of [13] potential users of the tool and platform was held through a workshop. Findings show that the test group were satisfied with the performance of the platforms (regarding accessibility and content). Accordingly, recommendations related to the expansion of (i) the knowledge database; and (ii) different languages of the knowledge content.

38. Tata, J. S., & McNamara, P. E. (2016). Social Factors That Influence Use of ICT in Agricultural Extension in Southern Africa. *Agriculture-Basel*, *6*(2), 15. http://doi.org/10.3390/agriculture6020015

Tata & McNamara (2016 [R4.1], [R5], [R5.1]) examine the social factors that influence the use of the internet-based platform 'Farmbook' among extension officers in the Southern African region. Per the demand of the Southern African Agro-Enterprise Learning Alliance Consortium, the Catholic Relief Services are testing the ability of the platform in supplying extension officers with technical knowledge. The devices should support agents to help farmers in business planning. The authors aim at assessing the influence of socio-economic factors on the adoption of the Farmbook platform by extension officers in Southern Africa. The date was analysed based on results from focus groups discussions with extension agents introduced to the platform during three workshops [40 participants with 75 percent response rate]. The authors divided up the challenges between 'Farmbook challenges' (relates to the context in which the farmer operates) and 'technical challenges' (relates to problems that arise with the platform). Results show that the agents where principally experiencing challenges that relate to Farmbook challenges (e.g. the accuracy of the device with respect to the farmers demands, female extension agents experienced more difficulty at farm level). The largest technical challenge is, accordingly, access to the internet. The authors conclude that this type of device can act as a complementary knowledge-base to extension agents.

39. Wawire, A. W., Wangia, S. M., & Okello, J. J. (2017). Determinants of Use of Information and Communication Technologies in Agriculture: The Case of Kenya Agricultural Commodity Exchange in Bungoma County, Kenya. *Journal of Agricultural Science*, *9*(3), 128–137. http://doi.org/10.5539/jas.v9n3p128

Wawire et al. (2017 [R4.2]) examine the determinants in the use of the KACE platform among small-scale farmers for agricultural transactions. It is based on the case of Kenya. The aim is two-fold. In first, the authors seek to establish the factors that influence access to agricultural information. In second, they wish to determine factors that define the intensity in use of the platform in accessing agricultural information. [136] farmers where sampled and interviewed in two districts in Kenya considered the hub of KACE operations. Results show that female farmers have less access to the platform and knowledge content therein. Findings show that women farmers seem to be less prone in using different types of ICT tools (not only knowledge-based platforms) to support them in their technical choices compared to men farmers. The authors attribute this low access and use of ICT platforms in agriculture to given gender roles in society, age and unequal access to education. The paper also provide evidence in the fact that gender, age and education matter when it comes to the determinants of the intensity use of ICT tools. It is more likely that educated males at a younger age uses different ICT tools to access for instance agricultural marketing information and virtual advisory services. The authors attribute this to the fact that they are the final decision makers of farm related investments in most rural households.
40. Hudson, H. E., Leclair, M., Pelletier, B., & Sullivan, B. (2017). Using radio and interactive ICTs to improve food security among smallholder farmers in Sub-Saharan Africa. *Telecommunications Policy*, *41*(7–8, SI), 670–684. http://doi.org/10.1016/j.telpol.2017.05.010 Hudson et al. (2017 [R4.1], [R5], [R5.1]) present a framework that assimilates ICTs with radio programming for the purpose of enhancing interactivity and farmer participation. Four countries are studied in the paper (Ethiopia, Malawi, Tanzania, and Uganda). More precisely, the authors investigate how a ICT-enhanced participatory radio campaign (PRC) impacted listenership, knowledge levels and adoption of agricultural practices. It is expected that the PRC should increase the adoption levels and scale-up the potential for agricultural innovations. The ICT-based platform solution is implemented by and financed through Farm Radio International. The authors explain what they mean by 'ICT-enhanced PRC' and how such technology can be classified as a knowledge-based platform. Accordingly, radio programmes do not enable interaction per se. Therefore, the programme is connected to a mobile-based platform, to allow for a two-way interaction between farmers and/or platform developers (e.g. via Interactive Voice Response). [1,931] respondents were interviewed within 26 communities based on an outcome evaluation survey assessing the performance of the PRCs across the four countries. The authors conclude that agricultural radio programmes have a large potential in reaching a vast and remote number of farmers, especially women farmers, but it does not guarantee adoption. It is suggested to complement radio programmes with interactive types of methods, such as via mobile-based platforms.

Relevant scientific articles in economic sciences on knowledge-based platform development in chronological order				
Reference	**Type of study**	**Target group and data collection**	**Relation to research question**	**Main findings**
1. Steins & Edwards, 1999a [Special issue, Agriculture and Human Values]	Conceptual paper, the role of platforms for common pool resources.	Rural communities in developing countries, concentrated around a common natural resource.	Introduces the Special Issues in *Agricultural and Human Values*. Initiates the debate around platforms as possible tools for organising and facilitating collective action in articulating multi-stakeholder interests in common-pool resources (CRPs).	Findings show that for platforms to become effective tools in the management of the multi-use CRPs, a number of factors need to be addressed. In first, all stakeholders must be involved. Second, platforms must be accessible and context specific. Third, platform performance depends of its relevance to the user groups. Four, multi-use CRPs should not be based upon single-use resource management. Finally, platforms must be facilitated by a third party.
2. Maarleveld & Dangbegnon, 1999 [Special issue, Agriculture and Human Values]	Empirically based paper, water resource management	Fishing community of Lake Aheme, Benin.	Examine whether ongoing adaptation in managed resource systems can be facilitated through platforms, based on the social learning perspective.	The authors illustrate that by applying a social learning perspective into collective management of natural resource systems, limitations and potentials emerging from the interaction around resources, stakeholder interests, and institutions become visible. Multi-stakeholder platforms can be used a main point for collective action but does not guarantee sustainable resource management.
3. Ravnborg & del Pilar Guerrero, 1999 [Special issue, Agriculture and Human Values]	Empirically based paper, watershed management in the Andean Hillsides, Columbia	Local communities part of hillside project initiated by CIAT [1,100] individual decision-making families part of watershed users' association for Cabuyal river water-shed. Mostly farmers.	Aim at describing a process aimed at fostering collective watershed management.	The paper show the relevance of platforms as a mechanism for coordinating and negotiating collective action by various stakeholders. The authors argue that platforms in collective action procedures must involve facilitation by a third party. Further, if the platform ought to be effective as negotiating body, all stakeholders must be involved in the decision-making process.
4. Röling & Maarleveld, 1999 [Special	Conceptual paper, platform use in	Rural communities in developing countries, concentrated around a	Study the feasibility and eventual social acceptance of alternate narratives based on	Röling & Maarleveld (1999) stress that to ensure sustainable development and management of natural resources, effective

issue, Agriculture and Human Values]	collective action management	common natural resource.	platforms for land use negotiation.	mechanisms, and policy strategies are required for encompassing collective action. For instance, building platforms for land use management and facilitation of social learning.
5. Steins & Edwards, 1999b [Special issue, Agriculture and Human Values]	Conceptual paper, summarises the papers from the special issue on platforms, collective action and social learning	Rural communities in developing countries, concentrated around a common natural resource.	Objective of the paper is to animate the debate around the management of multiple-use CRPs via platforms.	After recapitulating the findings from the other papers from this special issue, the authors conclude that platforms in the management of CRPs have great potential. Yet, the authors highlight that each CRP has its own dynamic setting, whereby locality-specific factors must be considered.
6. Zack, 1999	Empirically based paper, information and knowledge resource management	Bases the analysis on data collection from two firms.	Suggests a framework for aligning technical and organisational resources and capabilities to leverage explicit knowledge. Elaborates on the role of platforms in a knowledge management architecture.	The author defines a knowledge-based platform within the knowledge management structure and defines the object. Zack (1999) highlight that a platform consists of multiple repositories, whereby each repository contains a structure appropriate to a particular type of knowledge or content. The author brings out four factors that influence the impact of knowledge management on the performance of an organisation: strategic context, knowledge context, organisational context, and technology context.
7. Purvis et al., 2001	Empirically based paper, knowledge management and technology assimilation	Based on the CASE platform in system development projects in organisations. Gathered data based on a questionnaire survey. Studied [176] responses of active platform users.	Examine the institutional factors that influence the assimilation of knowledge platforms in organisational practice, based on the CASE platform.	The authors provide evidence in the important role of institutional forces, having an impact upon the rate of assimilation of the platform. Namely, that prevalent institutional factors within organisations could establish important inertia and impede the adequate use of the technological innovations.
8. Isard et al., 2006	Conceptually based paper. Platform development,	Soybean farmers in the U.S.	Discuss the value of the Pest Information Platform for	The authors argue that the PIPE enhances the role of extension specialists in integrated pest management. They conclude that the

	knowledge management and assimilation.		Extension and Education (PIPE).	future challenge of PIPE is to ensure its financial sustainability.
9. Jensen, 2007	Empirically based paper. Technology innovation in the agricultural sector.	A randomised control trial was used, based on [300] sardine fishing units in India.	Aims at estimating the effect of the use of mobile phones on fisherman profits in India.	The author finds that the expansion of mobile phone coverage leads to a reduction in the scattering of fish prices across markets, and a decline in fish waste. The findings show that as a result of increased mobile phone use, fishermen's profits increased by 8 percent, consumer prices declined by 4 percent and consumer surplus increased by 6 percent.
10. Meisel, 2007	Conceptually based paper. Video distribution platforms, economic and regulatory stakes that emerge with internet and globalisation.	Platform development analysis at national level and its implications.	Discusses the example of the impact of the internet as a video distribution platform and analyses the related economic and legal issues appearing as a result.	The paper presents the different layers of a distribution platform, with a particular focus on the stakes that relates to the dissemination of content. Meisel (2007) stresses concerns around unbalanced power relations between private versus public actors involved in platform development. Regulatory concerns are also highlighted in the paper (type of regulation on broadband companies, property rights and control of content).
11. Lazaric et al., 2008	Empirically based paper. Platform of knowledge development and management.	The Sophia Antipolis knowledge management platform is used as case study. Conducted exploratory interviews of potential users, semi-directive interviews, ad-hoc committees, committees and open interviews with pilot users.	The authors aim at showcasing interaction that is occurring in high-technology clusters via online platforms of knowledge. The objective of the paper is to illustrate why the development of clusters rests on the creation of local competencies via geographical proximity, cognitive interactions and entrepreneurial initiatives.	Authors conclude that the knowledge management platform provides an adequate example of the gradual transformation of a satellite platform into a high-technology clusters merging localised capabilities with global innovative networks. Moreover, the distinction between the aptitude to absorb new knowledge and to effectively combine it, is a fundamental factor for successful platform development and knowledge dissemination.

12. Goyal, 2010	Empirical study. Agricultural markets and marketing, internet based solutions to farmers.	Panel data on internet kiosks (e.g. their installation, location) from prices, sales volume and output of soy, maize, groundnut and rice.	Investigates the effect of 'e-choupals' (i.e. internet kiosks) on soybean prices in India.	Findings show that the introduction of the e-choupals had a positive effect on soybean prices, with a 1-3 percent increase in markets located in districts where kiosks were introduced. Such technology also yielded a 19 percent increase in soy production, leading to an overall increase of 33 percent in farmers' net profits, which seems to have come from a redistribution of surpluses away from traders.
13. Jensen, 2010	Literature review. Agricultural markets and marketing, internet based solutions to farmers.	Farmers in developing countries.	Author discuss the possible impacts of ICTs on welfare, with regards to potential efficiency gains, and welfare transfers among agents in the supply chain. Mobile-based platforms are discussed. The author aims at providing evidence of the impacts of ICTs on the functioning of agricultural markets.	Results show that there are five primary impacts of ICTs in the forestry, fishery and agricultural sector in developing countries. These are: (1) efficient arbitrage; (2) reduced market power; (3) supply responses; (4) reduced use of transportation; and (5) reduced price variability. For instance, ICTs can be used to access commodity price quotes in distant markets, resulting in reduced intermarket price differentials.
14. Livingston, 2010	Empirically based paper. Platform on knowledge development and management in the agricultural sector.	Based on the case study of the U.S. The author uses filled in questionnaires from 2006 of [1,884] U.S. soybean farmers.	The author examines: (i) the relationship between the PIPE website visitation and probability beliefs; (ii) the use of fungicides to control rust; and (iii) if information found on the platform is more likely to modify the management behaviour of producers.	The findings show that the geographical location of the farms is the most significant determinant of a soybean producer's probability beliefs and in using the PIPE website. The author stresses policy action measures, namely that of reducing the costs of internet access in southern areas of the U.S.
15. Aker, 2011	Literature review. Agricultural markets and marketing, internet based solutions to farmers.	A review of the current scientific literature. ICTs in agriculture	The likely mechanisms by which ICT may facilitate agricultural adoption and the provision of extension services	Aker (2011) emphasises in the importance of information sharing as central mechanism by which ICT can contribute to an increase in agricultural productivity. It is nonetheless denoted that ICTs in extension can become

			in sub-Saharan Africa is presented.	unsustainable (particularly related to the inaccessibility for target groups). The author calls for rigorous impact evaluations of ICTs such as platforms (however at a micro-level, assessing the demand-side of the service).
16. George et al., 2011	ICT in Agriculture e-Sourcebook report published by the World Bank.	Small-scale farmers in developing countries	The objective of the report is to provide new insights on ICT progress in agriculture in developing countries.	Case studies from various developing countries are presented in the report relating to ICT development in agriculture. The report is presenting different types of financial models and solutions for ICT devices in agriculture, in particular public-private partnerships (PPPs). Authors from the report have a positive stance towards the capacity of ICTs in agriculture in providing female and male farmers in developing countries with technical knowledge.
17. Fafchamps & Minten, 2012	Empirically based paper. Agricultural markets and marketing, mobile-based solutions to farmers.	Based on the case of India with [1,000] farmers. Randomised controlled trial is used to test the effect of Reuters Market Light (RML) on the price received by farmers in India.	Examine the impact of the ICT initiative by the Thomas Reuters company: the RML SMS-based price and weather information system, provided via mobile phones.	On average, the authors find no differences in average prices for farmers with RML subscriptions as compared to those without. The authors suggest that low levels of actual RML usage and the fact that farmers mostly sell at a single local market may have contributed to this finding.
18. Liotard, 2012a	Empirically based paper. Platform of knowledge development and management.	Based on a case study of a platform called 'Innocentive' developed for the pharmaceutical industry. Qualitative interviews were conducted with platforms users (paying clients and non-paying clients) and developers.	Aims at understanding how a platform 'Innocentive' respond to information asymmetry and uncertainty inherently embedded in technology transfer.	Provide evidence in a certain number of opportunities that arise with the use of platforms, e.g. access to the state of the art, speed of the solution, cost reduction, the quality of solutions, the procedures for signing new licences. Results also show different constraints surfacing with these technologies. The transitioning to the platform requires important internal organisation; good management of

				intellectual property and an ex-ante reflection on the transfer of contracts.
19. Liotard, 2012b	Conceptual paper (building on paper from Liotard, 2012a). Platform of knowledge development and management.	Studying the 'Innocentive' platform to prove her case. The platform was developed for the pharmaceutical industry.	The objective of the paper is two-fold. In first, the author provides evidence in original ways to manage innovation via 'crowdsourcing' by analysing platform mechanisms. Second, the author presents how platform intellectual property can be managed.	Accordingly, 'Innocentive' introduces new contractual arrangements by suggesting intermediation tools, having the ability to attenuate the problems of asymmetry. The author illustrates how a platform can serve as intermediary in an innovation relationship. The author does nonetheless evoke the importance of a thorough management of intellectual property rights.
20. Poetz et al., 2012	Empirically based paper. Platform of knowledge development and management in the agricultural sector.	Case study based on the Sustainable Agriculture Initiative (SAI) platform. Based on secondary based data sources.	Evaluate the SAI platform from a business management perspective.	The authors are interested in understanding how innovation processes among multi-national companies (MNCs), via platforms, can contribute to sustainable agricultural development. The intentions of these MNCs for jointly investing in the SAI platform is essentially related to image and reputation.
21. Karippacheril et al., 2013	An empirically based paper. Platform of knowledge development and management in the agricultural sector.	Interviews with [31] individuals working with ICT services.	Aim at assessing the capacity of platforms for supplying services to the poor.	Mobile based platforms may have the largest potential to reach the most marginalised part of the population for different reasons (e.g. cost of device, usability, accessibility, network coverage). It is also highlighted that policy makers will need to revise strategic frameworks to stimulate mobile based platforms. Accordingly, it should be based on PPP models, promoting openness, collaboration and competition.
22. FAO, 2014	The state of food and agriculture report 2014 by the FAO	Small-scale farmers in developing countries.	Examines the role of innovation in family farming in developing countries.	ICTs are a type of innovation system highlighted as fundamental in supplying farmers with knowledge and information, through effective advisory services and networks. In turn, ICTs will support farmers to increase farm productivity and improve their livelihood. Case studies from various

				developing countries are presented in the report relating to the development of ICTs in farm advisory service systems.
23. Nakasone et al., 2014	A review of the literature and a conceptual paper.	Small-scale farmers in developing countries.	Investigate the state and impact of ICTs on agricultural development in selected developing countries. The authors restrict their study to the use of mobile-based ICT platforms by farmers to access and use market information services (MIS).	Findings reveal an overall improved access to agricultural MIS via mobile phones. Yet, impacts at farm level vary. There is also still limited evidence regarding the impact of MIS on farm prices. Likewise, the rollout of extension programs via ICTs is at an early stage. The financial sustainability of ICT-driven extension services is questioned. The authors stress that such systems ought to be less dependent upon donor funding.
24. Ogutu et al., 2014	Empirically based paper. Platform of knowledge development and management in the agricultural sector.	Kenyan farmers, analysed data from farmers introduced to the ICT platform, divided into groups of farmers using [144] and those who did not use the platform [231].	Examine ICT platforms ability to reduce information asymmetries for farmers in Kenya.	Results show that farmers' participation in the ICT-based MIS project has a positive and significant effect on the use of purchased seed, fertilizer, labour and land productivity. On the other hand, it has a negative and significant impact on the use of hired, family, and total labour. The authors recommend to up-scale this type of ICT project. It enhances smallholder farmers' participation in agricultural markets, and strengthening their bargaining position as a result of reduced information asymmetries.
25. Okello et al., 2014	Empirically based paper. Mobile-based platform development in the agricultural sector.	Based on the case of Kenya. A total of 397 farmers were sampled in the study at three different sites in Kenya.	Study the conditions for awareness and use of ICT-based market information services (MIS) by small-scale farmers in Kenya.	Findings show that farmers that are aware of and use ICT-based MIS face smaller transactions costs. Results also show that the geographical location of farm households particularly affects the awareness levels of farmers. The levels of income, group membership and access to technological devices affects the use of MIS-platforms.
26. Mukhebi & Kundu, 2014	A conceptual paper. Platform of	Based on the case of Kenya.	Describes the different development stages of the	The authors denote that the KACE platform is experiencing challenges in finding the

	knowledge development in the agricultural sector.		Kenya Agricultural Commodity Exchange Limited (KACE) platform model.	adequate set of appropriate and affordable services and technologies within the platform. Other difficulties are to develop adequate services, with the right technologies, for farmers for an efficient management of the platform and; ensure financial sustainability of the device.
27. van der Boor et al., 2014	Empirically based paper. Platform development, financial services, developing countries	A multi-method longitudinal analysis is used in the paper, encompassing a historical analysis based on primary and secondary sources.	Examine the extent to which users in developing countries innovate, the factors that enable these innovations, and if such factors are meaningful on a global scale.	Findings show that user-innovators come from less-developed countries, as a result of a long-standing unfilled need for inexpensive banking services. The authors conclude that there is a need to acknowledge the role of producers when developing ICT platforms, providing financial services.
28. Courtois & Subervie, 2015	Empirically based paper. Mobile-based platform development, market information services, farming	Based on the case of [396] small-scale farmers in Ghana.	Evaluate the performance of the ESOKO platform (ICT-based mobile platform) in Northern Ghana.	Findings show that farmers who received MIS received higher prices for their crops. On the other hand, the authors could not find evidence in the conditions for a continued use of the MIS-based platform.
29. Peters & Heraud, 2015	Conceptual paper. Platform development and management, collective space	Platform development in firms.	Discuss recent claims made for the ways in which social innovation can co-create public goods and services through the utilisations of various types of collection intelligence (CI) and CI internet-based platforms.	Emerging forms and ways of delivering social goods and services via forms of co-creation and co-production is of particular concern. Internet-based platforms are the devices used as collective forums for knowledge co-creation. The authors conclude that greater attention should be paid to the process of collective conceptualisation and learning.
30. Rodriguez et al., 2015	Literature review. Platform development and management, gender inequality, access and use of ICTs	Agriculture, ICTs and gender in developing countries	Examining the information-seeking behaviours of rural women in Africa, Asia and South America.	Findings show how emerging ICTs are promoted by development agencies and various donors as solutions for providing services to women farmers. Particularly web-based platforms, given their multi-functional features. Rodriguez et al. (2015) are however questioning this agenda,

				whereby they ask why platforms are promoted as a universal solution capable of addressing rural women's needs compared to other types of service providers and methods.
31. Aker et al., 2016	Literature review. ICT development in agriculture, developing countries, inequality	Agriculture and ICTs in developing countries	Performs a multidisciplinary literature review to identify how ICTs perform in the agriculture sector in developing countries. The authors aim at finding evidence in the impact of ICTs in agriculture.	The authors denote that there should be more efforts put into making ICTs, such as platforms, more adjusted to farmers demands (based on needs assessments). There is also an important effort that ought to be done in policy intervention (e.g. ensured network coverage in remote and rural areas), to avoid that ICTs exacerbate the digital divide. The authors recommend that questions relating to trust, quality of information, usability of technology, and heterogeneity of impacts across populations could be integrated on a routine basis into economic studies on ICT platform development.
32. Aulkemeier et al., 2016	Conceptual paper. Platform development and model	The paper is based on the case of the U.S. Platform development in firms.	Suggest an e-commerce platform especially focusing on certain key capabilities of retailers situated in a certain value chain and then create a partner ecosystem around them.	Aulkemeier et al. (2016) suggest an extended reference model that can improve the ease of integration for service users. Furthermore, the availability of platform compatible e-commerce services will be limited unless the platform is gaining strong support from service providers. Also, the adoption of the platform requires integration of existing services and therefore a strong commitment and initial investment from the e-commerce company.
33. Blanc et al., 2016	Empirically based paper. Platform performance in the health sector.	Based on the case of Nigeria, sexual and reproductive health. Content of 300,000 text	Investigate the performance of the 'MyQuestion' platform.	Provide evidence in dissatisfied needs for elementary SRH information. The authors conclude that SMS-based platform may provide too standardised information in

		messages was analysed by the authors.		regards to the issue, creating confusion and misunderstanding for the users.
34. Deichmann et al., 2016	Literature review. ICT development in agriculture, developing countries	A review on the ability of new ICTs in providing services to small-scale farmers in developing countries	Introduce a framework for describing the benefits from emerging ICTs in agriculture in developing countries.	The authors find various papers showing positive and significant impacts of ICTs on farm livelihoods. They do highlight that there is a problem of scaling up ICT projects, whereby they have not reached the expected impact. Two reasons are denoted here. One, problems related to the financial sustainability of farm advisory ICT services systems. Two, technology can only address certain, although not all of difficulties faced by small-scale farmers in developing countries. The authors stress that platform development in agriculture may require some degree of regulation.
35. Kadiyala et al., 2016	Empirically based paper. Platform development in agriculture related to nutrition in India.	The sampling of farm women was conducted using village stratification, selected the 15 of the 30 villages having women's groups active with the Digital Green Programme.	Explore the feasibility of supplying child nutrition behaviour change communication via an agricultural extension programme based on video programmes serving nutritionally vulnerable groups in rural India.	Findings reveal that there is a need to continuously develop adequate content based on the norms, values and traditions at microscale level. The authors also stress the importance in having in place coordination mechanisms with public authorities on this issue.

36. Nakasone & Torero, 2016	Literature review. ICT development in agriculture, developing countries	A review of the literature on the ability of new ICTs in providing services to small-scale farmers	Aim at providing a synopsis of the impact of ICTs on food security in developing countries.	Findings show that under certain circumstances, services and information provided via mobile phones may improve the livelihoods of farmers. Focus on accessibility is accordingly fundamental for scaling-up ICT related projects. The authors also reveal a limited number of studies focusing on the aspect of content but that it is fundamental to ensure usability and replicability of ICTs. Finally, understanding the local conditions and farmers' ability to internalise technical advice is required to make enhanced use of ICTs in developing countries.
37. Rodenburg et al., 2016	Empirically based paper. Platform development in rice farming in sub-Saharan Africa.	Based on the case of an online weed identification tool (AFROweeds) and online exchange platform (Weedsbook). Interviews with [13] individuals.	The aim of the study is to evaluate the performance and usefulness of the platform.	Findings show that the test group was satisfied with the performance of the platforms (regarding accessibility and content). Accordingly, recommendations relate to the expansion of (i) the knowledge database, and (ii) the different languages of the knowledge content (e.g. in different local languages).
38. Tata & McNamara, 2016	Empirically based paper. Platform development in agriculture in Southern Africa.	Based on the case of Southern African countries. Focus group discussions with extension agents introduced to the platform: [40] participants with 75 percent response rate.	The authors examine the social factors that influence the use of the internet-based platform 'Farmbook' among extension officers in the Southern African region	Results show that the agents where principally experiencing problems that relate to Farmbook challenges (e.g. accuracy of the device with respect to the farmers demands). The largest technical challenge is, accordingly, access to the internet. The authors conclude that this type of device can act as a complementary knowledge-based to extension agents.
39. Wawire, et al., 2017	Empirically based paper. Platform development in	It is based on the case of Kenya. [136] farmers where sampled and interviewed in two	The authors examine the determinants of the use of the KACE platform among small-	Results show that female farmers have less access to the platform and the knowledge content therein. Findings show that women farmers seem to be less prone in using

	agriculture related to nutrition in Kenya.	districts in Kenya considered the hub of KACE operations.	scale farmers for agricultural transactions.	different types of ICT tools to support them in their technical choices compared to men farmers. The authors attribute this low access and use of ICT platforms in agriculture to given gender roles in society, age and unequal access to education.
40. Hudson et al., 2017	Empirically based paper. Platform development in agriculture related to nutrition in Africa.	Ethiopia, Malawi, Tanzania and Uganda are studied in the paper. [1,931] respondents were interviewed within 26 communities.	Present a framework that assimilates ICTs with radio programming for the purpose of enhancing interactivity and farmer participation.	Findings show that agricultural radio programmes have a large potential in reaching a vast and remote number of farmers, and especially women farmers, but it does not guarantee adoption. It is suggested to complement radio programmes with interactive types of methods.

Summary of the literature review on knowledge-based platform development

[40] papers have been identified dealing with knowledge-based platform development. Out of these papers, [22] are empirically based, [6] present reviews of the literature, [10] are conceptual papers and [2] are reports from international organisations (i.e. the World Bank and the FAO).

Analysis of the literature review show that there is a gradual progression around the conceptualisation of knowledge-based platforms. The special issue in *Agriculture and Human Values* from 1999 introduces the notion of platforms in agriculture as organisational tools in processes of collective action around natural resources management. While still indistinctly defined in this special issue, recent articles provide evidence in the concrete models and types platforms can take (Isard et al. 2006; Mukhebi & Kundu 2014; Rodenburg et al. 2016; Wawire et al. 2017). Simultaneously, the role of platforms in knowledge management process at firm level started evolving (Zack 1999; Purvis et al. 2001). At this stage, platforms were put in place to conceive a system for the effective management of knowledge resources at intra-firm level. Then in 2006, Isard et al. present a description of a platform in agriculture. Later, one other paper describes the development (and evolvement) of a platform in Kenya (Mukhebi & Kundu 2014).

Many of the identified papers from 2007 onwards, start focus on platform performance in project management (Lazaric et al. 2008), at firm level (Aulkemeier et al. 2016), in the agricultural sector (Livingston 2010) and, specifically in developing countries (Goyal 2010; Jensen 2007; Aker 2011; Fafchamps & Minten 2012; Karippacheril et al. 2013; Okello et al. 2014; Courtois & Subervie 2015; Aker et al. 2016; Nakasone & Torero 2016; Rodenburg et al. 2016; Tata & McNamara 2016; Wawire et al. 2017). These analyses are all rigorously conducted, providing evidence of or discussing the positive effects of ICT platforms at different levels of intervention.

In the agricultural sector, many of the identified papers of the economic literature from 2007 onwards, start focus on platform performance in developing countries. Jensen (2007) investigates the positive impacts of mobile phone services on fishermen in India. Results show that the expansion of mobile phone coverage leads to a reduction in the scattering of fish prices across markets and a decline in fish waste. Findings from Goyal (2010) study show that the introduction of the internet kiosks in India had a positive effect on soybean prices and farm productivity, leading to an overall increase of 33 percent in farmers' net profits. Jensen (2010) argues that mobile-based platforms have positive impacts on efficiency gains and welfare transfers in developing countries (e.g. ICTs can be used to access commodity price quotes in distant markets, resulting in reduced intermarket price differentials. Based on a review of the literature, Aker (2011) examines the likely mechanisms by which ICTs may facilitate agricultural adoption and the provision of extension services in sub-Saharan Africa. The importance of information sharing via ICTs is stressed as key mechanism to contribute to agricultural productivity. The impact of the Reuters Market Light services (RML) (i.e. an SMS-based price and weather information system provided via the mobile phone) is analysed by Fafchamps & Minten (2012). On average, the authors find no differences in average prices for farmers with RML subscriptions as compared to those without. Karippacheril et al. (2013) argue that mobile based platforms have the largest potential to reach the most remote and marginalised strata of the population in developing countries. In their review of the literature, Nakasone et al. (2014) conclude that farmers in developing countries have experienced an improved access to MIS via mobile phones. They do however find little evidence of the positive

effects of MIS on farm prices. Ogutu et al. (2014) examine the ability of an ICT-based MIS project to reduce information asymmetries for farmers in Kenya. Results show that farmers' participation in the project enhances their participation in agricultural markets and strengthens their bargaining position as a result of reduced information asymmetries. Okello et al. (2014) study the conditions for awareness and use of ICT-based MIS by small-scale farmers. Findings show that farmers that are aware of and use ICT-based MIS face smaller transactions costs.

In the literature review by Aker et al. (2016), examples of ICT platforms are presented and discussed. The authors recommend that questions relating to trust, quality of information, usability of technology, and heterogeneity of impacts across populations could be integrated on a routine basis into economic studies on ICT platform development. Moreover, some studies are based upon on a case study of a particular platform. These include studies analysing the performance of platforms; (Tata & McNamara 2016) analysing the "Farmbook" platform in the Southern Africa region; (Rodenburg et al. 2016) assessing the "AFROweeds" service and "Weedsbook" platform in the rice value chain in sub-Saharan Africa; (Courtois & Subervie 2015) examining the "ESOKO" platform in Northern Ghana and; (Wawire et al. 2017) basing their case study on the "KACE" platform. Overall, these authors providing evidence of or discuss the positive effects of ICT platforms. For instance, Courtois & Subervie (2015) show that farmers who received MIS from the ICT-based mobile platform received higher prices for their crops.

Meisel's article from (2007) is the first of the identified papers in this literature review that focuses on the institutional dimension of platforms. Following this paper, the institutional dimension appears in the report published by the World Bank (George et al. 2011) and in the report by the The Food and Agriculture Organisation in 2014. For example: platforms should be based on models that are economically sustainable in the long-term. Moreover, the question of financial sustainability is discussed in the literature review by Nakasone et al. (2014). Also, four empirically based papers (Ogutu et al. 2014; van der Boor et al. 2014; Kadiyala et al. 2016; Hudson et al. 2017) and two reviews from the literature (Rodriguez et al. 2015; Deichmann et al. 2016), discuss the institutional dimension of platforms from an equity perspective (gender equality, questions of inclusion of small-scale farmers, etc.).

Poetz et al. (2012) examine the role of platforms in the CSR work of multi-national firms. I was therefore not able to place the paper by because it does not fit into the analysis of the institutional dimension of platforms, nor does it evaluate the performance of a platform.

Finally, I only managed to identify two empirically based (Blanc et al. 2016; Liotard 2012a) and two conceptual papers (Liotard 2012b; Peters & Heraud 2015) analysing the quality of the knowledge / technical content of platforms. None of these papers base their analysis on the agricultural sector.

In sum, observations from the literature review show that there is limited reflection upon the technical content of ICT platforms and the different configurations these devices can take (in exception of certain authors, Liotard 2012b; Meisel (2007). These dimensions do appear in an illustrative way in papers that deal with the development of ICTs in general. Still, reflections institutional types of platforms and respective stakeholder interests in these configurations are fairly restricted. For instance, PPP-based platforms.

Indeed, PPPs for platform development is rather encouraged by some authors (George et al. 2011; Karippacheril et al. 2013), arguing that PPPs make sense from an economic point of

view. Accordingly, PPPs provide a solution given the high costs of maintaining an ICT driven agricultural extension system. Especially, vis-à-vis the required finances in maintaining back-office work and institutional coordination mechanisms. Indeed, there is an important back-office dimension required to ensure that services provided by platforms are accurate. Besides, the majority of recent literature, have high expectations on PPP-based platforms and their ability to provide knowledge to farmers. These devices are presented as a universal solution to a highly complex problem, e.g. in solving certain gender inequalities in rural areas (Rodriguez et al. 2015). Yet, a high number of these studies implicitly show that it is tricky to develop ICT-based services that adequately address a heterogeneous group of farmers with highly dissimilar demands (Aker et al. 2016; Hudson et al. 2017; Nakasone & Torero 2016). The question is thus at what conditions ICT platforms can replace traditional types of farm advisory services to be inclusive of female and male farmers demands. Analysis on farm women's and men's specific demands, that are context-bound, is not reflected upon and how platforms can address such issues.

With this fact, results from the review reveal a confined number of papers examining the link between gender relations and platform emergence in farm advisory intervention. Some papers argue that platforms have a higher potential compared to traditional AES in reaching the most vulnerable strata of the population of developing countries (Aker 2011; Karippacheril et al. 2013). In particular farm women (Kadiyala et al. 2016). Also, few papers bring out important inclusion criteria's that ought to be considered in platforms, e.g. socio-economic characteristics, importance of collective action (for instance Wawire et al. 2017; Hudson et al. 2017). It is also not explicitly formulated however.

Appendix 2: ICT knowledge-based platforms in agriculture as policy instruments

The policy dimension of ICT knowledge-based platforms

Lascoumes & Le Gales (2007) encounter difficulties with the classification and definitions of different intertwined devices, at various levels, used in policy intervention. It is also stressed by the authors that these devices generate outcomes hard to measure at political, economic and social level.

A similar difficulty is encountered in the context of this research. ICT knowledge-based platforms, more frequently based on PPP stakeholder models, are increasingly used within public intervention to achieve specific public policy objectives. One example can be to reach a vast and remote farming population with new technical knowledge in agriculture more effectively compared to traditional types of farm advisory services.

In this respect, Lascoumes & Le Gales (2007) construct the notion of 'policy instrument'. *"A public policy instrument constitutes a device that is both technical and social, that organize specific social relations between the state and those it is addressed to, according to the representations and meanings it carries. It is a particular type of institution, a technical device with the generic purpose of carrying a concrete concept of the politics/society relationship and sustained by a concept of regulation."* (Lascoumes & Le Gales, 2007, p. 4). The definition stresses the technical and social aspects of policy instruments, the social relations and the implicit dimensions therein.

The definition of a policy instrument is accompanied by (and interlinked with) public policy instrumentation, accentuating the importance of understanding the effects produced by the choice of a certain instrument. *"Public policy instrumentation – in our understanding – means the set of problems posed by the choice and use of instruments (techniques, methods of operation, devices) that allow government policy to be made material and operational. Another way of formulating the issue is to say that it involves not only understanding the reasons that drive towards retaining one instrument rather than another, but also envisaging the effects produced by these choices."* (Lascoumes & Le Gales, 2007, p. 4).

According to the authors, the multiplication of actors and coordination of institutional instruments have been noticed in an increasing number of sectors (Lascoumes & Le Gales 2007). Public policies are as a consequence less hierarchized and organised within a sector, defined and structured by powerful stakeholders risking to deny the interplay of social interests and of masking power relations (Borraz 2004). For instance in the case of gender relations (Molyneux 2002). When it comes to agricultural extension services, the economic and institutional model, technical and social dimension of a given instrument and target group could therefore differ depending on the dynamics between actors.

An instrument is also context bound according to Howlett (1991) and Linder & Peters (1984). And not easily transposed from one sector to another, nor from one cultural context to another. Indeed, findings from Linder & Peters (1984) analysis of the effectiveness of economic policy instruments implemented at macro level, show that it is problematic to generate adequate and precise policies. *"Levels of aggregation correspond to levels of acceptable error in dealing with human behaviour. Thus, to a large extent, the transition from a micro to a macro-level explanation involves the implicit choice between alternative mixes of precision and inclusiveness. The available set of choices is constrained by complexity."* (1984, p.245). The

argument put forward by the authors is important in the context of this research since certain of the knowledge-based platforms, based on multi-actor partnerships that involve foreign based organisms, are not context related. A question that emerges is therefore whether foreign based platforms, a type of policy instrument implemented in a different country and context, can adequately meet local political, economic and social expectations?

In this regard, (Hood 2007) reflects on the mixture of ideology, technological change and interests. Governmental instrumentalities are central to the author's analysis. Hood (2007) provides a reflection upon the role and effects of new policy tools, such as ICT instruments used to policy intervention. According to the author, changing technologies raise questions about alterations in the form and relative costs of diverse varieties of policy instruments in what Hood calls '*the information age'* (2007, p.140). The effects of these new instruments are highlighted as a potential issue. So, given emerging stakes, there is a need for a systematic analysis of the outcomes of information and communication based policy instruments.

It is therefore challenging to define these tools and understand the basis upon which they are selected, and also from an economic point of view. Namely: Why are an increasing number of foreign private investors interested in developing these types of tools? Why have certain governments prioritised the implementation and development of ICT platforms rather than others tools and methods to supply farmers with knowledge? Their potential outcomes also need to be given attention. Based on these grounds, it is legitimate and heuristic to use the notion of 'policy instrument' for analysing ICT knowledge-based platforms in agriculture.

Policy instruments comprehend an economic dimension

Any type of policy instrument (whether is it more traditional types or new policy instruments), comprehend an economic dimension (Palier 2004; Lorrain 2004; Lascoumes & Le Galès 2004b).

It is also the case for ICT knowledge-based platforms. The knowledge content within these tools are on the one hand instruments of power. On the other hand, it is an economic resource in the production of different goods (e.g. for foodstuff, agricultural goods) to a number of concerned stakeholders, such as small-scale female farmers. In this regard, Laurent (2005) provides evidence in the importance of adequate knowledge development for (and with) small-scale farmers in bridging the complex nexus of biodiversity conservation and farm productivity. Namely, how farmers can increase farm yields whilst in parallel adopt practices preserving the environment.

Besides, knowledge accumulation (and the investment in this economic component) is decisive for economic growth according to authors such as (Freeman 1995). Accordingly, key innovations and technology advancement highly depends upon tacit knowledge and the ability in codifying such knowledge in order to make it explicit (i.e. knowledge transfer). Throughout history, innovations and technology advancement are key for the advancement of sectors in different countries (e.g. the manufacturing industry).

Indeed, knowledge content within policy instruments comprehends an economic dimension, and in this case ICT knowledge-based platforms. In this respect, Borrás & Edquist (2013) posit

that the choice of a policy instrument in the area of innovation[159] policy have large macro-economic effects. According to the authors, if poorly planned, they can have potential (and unexpected) negative effects at political and social level, and it is apparently not uncommon. *"As a matter of fact, the selection and use of innovation policy instruments are not always based on a clear identification of problems. Unfortunately, many instruments are selected by means of an ad-hoc set of decisions (or non-decisions), largely based on a continuation of previous schemes, or on lobby activity or specific interest groups, rather than on the visionary considerations of a holistic innovation policy and a critical assessment of the actual problems that need action."* (2013, p.29). One scenario could be ill-planned knowledge-based dissemination systems via ICTs (e.g. the lack of the establishment of a robust evaluation system to assess the outcomes of an innovation instrument; economic priorities of one involved actor is prioritised over social concerns leading to the exclusion of certain socio-economic groups in the case of PPPs). This can in turn burden government finances and create socio-economic disparities.

Thus, on the one side, the knowledge within these platforms is considered an economic resource for farmers to sustain yields, produce agricultural goods and generate profits. On the other side, at an institutional level, there are economic stakes and incentives emerging behind the choice of these types of policy instruments in agriculture regarding: (1) the generation of profits for the actors involved in developing and disseminating the knowledge (depending on the legal status of the actors, i.e. public, private, development agencies, etc.); and (2) the economic sustainability of these instruments based on the financial model behind these devices (e.g. financed through public means or based on a PPP). It also implies that such instrument possibly serves certain economic interests, in addition to the political interests.

[159] *"Innovations are defined here as new creations of economic and societal significance, primarily carried out by firms (but not in isolation). They include product innovations as well as process innovations. Innovation systems are the determinants of innovation processes and the innovations themselves. Innovation policy comprises all combined actions that are undertaken by public organizations that influence innovation processes."* (Borrás & Edquist 2013, p.3).

The implicit gender dimension of ICT knowledge-based platforms in agriculture

To determine the priorities, expectations and needs of rural women, there is a need to assess how the gender content is addressed within ICT policy instruments and thus how knowledge-based platforms consider women farmers' demands.

Instruments used in policy (e.g. development policy), comprehends certain pre-conceived gender dimensions, that are set based on established power relations among involved actors. Hence how gender is defined depends upon compromises between stakeholders.

ICT knowledge-based platforms are therefore considered as a policy instrument, because they comprehend a non-neutral dimension, based on power relations and implicit choices.

A typology framework for analysing the extent government intervention ensures gender equality in public policy and via ICT platforms

The integration of gender relations into public policy and ICT knowledge-based platforms are based upon a set of institutional compromises between actors. The involved actors also have a different understanding of gender relations, and consequently agenda for the type of gender equality interventions, thus, the inherent gender dimension therein.

In this respect, the typology framework of policy instruments developed by Lascoumes & Le Gales (2007, p.12) gives the possibility to analyse with what means a government intervenes to ensure gender equality and the potential issues that arise in the case of reduced State intervention.

The framework is a classification typology of policy instruments, developed to elucidate the place of instruments in the technologies of government. It is distinguished into five main models (Table 1 of this Appendix). Out of these five types, three are considered as '*new public policy instruments'*, offering less interventionist forms of public regulation, e.g. ICT knowledge-based platforms. In this regard, public regulation is organised differently, based on consultation, contracting out and partnerships. In such cases, there could be a shift in power relations from the State towards non-public actors with these types of instruments.

Table 1 of this Appendix consider different types of political relations organised by policy instruments, followed by the types of legitimacy such relations presume. The first type of instruments, '*legislative and regulatory'*, borrow from routinized legal forms, constituting the 'blueprint' of state interventionism. Such type of instrument is not neutral and include three main functions: a symbolic one (representing legitimate power via legislative and regulatory measures); an axiological one (value and interests protected by the state); and a pragmatic one (directing social behaviours and organising supervisory systems).

The second type, '*economic and fiscal policy instruments'*, derive their legitimacy and power on a legal base (similar to the first type of policy instrument). Compared to the first type, these instruments are based upon economic and social efficiency. Such type of policy instrument is using monetary techniques and tools (for instance, subsidies or allowing deduction of expenses), to orient the behaviours of actors or to collect resources that are intended to be redistributed.

Appendix 2 Table 1: Typology of policy instruments

Type of instrument	Type of political relations	Type of legitimacy
(1) Legislative and regulatory	Social guardian state	Imposition of a general interest by mandated elected representatives
(2) Economic and fiscal	Wealth producer State, and redistributive State	Seeks benefit to the community, social and economic efficiency
(3) Agreement-based and incentive-based	Mobilising State	Seek direct involvement
(4) Information-based and communication-based	Audience democracy	Explanation of decisions and accountability of actors
(5) De facto and de jure standards best practices	Adjustments within civil society, competitive mechanisms	Mixed: Scientific/technical, technical, democratically negotiated and/or competition, pressure of market mechanism

Source: (Lascoumes & Le Gales 2007, p.12).

The three last types of policy instruments from Table 1 are referred to by the authors as new types of policy instruments (Lascoumes & Le Gales 2007). They are characterised by less interventionist forms of public regulation, organising dissimilar kinds of political relations, based on communication and consultation.

The third policy instrument, *'agreement-based and incentive-based'*, as referred to as 'govern by contract', assumes a less interventionist state, increasingly involved in contractual exchange with non-public actors. The authors stress that limited research has been conducted to evaluate the effectiveness of the new role given to a government (principally as coordinator, noninterfering, bridging into coherence).

The fourth type of policy instrument, *'communication and information based'*, form part of the development of *'audience democracy'* or *'democracy of opinion' – "that is, a relatively autonomous public space in the political sphere traditionally based on representation."* (Lascoumes & Le Gales 2007, p.14). It is argued that given the growing use of such type of instruments in public policy intervention, a precise political dimension is present. It is because information and communication agreements are instituted based on institutional compromises between actors. ICT knowledge-based platforms fall under this type of policy instrument type since (1) they are information and communication based; (2) there is an important economic and political relations dimension to these platforms; and (3) they are not impartial devices disseminating neutral knowledge to anyone.

'De jure and de facto standards', and the fifth policy instrument type, organise particular power relations between economic actors and civil society or nongovernmental organisations. These combine technical and scientific rationality, supposed to neutralise their political weight. Competition mechanisms, impositions of objectives and exertion of strong coercion can be allowed for this type of instrument.

Using an instrument typology approach as developed by Lascoumes & Le Gales (2007) is meaningful because it has the ability to disentangle the interplay between concerned actors and representations inherent to each instrument type (for example, implicit representations of women or of gender norms).

Per the definition of a policy instrument, such device is not neutral, based on implicit choices and institutional compromises among actors (i.e. between a government and involved actors) (Delorme & André 1983). This could also be the case of ICT knowledge-based platforms in farm advisory intervention. It could in turn have consequences upon the definition, consideration and prioritisation of the demands of women farmers (e.g. inadequately defined, or misrepresented).

Therefore, such typology framework developed by (Lascoumes & Le Gales 2007) allows to: (1) classify these ICT knowledge-based platforms within public policy; (2) assess the social relations (e.g. gender relations); and (3) understand the nature of institutional compromises in ICT policy instruments in agriculture (to detect the power relations established between actors, and hence the different stakes emerging among involved actors).

Appendix 3: Complementary frameworks based on institutional economics to analyse emanating stakes with knowledge-based platforms

Institutional economic approaches suggest considering the institutional dimension in policy intervention to analyse emerging stakes regarding gender relations in ICT platforms. I have identified three interlinked theoretical dimensions in institutional economic approaches.
(1) The importance of informal networks;
(2) Institutional compromises; and
(3) Institutional coordination.
Some of these dimensions have been complemented with literature from sociological sciences.

Getting an understanding of informal networks in policy action to identify how gender is valued and perceived

Informal networks are important in public policy intervention (Granovetter 1973). These interactions take place within political, social, and economic institutions (Gadrey 1990; Jessop & Sum 2006). It is in these contexts that social relations and levels of trust are created, often implicitly, leading to compromises between actors, setting the agenda together with Governments, in turn setting the objectives for public policy (Lascoumes & Le Galès 2004a). Some of these developed informal networks and processes are nearly impossible to codify (e.g. in the case of tacit knowledge exchange) (Nonaka et al. 1996). Therefore, highly difficult to decipher and understand. It is also the case for policy action in the farm advisory services sector (Laurent et al. 2006).

In this regard, Granovetter (1973) stresses the importance of the cohesive power of dyadic ties. The strength of weak ties within networks and network formation is, accordingly, disregarded in the literature, generally focusing on the opposite, i.e. strong ties in networks. *"Emphasis on weak ties lends itself to discussion of relations between groups and to analysis of segments of social structure not easily defined in terms of primary groups."* (1973, p.1360). The author posits that the analysis of processes in interpersonal networks provide the most effective micro-macro link (between demand and the configuration of supply in public policy at national level). It is via such networks that small-scale interaction is translated into large-scale patterns (e.g. diffusion, social cohesion, political organisation), in turn, feeding back into the smaller groups in a given society. Hence, personal experiences of individuals are thoroughly bound to larger characteristics of social structures, and goes beyond the control of a particular individual.

Furthermore, the same author explores the extent to which economic action is embedded in structures of social relations (Granovetter 1985). Findings reveal that social relations at individual level have a fundamental role in the development and organisational processes of economic institutions and for economic action. Similar to his paper from (1973), Granovetter show that most behaviour is closely embedded in networks of interpersonal relations, interconnected with a number of shared values, shaping economic public policy action.

It is therefore how experiences among individuals, based on and resulting in different inherent values, within informal networks at policy intervention level, that gender and gender relations is given its actual value. Based on these dyadic ties, the principles for gender equality integration are agreed upon and the agenda for action is then set.

How the demands of women farmers are considered in ICT devices are based upon institutional compromises between concerned actors

Institutional compromises result from a situation where tensions and conflicts arise between different socio-economic groups over a longer period in time, settling in an organisational type defining regulations, rights and legal obligations for the involved stakeholders (Delorme & André 1983). Institutional compromises thus become 'self-imposed' frameworks for which concerned populations and groups adjust their behaviour and strategies, and the fundamental principles remain unchanged in the long-term, e.g. the nature of institutional compromises in the balance of power concerning the distribution of economic resources and profits. The frameworks put in place proves to be particularly resistant to change and exerts a decisive influence upon the dynamics of government intervention (André 2002).

Delorme & André (1983) stress that there are four inherent dimensions to institutional compromises between actors. In first, are the origins of the compromise, i.e. emerging frictions and possible conflicts between socio-economic groups. Particularly since the interests of involved actors generally are subject to economic and financial interests on the one side, and social interests on the other. In second, the institutionalisation of these compromises requires the set-up of organisational forms, in turn creating laws, rights, and obligations. Hence, it inflicts a (non-objective) discipline vis-à-vis the institution originally appearing as a neutral measure for each actor. In third, is the theme concerning the institutional compromise, which sets the obligations for the concerned actors. The theme also unifies the institutes/actors advocating for a change, placing them in an advantaged power relation situation. The fourth dimension is the high robustness of these compromises once established, which is according to the authors, astonishing given that they are the result of a set of static choices, out of multiple possible solutions. As a result, *"The institutionalised compromises are thereupon imposed as set frameworks upon the population, where the concerned individuals adopt their behaviours accordingly."* (Personal interpretation from French from Delorme & André, 1983, p. 674).

In this regard, the services provided through ICT platforms, the types of services and knowledge content therein (and how the demands of women farmers are considered), are based upon power relations established between involved actors (and the representations these stakeholders have of female farmers). Hence, what are the established (implicit) institutional compromises between a government and non-public actors involved in the set-up of these platforms for an ensured dissemination of knowledge to female farmers (in need of technical knowledge to sustain farm yields)? Whose interests are prioritised in these devices?

Institutional coordination allows to understand how concerned actors are organised for an integration of the demands of women farmers

Institutional coordination, within a given sector or system (in this case farm advisory services), refers to the coordinating structures and bodies in place to interlink supply and demand (Laurent et al. 2006). It also comprehends the configuration of the interrelation between front-office activities (interactions between client and service supplier) and back-office activities (construction and update of databases based on field observations, monitoring, research).

Coordination structures in the context of farm advisory services (for instance, public or parastatal coordination structures), need to be in place to co-construct knowledge between female farmers and the service supplier. This, since these structures represent a variety of agricultural holdings and farmers, with heterogeneous objectives. It is therefore only the farmer

her- or himself that are able to express their vision of the farming project to the service supplier (Labarthe & Laurent 2011). In turn, the farm advisor provides technical expertise to the farmer. As such, the farmer is able to select and demand for the technologies and type of knowledge adequately suited to her or his priorities. Hence, the authors of this study provide evidence (1) in the importance of institutional coordination in farm advisory intervention, and (2) the consequences in the dismantling of such system, ultimately having a negative impact upon small-scale farmers' access to relevant and reliable services and technical knowledge.

Thus, institutional coordination structures ought to be ensured via policy intervention. It is via policy action, comprehending such type of organisational mechanisms, that the particular demands of female farmers can be taken into account. The set-up of adequate institutional coordination systems in the agricultural extension services system, and how gender equality is considered therein, depends however upon the political and economic agenda of a government.

Appendix 4: Technology and innovation in public policy: Evolutionary economic approaches

Evolutionary economists such as (David 1994; Arthur 1989; Freeman 1995; Freeman 2002) demonstrate the importance of technology and innovation, related to organisational innovation (e.g. institutional change) for economic development.

Dosi (1982) show that the history of a technology is contextual to the history of the industrial structures associated with that technology. The author stresses that there is a causal relationship between economic growth and technical progress (related to the role played by institutional factors and the rate and direction of innovative activity) vis-à-vis market mechanisms. Similar to Dosi, Freeman (1995, 2002) provides evidence in the fundamental role of national and regional systems of innovation in economic analysis, derived from networks of relations, necessary for any organisation to innovate. Accordingly, it is intangible investment in knowledge accumulation, adequately inserted in institutional structures that is decisive for the advancement of innovation and subsequently economic growth.

In this regard, it is argued that institutional and organisational innovation (e.g. the establishment of policy directives for the integration of women in the innovation, technology and entrepreneurship sector) are fundamental to avoid discriminations of different social groups (Ranga & Etzkowitz 2010). According to the authors, innovation is inherently gender-biased, as a result of an implicit, socially constructed assumption that women are less innovative and more technophobic than men. Their study show that such representations are caused by misplaced gender values embedded in technological institutions.

This school of thought has also studied the phenomena of 'technological lock-in', where one technology as a result of different factors (political, economic, social) is selected over another, leading to a lock-in of this technology (Arthur 1989; David 1985). The concept of technological lock-in describes any situation where technology A can be approved and permanently adopted at the expense of technology B, even though technology B appears as the most effective solution thereafter (Arthur 1989). The author shows how insignificant events may by chance give one competing technology advantage over the other and thus 'corner the market' of potential adopters, locking other technologies out (Arthur 1989). Such lock-in can equally occur under certain political circumstances and institutional dynamics, e.g. in the case of institutional comprises over emerging technologies. In this context, David (1994) highlight that institutions are carriers of history, assimilated with innovation and technological choices, where one solution is selected over another, as a result of path dependency. According to the author, technological innovation and organisational innovation are intrinsically linked.

It could be the case for new technological innovations in farm advisory services (Labarthe 2010). The author emphasises that some of the technical advice provided to farmers could potentially be 'locked-in' due to institutionalised power relations between actors. Labarthe provides the example of the transformation in the conditions and standards for knowledge production in the context of PPP set-ups. The modalities for knowledge production could be locked in as a result of an imbalance in power relations between actors in PPPs (for instance the validation of the type of knowledge that should be developed, disseminated and collected). As a consequence, and in the context of this research, certain of these emerging technologies and services could be more adequate for integrating gender equality but may be excluded due to a 'lock-out', overruled by another seemingly more appropriate at the time for political or economic reasons.

Appendix 5A: Open questions: Interviews with staff from the Kenyan Ministry of Agriculture at National Level

I wish to start this interview by asking you about your professional background.

1. Please tell me about the history of the emergence of e-extension services in Kenya.

2. Why has the Kenyan Government decided to invest in a number of emerging ICT services used in agricultural extension services?
   a. What is your opinion of newly emerging ICT services used in agricultural extension services?
   b. What are the gendered impacts as a result of these new e-services according to you?
   c. What are your thoughts on the future of knowledge based platforms such as the National Farmers Information Service (Nafis) in regards to farm advisory services? Who should they serve, i.e. who should be the end users?
      i. Can they become conflict of interest for direct farm advisory services?
      ii. If yes, how should these potential risks be handled?

3. How do you think that the devolution will impact the landscape of agricultural extension services?

4. How are you interconnected to other departments working with agricultural issues (e.g. livestock, fisheries, research, education, gender…)? Do you run any projects together?

5. What is your annual budget to carry out your operations?

6. From where do you get your finances? Is it solely governmental support or do you receive support from international donors? If yes, whom?

7. What government policies do you follow and report to in regards to farm advisory services (FAS) (and in particular e-extension)?

8. Do you work with gender mainstreaming and/or affirmative action measures? If yes, how?

9. Do you have monitoring and evaluation devices in place to measure the number of women and men in PPP and public devices in FAS? If yes, how many farming women and men are you presently covering?
   a. What services are they using per gender?
   b. Is there a difference?

10. Do you have specific financial reporting procedures in place able to verify if rural women's and men's demands are effectively integrated in PPP and public devices (within FAS)?

11. Do you have evaluation tools in place within the different policies that you have to adhere to able to measure if rural women and men's demands are effectively integrated in PPP and public devices (within FAS)?

12. Do the various government policies have a legal reporting framework in place (with particular procedures) guiding PPP and public devices on how to effectively integrate gender issues?
   a. If yes, what is this framework called?
   b. What are the results?

13. Do you have an evaluation tool in place measuring, within your policies, if gender mainstreaming is effectively integrating rural women and men's demands in PPP and public FAS devices?
   a. If yes, how is this measured?
   b. What are the results?

14. Do you have monitoring and evaluation devices in place to measure the importance of institutions and in particular women's groups?
   a. If yes, how are these results considered in the policies and administrative documents?

15. Do you have knowledge facilitation procedures in place within government policies and administrative documents to exchange knowledge between public entities and target groups (e.g. meetings between public support and different women's groups)?
   a. If yes, how is the feedback integrated and followed up?

16. Do you have an evaluation tool in place to measure if gender mainstreaming is integrating rural women's and men's demands? If yes, how is this measured? What are the results?

17. Do you have knowledge facilitation procedures in place within government policies and administrative documents to exchange knowledge between Ministries and target groups (e.g. meetings between Ministry staff and different target groups)?
   a. How many times per year is this done?
   b. How is the feedback integrated and followed up?

18. Do you have interaction tools in place in government policies and administrative documents (interaction between farmers and institutions)?

19. Do you have evaluation measures in place, assessing the performance of these tools? If yes, what are the results?

20. Do you have evaluation measures in place to evaluate if these tools are effectively addressing rural women's and men's demands?

21. Do you have an R&D policy and legal framework for gender research in farm advisory services?

22. Do you have an assigned R&D budget dedicated to gender research in farm advisory services? If yes, how much is this annually?

23. Do you have evaluation measures in place, assessing the performance of R&D in farm advisory services, and in particular for gender issues? If yes, what are the results?

24. Is there anything else that you wish to add?

Appendix 5B: Open questions: Interview with staff from the Kenyan Ministry of Public Service, Youth and Gender at National level

1. Tell me about your professional background (prior to this position).

2. What is your role at the Ministry?

3. When did you start working as Gender Specialist?

4. What is your annual budget to carry out your operations?

5. How are you structured and what operations / activities do you carry out to meet the needs of the farmers?

6. Do you work with gender mainstreaming and/or affirmative action measures?
    a. If yes, how?

7. How are you interconnected to other departments working with agricultural issues (e.g. livestock, fisheries, research, education…)? Do you run any projects together?

8. Please tell me about the history of agricultural extension services.

9. How did the structural adjustment programmes impact upon the landscape of agricultural extension services?
    a. And the small-scale farmers, women and men?

10. How do you think that the devolution will impact upon the landscape of agricultural extension services?
    a. And the small-scale farmers, women and men?

11. Why has the government decided to invest in a number of emerging ICT services used in agricultural extension services?

12. What is your opinion of newly emerging ICT services used in agricultural extension services?

13. What are the gendered impacts as a result of these new e-services according to you?

Appendix 5C: Open questions: Interviews with staff from the Kenyan Ministry of Agriculture, Machakos County

1. Tell me about your professional background.

2. What is your role at the Ministry?

3. What is your annual budget to carry out your operations?

4. How are you structured and what operations / activities do you carry out to meet the needs of the farmers before devolution?
    a. How did has this changed (after devolution)?

5. What is the total number of staff (full-time staff) working in your department?
    a. And in total for the Ministry of Agriculture and Livestock?

6. How many women and men are you at the office?

7. How are you interconnected to other departments working with agricultural issues (e.g. livestock, fisheries, research, education, gender…)?
    a. Do you run any projects together?

8. From where do you get your finances?
    a. Is it solely governmental support or do you receive support from international donors?
    b. If yes, whom?

9. How do you think that the devolution will impact upon the landscape of agricultural extension services?
    a. And the small-scale farmers, women and men?

10. Why has the government decided to invest in a number of emerging ICT services used in agricultural extension services?
11. What is your opinion of newly emerging ICT services used in agricultural extension services?

12. What are the gendered impacts as a result of these new e-services according to you?

Appendix 5D: Open questions: Interview with individual working at a University

March 7th 2016

I am conducting my PhD thesis at The French National Research Institute for Agricultural Research (INRA) and AgroParisTech in Paris, in Institutional Economics. I am assessing if emerging ICT tools, i.e. knowledge-based platforms accessible via the internet, in farm advisory services are carriers of implicit gender representations and thus provoking particular discriminations for women. The research is conducted in Kenya.

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1. I wish to start this interview by asking you to say a few words about your career.

2. What is your opinion on the future of ICT development in Kenya and what is the impact on the major economic sectors in Kenya (agriculture, health, education…)?
   a. In particular, with regards to the devolution and the role of the National Government, the Intergovernmental body and the County Government?
   b. What is the role of policy and legislation in this regard (in particular related to negative impacts of 'open' ICT, e.g. the post-election violence in 2007, gendered impacts, etc.)?
   c. You mention the importance of PPPs a number of times in the interview with Rushda Majeed[160]. In particular, in regards to the advancement of ICTs in Kenya. Who are generally the main actors in this type of partnerships and who provides the majority of the finances?

3. What are the gendered effects of the ICT development in Kenya[161]?
   a. And in particular in rural areas?
   b. How have gender issues been taken into account in the 2014-2017 ICT Master Plan[162]?

4. What is the role of ICT in agriculture in Kenya and in particular when it comes to farm extension services (knowledge-based platforms, mobile applications)?
   a. Are there public evaluation measures in place to assess the impacts of emerging ICT services in agriculture in Kenya? Or perhaps you and your team at the time in Government put in place such measures? If yes, which ones?
   b. What is the role of ICT suppliers in delivering agricultural services? How should these services be developed in order to meet the needs of the users?
   c. What, in your opinion, are the needs of ICT users, in this case the farmers[163]?

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[160] Interview dates: 18/06/2012 and 04/07/2012

[161] Based on your paper from 2007, *"Women entrepreneurs and strategic decision-making",* under *"Women and economic development",* it is mentioned that in 2000, 47 per cent of MSEs are women-owned in Kenya (USAID data), suggesting that this number will rise but that there are a few factors hampering this growth and women empowerment (e.g. sexual stereotypes, double-shift burden, gendered influence in decision making etc.). What is the role of ICT in addressing these gender inequalities?

[162] Based on the 2006 ICT Master Plan Summary made by yourself and team at the Ministry of Information and Communications at the time

[163] (Also referring to a transcribed interview with Rushda Majeed, 18/06/2012 and 04/07/2012, where you mention talk about subsistence farming and food insecurity, [quote] *"So the work "break-even" is not in any African language. "Productivity" is not in any African language. So the only language you use is that this is not helping because you are not able to meet your needs." (Majeed, 2012, pp. 13-14).*

5. I am analysing data from the Population and Housing Data (PHC) from 2009 in Kenya Eastern Province, trying to understand the numbers with the global figures from Kenya, in particular internet use and have some questions.

I have noticed that in 2009, there were very few internet users (in particular in rural areas; ~1% internet users at individual level per gender per county in Kenya Eastern Province). Women are using internet less as compared to men.

However, when I look at World Bank Data from 2009 on the number of internet users in Kenya (per 100 people), the numbers show an Internet using rate of 10% in Kenya. Let's have a look at the table below.

	2009		2010	
	Internet subscriptions	Internet users	Internet subscriptions	Internet users
Kenya National Bureau of Statistics (A)	4%		8%	
Kenya National Bureau of Statistics (B)	N/a		Female: 15,9% Male: 16,3%	
World Bank Data		10%		14%
PHC Eastern Province Data		1%		N/a

a. In 2009; How come there is such a discrepancy between the two sources?
b. The PHC raw data from the Eastern province in Kenya also gives a very low number of Internet users (in 2009; 14% of the Kenyan population). Where does the other 9% Internet users then come from in this case? What is your opinion?

By looking at data from KNBS in 2010, it is mentioned that the total fixed and wireless Internet subscriptions in Kenya were in total 8%. This result is not only for individual users, as I have understood it, i.e. it can be services providers, organizations, etc.

However, according to the same Statistical Abstract from 2015, in the year 2010, 16,3% and 15,9% men and women of the Kenyan population respectively had Internet subscriptions (how they got this result is not explained). But then, the source from KNBS mentions that there are in total 8% of Internet subscriptions in Kenya in 2010.

c. Do you know how to explain those figures?
d. What, according to you, is the positioning of the present Kenyan Government in regards to the Open Data Initiative? *(Do you still have a formal role in the Open Data Initiative today?)*
e. What is required for the initiative to gain importance in Kenya?
f. Has the Freedom of Information Law gone through in parliament in this regard? If no, why not?

6. Is there anything that you wish to add?

Appendix 5E: Open questions: Interviews with staff from Machakos Cooperative Union

1. Do you have knowledge facilitation procedures in place within the Cooperative Societies Act to exchange knowledge between cooperatives and target groups (e.g. meetings between cooperative employees and different women's groups)?
    a. If yes, how is the feedback integrated and followed up?

2. Do you have knowledge facilitation procedures and tools at Cooperative Society level to exchange knowledge between cooperatives and target groups (e.g. meetings between cooperative employees and different women's groups)?
    a. If yes, how is the feedback integrated and followed up?

3. Do you measure if and how rural women's and men's demands are integrated in your daily operations?

4. Do you have evaluation tools in place to measure if rural women's and men's demands are integrated?
    a. If yes, how was this framework developed?

5. Does the Cooperative Societies Act provide you with these evaluation tools?

6. Do you have an R&D policy for gender research in your organisation?

7. Do you have an R&D legal framework for gender research in your organisation?

8. Do you have an assigned R&D budget dedicated to gender research in your organisation?
    a. If yes, how much is this annually?

9. Do you have evaluation measures in place, assessing the performance of R&D in in your organisation, and in particular for gender issues?
    b. If yes, what are the results?

10. Do you use the principles of affirmative action in the Union?
11. Do you have an evaluation tool in place measuring if affirmative action is integrating rural women's demands?
    a. If yes, how is this measured?
    b. What are the results?

12. Do you have an evaluation tool in place measuring if the principles of affirmative action are integrating rural women demands?
    c. If yes, how is this measured?
    d. What are the results?

13. Do you have a legal reporting framework in place (with particular procedures) guiding the network on how to integrate gender issues?

14. Do you have an evaluation tool in place measuring if gender mainstreaming is integrating rural women's and men's demands?
    a. If yes, how is this measured?
    b. What are the results?

I have been assessing the Population and Housing Data (PHC) from 2009 in Kenya Eastern Province, trying to understand the numbers with the global figures from Kenya, in particular internet use.

I have noticed that in 2009, there were very few internet users (in particular in rural areas; ~1% internet users at individual level per gender per County at the time, and on average 1% internet users for rural Kenya Eastern Province). Women are using internet less compared to men.

However, when I look at World Bank Data from 2009 on the number of internet users in Kenya (per 100 people), the numbers show an Internet using rate of 10% in Kenya. Let's have a look at the table below.

	2009		2010	
	Internet subscriptions	Internet users	Internet subscriptions	Internet users
Kenya National Bureau of Statistics (A)	4%		8%	
Kenya National Bureau of Statistics (B)	N/a		Female: 15,9% Male: 16,3%	
World Bank Data		10%		14%
PHC Eastern Province Data		1%		N/a

World Bank definition of Internet users: *"Internet users (per 100 people): Internet users are individuals who have used the Internet (from any location) in the last 12 months. Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc."*

15. In 2009; How come there is such a discrepancy between the two sources?

16. The PHC raw data from the Eastern province in Kenya also gives a very low number of Internet users (in 2009; 14% of the Kenyan population, second largest after Rift Valley). Where does the other 9% Internet users then come from in this case? What is your opinion?

By looking at data from KNBS in 2010, it is mentioned that the total fixed and wireless Internet subscriptions in Kenya were in total 8%. This result is not only for individual users, as I have understood it, i.e. it can be services providers, organisations.

However, according to the same Statistical Abstract from 2015, in the year 2010, 16,3% and 15,9% men and women of the Kenyan population respectively had Internet subscriptions (how they got this result is not explained). But then, the source from KNBS mentions that there are in total 8% of internet subscriptions in Kenya in 2010.

Appendix 5F: Contextual analysis: Open questions with staff in Machakos County

I. Agricultural landscape in Machakos County

1. What is the agricultural development and farming history in Machakos County?
2. What does the farming systems look like here? Which agricultural activities generate the most income? Who controls what activities in the household?
3. Has this changed since independence and onwards?
4. How has extension services changed since the beginning of the 1990s?
5. How has this affected the production levels?
6. How has different groups in society been affected?
7. Who has been and who are the target groups for extension services/cooperatives?
8. Is coffee an important crop in the region? If yes, why?
9. How has the production levels been evolving since independence and onwards?
10. Who is mainly responsible for coffee production in the farms?
11. What has been and what is rural women's role in the evolution of the agricultural landscape and farming systems?
12. What is the role of farming and agriculture to women according to you?

13. Sketch of the coffee value chain (actors, prices, sex disaggregated)

II. Asset base

II.1. Management of household assets and benefits

1. Who manages what household tasks?
2. What have been and what are women's roles in the household according to institutions?
3. Who manages what agricultural activities on the farm?
4. Do women and men get the same access to different services and groups? If yes, what services do men and women get from different groups and how do it different per gender?

II. 2. Rights/claims/control over assets

1. What are the existing farming[164]/land structures[165] in the county?
2. Who owns land in general?
3. Can land/other assets (e.g. coffee plots) be accessible for 'excluded' groups through social networks (e.g. cooperatives)?
4. Are the assets divided differently amongst women and men?
5. Are different types of plots more or less likely to be owned by different groups within the household (e.g. younger women, older men)?
6. Does land tenure/ownership or plot type differ by gender?
7. Do agricultural activities or inputs vary across plots owned by men and women?
8. How do inputs and activities on men's and women's plots change over time?

II.3. Decision-making around community assets (e.g. access to knowledge and services, centres/cooperatives, communal land)

1. Who decides about community assets in the household?
2. How does decision-making around community assets prevent women from gaining access to or affecting decisions in to their decision management?
3. How does decision-making around community assets enable women from gaining access to or affecting decisions in to their decision management?

II.4. Claiming rights, participation in decision making

1. Do you use the Constitution of Kenya (2010) throughout your work?
2. If yes, how?

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[164] Own land and own land use; renting out, renting in; "pure" sharecropping in; "pure" sharecropping out; "cost-sharing" sharecropping in; "cost-sharing" sharecropping out; communal land; borrowed land in; borrowed land out

[165] Government title, customary tenure (no written title: inherited, family, or clan land), no title, leased from government, private lease

3. Do you use the National Gender and Development Policy in your work? If yes, how? If no, why not?

4. Have you been able to use it to allow women and youth to get better access to different assets/resources/information[166]?

5. What is gender mainstreaming to you?

6. Have you received a specific training in gender mainstreaming? If yes, have you been able to use this knowledge within your work? How?

7. If no, would you like to be trained in gender mainstreaming? If yes, why? If no, why not?

8. What other policies are you working according to? How?

III. Decision-making

1. What are the ways (strategies) employed by women to access different services?

2. What are the consequences, i.e. how has this affected them socially and economically?

IV. Awareness and Innovation

1. How has local knowledge been changing and why?

2. How is local knowledge valued and used?

3. How do the values and beliefs of men and women differ?

4. Is there any possibility to get access to different community organisations? If yes, what institutions? What role to they play?

5. Is this something that is appreciated by the family members and the community?

V. Knowledge and Information

1. Where do you get access to information and knowledge?

2. How are you linked to different research institutions and universities?

3. What are the methodologies/tools that you use? T&V, FFS, 1 to 1 advice, demo day, FO meeting, community meetings

4. What are the advantages/disadvantages with these tools/methodologies?

5. What type of advice/information to you provide to the farmers? What information do you support them with?

6. Is it being adopted by the farmers? Any specific group? If not, why?

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[166] Specific objective in the policy (2.2.2.d): *Re-orientate extension services to emphasise gender sensitisation and participatory planning to enhance their responsiveness to the needs of women*

VI. Institutions and Governance

1. Where do you get your finances from?
2. Do you know if you are part of a programme or a project?
3. If yes, what is the name of the programme/project (and objective), who are you targeting and who are the donors?
4. Are you using the Gender and Development Policy and/or the Constitution of Kenya is this regard?
5. Do you have specific gender activities within this programme/project? If yes, which?
6. Are you targeting any specific value chains?
7. Have you budgeted for these activities?
8. Who are your target groups (in general)? (related to tools and methodologies)
9. How often do you go out to see the farmers? Do you assist farmers continuously or is it "once in a while" visits?
10. Is it per request (i.e. demand from the farmers)? If yes, who in the household generally asks for advice?
11. Does it imply a cost for the farmer (for the advice)? If yes, how much?
12. Would you say that a certain group has been/is being excluded? If yes, who and why?
13. Do you know if the information is relevant and accessible for all groups? If yes, how?
14. What are the different types of groups that men and women are members of? What are the barriers to group membership for both sexes?
15. Have you started involving women in the services that you provide? If yes, what are the implications on their workload?

Appendix 5G: Semi-open questionnaire with staff from the Ministry of Agriculture, Machakos county

Section 1: Job description

a. Are you:

☐ Female
☐ Male

b. What is the highest form of schooling you attended (select ONE OPTION ONLY)?

☐ None
☐ Primary education
☐ Secondary education
☐ Tertiary education
☐ University degree

c. Are you an extension officer?

☐ Yes
☐ No

d. Specify your employer: _____

e. Do organisations, other than your formal employer, contact you to delivery advisory services to farmers?

☐ Yes (answer to (i) below)
☐ No

i. Please specify the name of this/these organisation(s):

_____

f. Specify your current title: _____

g. Specify in what county(ies) you operate: _____

h. Do you manage other staff?

☐ Yes
☐ No

i. Are you:

☐ Agriculture extension officer
☐ Livestock extension officer
☐ Veterinary extension officer
☐ Horticulture and crop extension officer
☐ Other? Please specify: _____

_____

Section 2: Access to and usage of Information and Communication Technology (ICT)

a. Do you have a smart phone?

☐ Yes
☐ No

b. Do you regularly (once per month or more) use a computer yourself?

☐ Yes
☐ No

c. Do you feel comfortable reading and accessing information from a computer screen?

☐ Yes
☐ No

d. How often do you use Internet (ex: email, chatting, accessing information, etc.) – (select ONE OPTION ONLY)?

☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Less than yearly
☐ Never

e. Where did you mainly use the Internet (select ONE OPTION ONLY)?

☐ Own house
☐ A friend's house
☐ Community groups (for example: Agriculture group; Micro-finance group; VSLA group…)
☐ Office/workplace
☐ Cyber café
☐ Community center
☐ Education center
☐ Cooperative society
☐ Through the mobile phone
☐ Other, please specify: _____

Section 3: Delivery of farm advisory services

a. What method do you mainly USE to deliver a service to the farmer (ONE OPTION only)?

☐ Meeting in person individually
☐ Meeting in person in group trainings
☐ Over the mobile phone
☐ Over the landline phone
☐ Per SMS
☐ Through participation in farm TV show (e.g. Shamba Shape Up)
☐ Through participation in radio talk (providing advice via the radio)
☐ Interacting with the farmer on a website using Internet (e.g. blog, forum, chatting, Facebook, Twitter…)
☐ Other? Please specify: _____

b. How often do you interact with farmers?

☐ Daily
☐ Weekly

☐ Monthly
☐ Yearly
☐ Less than yearly
☐ Never

c. What is generally the gender of the persons that you deliver farm services to (ONE OPTION only)?

☐ Women
☐ Men

d. Has this interaction with farmers changed since the last 20 years?

☐ Decreased (answer nr. (i) below)
☐ Increased (answer nr. (ii) below)
☐ Remained the same

i. If this interaction has decreased, please explain why.

ii. If this interaction has increased, please explain why.

e. What service delivery method do you mainly PREFER? Please score the following options with 1=preferred option and 7=least preferred option).

Service delivery method	Scoring
Meeting farmer individually at their farm	
Meeting farmers in group trainings	
Giving advice to farmer per SMS	
Giving advice to farmer over the phone	
Giving advice to farmer via website using Internet (e.g. chatting, Facebook, Twitter…)	
Giving advice to farmer over the radio (e.g. talk programs)	
Giving advice to farmer through TV shows	

f. Does the client/farmer pay for the service delivery?

☐ Yes (answer nr. (i) and (ii) in question g below)
☐ No
☐ Sometimes (answer nr. (i) and (ii) in question g below)

g. If you answered "yes" or "sometimes" to the question above, please specify:

i. How much the farmer generally pays for the service: _____KES

ii. To which organisation this fee goes to: _____

Section 4: Access to and usage of Nafis and/or AgriProFocus Platforms to deliver farm advisory services

a. Have you been able to retrieve knowledge from from any of these two platforms to delivery farm advice to farmers?

Nafis (The National Farmers Information Service)	☐ Yes (if yes, proceed to the following questions) ☐ No (if no, you can stop here) ☐ Not aware of platform (if not aware, you can stop here)
AgriProFocus	☐ Yes (if yes, proceed to the following questions) ☐ No (if no, you can stop here) ☐ Not aware of platform (if not aware, you can stop here)

b. How did you mainly ACCESS the service (You can select MULTIPLE options)?

Nafis (The National Farmers Information Service)	☐ A computer using Internet myself ☐ A computer using Internet with the help of somebody ☐ Interacting with another advisor on Internet (chatting) ☐ Interacting with another advisor over the phone ☐ Interacting with another advisor through SMS on my phone ☐ Through an organized training on the platform ☐ Through direct advice from Nafis staff ☐ Other? Please specify and their role
AgriProFocus	☐ A computer using Internet myself ☐ A computer using Internet with the help of somebody ☐ Interacting with an advisor on Internet (chatting) ☐ Interacting with an advisor over the phone ☐ Interacting with an advisor through SMS on my phone ☐ Through an organized training ☐ Other? Please specify ad their role:

c. If you use Nafis to gain knowledge to delivery advisory services, for what purpose specifically (You can select MULTIPLE options)?

☐ Agricultural production information and agronomic practices
☐ Economic management of the farm
☐ Marketing management

d. If you use AgriProFocus to gain knowledge to delivery advisory services, for what purpose specifically (You can select MULTIPLE options)?

☐ Agricultural production information and agronomic practices
☐ Economic management of the farm
☐ Marketing management

e. Can you please tell me how you specifically use the service based on your answer above?

f. How often do you use the service?

g. Have you interacted with any person from the platform?
☐ Yes (answer to (i); (ii); (iii); (iv))
☐ No
   i. What are the different ways that you can interact with the platform?
   ii. Is it generally a mix between interacting with persons, getting information by reading on the platform website with phone or computer and/or via SMS services?
   iii. Do you always interact with the same person or is it different persons (by email, online chat, phone, etc.…)?
   iv. Do you think that it is easy to get in contact with the persons working with the platform to gain better knowledge when you deliver advisory services to farmers?

h. Do you feel confident when sharing a knowledge/an experience on the platform accessible by other advisors/farmers/people?
☐ Yes, why?
☐ No, why?

i. Do you use other sources of knowledge (for instance organized trainings) to complement the information you receive from the platform?
☐ Yes, why and which?
☐ No, why?

j. Are you satisfied with the knowledge and information provided from each platform (0=very dissatisfied; 1= dissatisfied; 2=either or; 3=satisfied; 4=very satisfied)

Nafis	0	1	2	3	4
AgriProFocus	0	1	2	3	4

k. Could you please comment on why you gave this score to the platform(s)?

l. Have you used any other platforms accessible via Internet not mentioned here?
☐Yes
☐No

m. If yes, kindly provide the name of the platform:

n. If you are not aware of any of these services and not using these networks, how come?

THANK YOU FOR YOUR COOPERATION!

Appendix 6A: Open questionnaire: Interviews with Nafis platform staff

1. Tell me about your professional background (prior to Nafis)

2. What is your role at Nafis and when did you start working for Nafis?

3. When was Nafis launched?

4. What is the primary objective of Nafis?

5. What is the organizational type of Nafis (public, PPP, NGO, CSO, private…)?

6. Do you think that certain areas in the platform could be improved?

7. How is Nafis structured (HQ placement, county offices…)?

8. What is your connection to the Ministry of Agriculture and Livestock? Where is Nafis place in the organogram of the Ministry of Agriculture and Livestock?

9. Who is the target group?

10. What type of gender structures does Nafis have in place / put in practice? (I.e. type action guideline applied; administrative documents used to support gender equality; evaluation and coordination measures in place to support gender equality; gender disaggregated data…)

11. Is Nafis based on a demand or supply based model?

12. What are the services you are offering to your target groups, i.e. what type of interaction model do you have in place (consulting, phone, Q&A, SMS via iShamba…)?

13. Are the services / trainings you deliver to the targets groups changed depending on the needs of the target groups?
14. Is the content of the training material adjusted according to the target group's needs?
15. What system does the platform have in place to verify whether the results respond to the platform objective(s) of the platform and the interaction quality with the target group?
    a. Can the target group add inputs/knowledge to the platform?
    b. Can they request certain type of knowledge and information?

16. How are you reaching out to the different target groups?

17. What are the types of contracts established between the supplier and the target groups?

18. How do you proceed when you develop training material and reports (R&D)?

19. Where does the platform get its information sources (R&D)? How is the research conducted?

20. What is your annual budget? Has it changed over the years?

21. From where do you get your finances? Is it from governmental support or do you receive support from international donors? If yes, whom?

22. How many full-time staff are you working at Nafis?

23. Is the service free of charge or not? If no, what is the cost / client?

24. Does the Government subsidize the services offered by Nafis?

25. Is NAFIS an economically self-sufficient organisation?

Appendix 6B: Open questions: Second interview with Nafis platform staff

1. When you have your quarterly content update meetings:
    a. Do you update the content for all 19 value chains that Nafis covers?
    b. If no, what decision procedures to you have in place to decide on what content that should be updated?
    c. Could you please tell me what stakeholders that are always involved during update of the content?
    d. Do you involve Nafis target groups, i.e. the producers? If yes, how? Every time?
    e. When content is altered based on feedback from clients, do you have a threshold of the number of clients that must complain about that content in order for you to change it?

2. Is the Nafis blog an interactive tool, i.e. can you post comments, findings, links, etc.?

3. Do you have a set response time-line when providing answers to clients (on the blog or the feedback window)?

4. Does Nafis have knowledge facilitation procedures in place facilitate to exchange knowledge between your staff and the target groups (e.g. meetings between staff / partners and different target groups)?
    a. If yes, how many times per year is this done?
    b. How is the feedback integrated and followed up?

5. Do you have a budget dedicated specifically for knowledge facilitation activities between staff, partners and farmers and/or farmer groups (e.g. workshops, trainings, etc.)?

6. Does Nafis adhere to any R&D policy and legal framework for gender research in farm advisory services?

7. Does Nafis have a budget to implement gender related activities?

8. Do you have an assigned R&D budget dedicated to gender research in farm advisory services?
    a. If yes, how much is this annually?

9. Do you have evaluation measures in place, assessing the performance of R&D in farm advisory services, and in particular for gender issues?
    a. If yes, what are the results?

10. Do you have a monitoring system in place measuring what services are used and not used by users and in particular women (e.g. more women compared to men are writing and sharing agricultural experiences on the platform, etc.) and how these services are used?
    a. If, how are the results used?

11. Do you have a budget dedicated for this type of monitoring system?
    a. If yes, how much is this annually?

12. From Google analytics:

a. Can you see from where the individuals are accessing the platform? I.e. in Kenya or other countries.
b. Can you determine if it is the same individuals accessing the platform multiple times or if it is different individuals?
c. Do you pay for this system? If yes, how much?

13. To what extent do you have to adhere to Kenya's Gender Policy? Do you have indicators that you follow based on the Gender Policy?

14. To what extent do you have to adhere to Kenya's ICT Policy? Do you have indicators that you follow based on the ICT Policy?

15. To what extent do you have to adhere to Kenya's National Agricultural Sector Extension Policy? Do you have indicators that you follow based on this Policy?

16. Do you have an evaluation tool in place measuring if affirmative action is integrating rural women's demands in the platform?
a. If yes, how is this measured?
b. What are the results?

17. Do you have an evaluation tool in place measuring if gender mainstreaming is integrating rural women and men's demands in the platform?
a. If yes, how is this measured?
b. What are the results?

18. What are your thoughts on the future of knowledge based platforms such as Nafis in regards to farm advisory services?
a. Who should they serve, i.e. who should be the end users?
b. Can they become conflict of interest for direct farm advisory services? If yes, how should these potential risks be handled?

19. And last questions:
a. How many staff are in total working for ASDSP at National level?
b. Do you know how many staff that are in total working for ASDSP in Kenya (County and National level)?
c. And how many of these staff are working with Nafis?

Appendix 7A: Open questions: Interviews with AgriProFocus staff

I. Module 1: Governance criteria

1. What are, according to you, the needs of (rural) women?

2. What are the objectives of the platform (according to you)?

3. Do you think that certain areas in the platform could be improved? What is difficult when working with this type of platform?

4. How many women and men are you at the office and what are your respective roles?

5. Type of model of the platform, i.e. demand or supply based?

6. Thematic and crosscutting knowledge of staff
   a. Have you been trained on how to work with crosscutting areas, in particular gender issues?
   b. Do you work with crosscutting areas for instance on gender issues?
   c. What is your understanding of gender issues?
   d. How does the organisation work with gender issues?
   e. Does the platform have a definition of gender mainstreaming?
   f. What is your opinion of gender mainstreaming?
   g. With whom do you discuss on gender (mainstreaming) issues?
   h. How do you work with gender mainstreaming in practice?

II. Module 2: Institutional access

1. Who are the target groups of the platform?

2. What are the different types of interaction that you have with the target groups?

3. What type of interaction model do you have in place (consulting, phone, Q&A)?
4. Have, according to you, possible obstacles been identified hindering them from getting access to certain types of information and thus knowledge?

5. What are the type(s) of access to different institutions the target group(s) receives via your platform?
   a. What types of services are offered to the platform members? And to the target groups?
   b. How often are the same target group visited per annum? And for how long generally?
   c. What are the types of contracts established between the supplier and the target groups?

6. What are the different types of information and communications technologies (channels) used by the platform?
   a. What problems can you foresee for different platform participants to access the platform?

b. Are there any particular groups of participants that have larger issues accessing the platform?

III. Module 3: Technical content

1. Type of learning processes
   a. What are the different information and knowledge techniques you are using to reach out the to target groups?
   b. What are the financial and technical means you use to deliver your services?
   c. Can the target group be co-innovators of the platform according to you?

2. What type of knowledge produced within the platform is out of reach to any of your target groups would you say?

3. Are the services / trainings you deliver to the targets groups changed depending on the needs of the target groups?

4. Is the content of the training material adjusted according to the target group's needs?

IV. Module 4: Assessment criteria

1. What system does the platform have in place to verify whether the results respond to the platform objective(s) of the platform and the interaction quality with the target group?
   a. Can the target group add inputs/knowledge to the platform?

   b. Can they request certain type of knowledge and information?

2. How do you proceed when you develop training material and reports (R&D)?

3. Where does the platform get its information sources (R&D)? How is the research conducted?

V. Module 5: Material access

1. Geographical proximity: How are you reaching out to the different target groups?

2. Timeliness of material access
   a. How do you deliver a certain type of service / information / knowledge?
   b. If a certain service is delivered to a target group is the time component (month, day, hour…) taken into account according to the target groups' constraints?

3. Need to access hardware, e.g. computer, Wi-Fi
   a. How is the access to hardware and software (particularly for certain target groups) ensured in order to get access to the information and knowledge stored in the platform?

VI. Module 6: Immaterial access

1. Assessment of target group capacities / Knowledge inventory of the target group
   a. How are the knowledge levels assessed of your target groups?

b. How do you know what type of knowledge the different platform participants possess/dispose of?

2. Do you know if an analysis of the various demographical indicators that your targeted audience possess is done?

3. What is the platforms' response if there is a demand from the end user that is not addressed / lacking in the platform?

4. How, according to you, are the priorities of the target group(s) assessed in the platform?

VII. Module 7: Futureability

1. What are the (different) funding mechanisms in place of the platform?

a. Do these funding mechanisms / partnerships have similar forms each time or is it generally different agreements?

2. What opportunities have been identified (especially in regards to the target group) as a result of the development and implementation of the platform?

3. What risks have been identified (especially in regards to the target group) as a result of the development and implementation of the platform?

Is there anything else you wish to add that I haven't asked about?

Appendix 7B: Open questions: Interview with AgriProFocus staff for cross-verifications

1. Kindly tell me about your professional background (prior to AgriProFocus).
2. Is AgriProFocus an NGO, private organisation, public entity?
3. Will this change in the future?
4. What is the purpose of AgriProFocus?
5. What is APFs connection to the Government of the Netherlands?

Appendix 7C: Online closed survey of AgriProFocus users in Kenya, administered by AgriProFocus Kenya

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SECTION 1: Characteristics of the household

a. Head – Is the head of the household:

☐ Widow
☐ Non-widow
☐ Bachelor

☐ Female
☐ Male

b. Marriage composition

☐ Monogamous
☐ Polygamous

c. Household composition

☐ Total number of adult males _____

☐ Total number of adult females _____

d. Which part of the value chain are you involved in?

☐ Production (primary farming)
☐ Processing
☐ Marketing
☐ Service provider (packaging, transport & logistics)
☐ Business development services – extension etc.

e. Is there a farming activity in the household? (You can select MULTIPLE options, for instance if you have livestock, coffee and crop farming you can tick all three options)?

☐ Crop farming
☐ Livestock farming
☐ Coffee farming

f. If you are a farmer, please specify the number of acres you are farming on

☐ < 1 acre
☐ 1 acre to 5 acres
☐ > 5 acres

SECTION 2: Individual characteristics

a. Sex

☐ Female
☐ Male

b. Kindly specify your age (years):

c. Do you consider yourself as the household head?

☐ Yes
☐ No

d. If you have answered NO to question above, then you are NOT the household head: Kindly tell us your relationship to the household head (you MUST be living in the same household unit and select ONE OPTION ONLY):

☐ Spouse
☐ Son/Daughter
☐ Grandchild
☐ Brother/Sister
☐ Father/Mother
☐ Other
☐ Nephew/Niece
☐ In law
☐ Grandparent
☐ Other relative
☐ Non-relative

e. Please cite the number of persons living at the household (including children and elderly)?_____

f. What is the highest form of schooling you attended (select ONE OPTION ONLY)?

☐ None
☐ Primary education
☐ Secondary education
☐ Tertiary education
☐ University degree

g. What do you work with (select ONE OPTION ONLY)?

☐ Worked for pay
☐ Salaried worker
☐ Working at home
☐ On leave
☐ Sick leave
☐ Work on own/family business
☐ Work on own agricultural holding
☐ Apprentice/intern
☐ Volunteer
☐ Seeking work (action taken)
☐ No work available
☐ Retired
☐ Homemaker
☐ Full-time student
☐ Incapacitated
☐ Other, please specify

h. Are you the member of any cooperative society?

☐ Yes
☐ No

SECTION 3: Access to and usage of Information and Communication Technologies and services

f. Do you regularly (once per month or more) use a computer yourself?

☐ Yes
☐ No

g. Do you feel comfortable reading and accessing information from a computer screen?

☐ Yes
☐ No

h. Have you received any agricultural service from the following items?

☐ Radio
☐ TV Set
☐ Mobile phone
☐ Landline
☐ Computer without Internet
☐ Computer using Internet
☐ Agricultural extension officer
☐ Livestock extension officer

i. Who in the household uses Internet (you can select MULTIPLE OPTIONS)?

☐ Myself
☐ My spouse
☐ My children
☐ A friend
☐ My parents
☐ Someone else; please specify

j. How often do you use Internet (ex: email, chatting, accessing information, etc.) – (select ONE OPTION ONLY)?

☐ Daily
☐ Weekly
☐ Monthly
☐ Yearly
☐ Less than yearly
☐ Never

k. Where did you mainly use the Internet (select ONE OPTION ONLY)?

☐ Own house
☐ A friend's house
☐ Community groups
☐ Office/workplace
☐ Cyber café
☐ Community centre
☐ Education centre
☐ *Cooperative society*
☐ Through the mobile phone
☐ Other, please specify

l. What source do you prefer getting agriculture service information from (select ONE OPTION ONLY)?

☐ Internet
☐ Over the phone
☐ Per SMS
☐ Meeting in person in group training
☐ Meeting in person individually
☐ Other? Please specify

SECTION 4: Access to and usages of AgriProFocus platform

a. Are you an active member of the AgriProFocus online platform?

☐ Yes
☐ No

b. How often do you log on to the online platform?

☐ Daily
☐ Once a week
☐ Once a month
☐ Quarterly
☐ Yearly
☐ Not at all

c. How did you mainly ACCESS the platform (You can select MULTIPLE options)?

AgriProFocus	☐ A computer using Internet myself ☐ A computer using Internet with the help of somebody ☐ Interacting with AgriProFocus over the phone ☐ Through networking events organised by AgriProFocus ☐ Other? Please specify and their role:

d. If you used AgriProFocus, for what purpose specifically (You can select MULTIPLE options)?

☐ Agricultural production information and agronomic practices
☐ Economic management of the farm
☐ Information sharing and learning
☐ Get contacts in the agribusiness sector
☐ Market products and services

e. Have you interacted with any person from the platform?

☐ Yes
☐ No

i. What are the different ways that you can interact with the platform?

☐ One on One Conversations with members
☐ Interaction on the online platform
☐ Referrals by members of the platform
☐ Reading information from the On-line platform

ii. Do you always interact with the same person or is it different persons?

☐ Yes
☐ No

iii. Do you think that it is easy to get in contact with the persons working with the platform for (agricultural) advice?

☐ Yes
☐ No

f. Do you feel confident when sharing information or experiences on the platform accessible by other farmers/people?

☐ Yes, why?
☐ No, why?

g. Do you use other farm advisory services to complement the information you receive from the platform (e.g. direct advice from other farmers, extension officer, SMS, group trainings…)?

☐ Yes, why and which?
☐ No, why?

h. How often do you use these "other" farm advisory services (every day, once per week, once per month, sometimes, rarely…)?

☐ Daily
☐ Once a week
☐ Once a month
☐ Quarterly
☐ Yearly
☐ Not at all

i. Do you prefer receiving other types of advisory services rather than from the platform (e.g. direct advice from other farmers, extension officer, SMS, group trainings…)?

☐ Yes
☐ No

i. If yes, which advisory services?

☐ Direct farm advisory services
☐ SMS based information
☐ Group trainings
☐ Leaflets, books, other training material
☐ Other? Please specify

j. Are you satisfied with the information (0=very dissatisfied; 1= dissatisfied; 2=either or; 3=satisfied; 4=very satisfied)?

AgriProFocus	0	1	2	3	4

k. What are the three main benefits of using the AgriProFocus online platform?

1.	
2.	
3.	

l. What are the three main pitfalls of the AgriProFocus online platform?

1.	
2.	
3.	

m. Have you used any other platforms accessible via Internet not mentioned here?

☐Yes
☐No

n. If yes, kindly provide the name of the platform:
o. How does the AgriProFocus online platform compare to other platforms?

	Extremely Useful	Very Useful	Moderately Useful	Slightly Useful	Not useful at all
Knowledge Sharing					
Market Place					
Contacts					

p. What can the AgriProFocus online platform improve to serve you better as a user?
q. It what County in Kenya is your business located?
r. Would you be interested in answering some additional questions? Please tell us:
    1) Name:
    2) Email:
    3) Phone:

Appendix 8: Closed survey of small-scale farmers in Machakos county

Access and Utilization of Information and Communication Technologies and Services /*makulyo-kukwata na kutumia mauvoo ma kuneenania na ui wa kiumunthi*

Survey period: Beginning January 2016 – Mid-March 2016/ ivinda ya makulyo aa ni kuma mwei wa mbee 2016 kuvika mwei wa katatu 2016

PLEASE notify the respondent that /tavya ula ukusungia atii:

- This survey is anonymous/ndukaandike isyitwa
- It will take 10 minutes of their time/makulyo aa wisungia na ndakika ikumi
- It should be filled in by the selected person ONLY and the same person CANNOT fill in the survey twice /makulyo aa maikasungiwe ni mundu keli

---

SECTION 1: Characteristics of the household /muungamie wa musyi ailyi ata

g. Head – Is the head of the household /*muungamie wa musyi* (Code: M1)*:*

☐ Widow/*ndiwa*
☐ Non-widow/*mundu wina muume*
☐ Bachelor /*mundu utatwaanite*

☐ Female / *Mundu muka*
☐ Male / *Munduume*

h. Marriage composition/*mutyaanile* (Code: M2)

☐ Monogamous/*mundu wi kiveti kimwe*
☐ Polygamous/ mundu wi iveti mbingi

i. Household composition /*museuvilye wa musyi* (Code: M3)

☐ Total number of adult males:/*aume ala aima*_____

☐ Total number of adult females:/*aka ala aima*_____

j. Is there a farming activity in the household? (You can select MULTIPLE options, for instance if you have livestock, coffee and crop farming you can tick all three options)? /*musyi kwenyu nimuimaa na muimaa kyau kati wa syindu ithyi syi vaa itheo?* (Code: M4)

☐ Crop farming/*uimi wa mimea*
☐ Livestock farming/*uimi wa ngombe*
☐ Coffee farming /*uimi wa kaawa*

k. If you are a farmer, please specify the number of acres you are farming on /*ethiwa wi muimi wa kaawa,wina kaawa eka siana* (Code: M5)

☐ < 1 acre/ *itheo wa eka umwe*
☐ 1 acre to 5 acres /*kati wa eka umwe na eka itano*
☐> 5 acres /*mbee wa eka itano*

SECTION 2: Individual characteristics/*mwikalile wa kimundu*

a. Sex/ *Muvai* (Code: M6)

☐ Female / *Mundu muka*
☐ Male / *Munduume*

b. Are you a farmer? *We wi muimi?* (Code: M7)

☐ Yes/ *ii*
☐ No/ *ayie*

c. Kindly specify your age (Code: M8):_____years/ *Elesya ukuu waku* _____

d. Do you consider yourself as the household head? *Niwiyosaaa we ta wimuungamii wa musyi waku?* (Code: M9)

☐ Yes/ *ii*
☐ No/ *ayie*

e. If you have answered NO to question above, then you are NOT the household head: Kindly tell us your relationship to the household head (you MUST be living in the same household unit and select ONE OPTION ONLY): / *Kethiwa usungiite tautemungamii wa musyi waku elesya we uilenie ata na mweene musyi usu wikalaa?* (Code: M10)

☐ Spouse / *kiveti kana musee wa musyi usu*
☐ Son/Daughter / *Mwana wa musyi usu*
☐ Grandchild / *Mwisukuue*
☐ Brother/Sister / *Mwana* inya/ithe
☐Father/Mother / *Asyai*
☐Other/*undu ungi*
☐ Nephew/Niece / *Syana sya ana syenyu*
☐ In law / *Athoni*
☐ Grandparent / *Umae/Usue*
☐ Other relative / *Andu ma musyi*
☐ Non-relative / *Atui*

f. Please cite the number of persons living at the household (including children and elderly) /*mwikalaa mwi meana musyi usu vamwe na syana na andu aima* (Code: M11)*?*_____

g. What is the highest form of schooling you attended (select ONE OPTION ONLY)? / *Kiwango kya kisomo kyaku?* (Code: M12)

☐ None/ *Ndwaasoma*
☐Primary education / S*ukulu ya kwambiia/primali*
☐ Secondary education / *Sukulu ya katikati/ sekondali*
☐ Tertiary education / *Sukulu / kisomo kyau uvundi / kolengi (college*)
☐University degree / *Kisomo kya iulu (University*)

h. What do you work with (select ONE OPTION ONLY)? *Uthukumaa wia mwau*? (Code: M13)

☐ Worked for pay /*wia wa kuivwa kila muthenya*
☐ Salaried worker /*wia wa musaala wa kila mwei*
☐ Working at home/*uthukumaa musyi*
☐ On leave/ *niluusa*
☐ Sick leave/*ni muwau*
☐ Work on own/family business/*uthukumaa wia wa andu mamusyi*
☐ Work on own agricultural holding /*uthukumaa muundani*
☐ Apprentice/intern/*wivundiasya wia*
☐ Volunteer/*wi yumitye kuthukuma andu mana*
☐ Seeking work (action taken)/*niendee kumantha wia*
☐ No work available/*vai wia wakutethya*
☐ Retired/ninaminie myaka yakwa ya wia
☐ Homemaker/*wi museuvya wa musyi*
☐ Full-time student/*ni sukulu*
☐ Incapacitated /*nditonya wia*
☐ Other, please specify/*wia ungi,weta ni wiva*

i. Are you the member of this cooperative society? /*wi umwe wa ala maseuvitye kyama kya ngwatanio* kya aimi? (Code: M14)

☐Yes / *ii*
☐No / *ayie*

SECTION 3: Access to and usage of Information and Communication Technologies and services /*kukwata na kutumia mauvoo ma kuneenania na ui wa kiumunthi*

m. Do you regularly (once per month or more) use a computer yourself? / *Niwisaa kutumia kombyuta kwa mavinda wiweka uteuteetheswa ni mundu?* (Code: M15)

☐ Yes / *ii*
☐ No / *ayie*

n. Do you feel comfortable reading and accessing information from a computer screen? / *Ni withwaa wimwianiie uisoma kana kutumia kombyuta?* (Code: M16)

☐ Yes / *ii*
☐ No / *ayie*

o. Have you received any agricultural service from the following items? (You can select MULTIPLE options) /*waa kwata mauvoo ma uimi kati wa imwe sya syindu ii syi vaa nthi?* (Code: M17)

☐ Radio/*kameme*
☐ TV Set/*televiseni*
☐ Mobile phone/*simu ya kwoko*
☐ Landline/*simu ya nyumba*
☐ Computer without Internet /*kombyuta itengwatanie naingi*
☐ Computer using Internet/*kombyuta ngwatanie na ingi*
☐Agricultural extension officer/*mundu wa ndilikasa*
☐Livestock extension officer/*mundu wa kuiita indo*

p. Who in the household uses Internet (you can select MULTIPLE OPTIONS)? /*nuu wa nyumba yenyu utumiaa mutandao? sakua vaa nthi* (Code: M18)

☐Myself/*nyie*
☐My spouse/*ula tutwaanite*

☐ My children/*syana syakwa*
☐ A friend/*munyanyawa*
☐ My parents/*asyai makwa*
☐ Someone else; please specify/*mundu ungi,weta nuu:*

q. How often do you use Internet (ex: email, chatting, accessing information, etc.) – (select ONE OPTION ONLY)?/*utumiaa mutandao ta keana?* (Code: M19)

☐ Daily/*kila muthenya*
☐ Weekly/*kila kyumwa*
☐ Monthly/*kila mwei*
☐ Yearly/*kila mwaka*
☐ Less than yearly/*itheo wa mwaka*
☐ Never/*nditumiaa mtandao*

r. Where did you mainly use the Internet (select ONE OPTION ONLY)? /*utumiaa mutandao muno muno va?* (Code: M20)

☐ Own house /*nyumbani kwaka*
☐ A friend's house/*kwa munyanyawa*
☐ Community groups (for example: Agriculture group; Micro-finance group; VSLA group…)/*kikundini kya ngwatanio*
☐ Office/workplace/*vala nthukumiaa*
☐ Cyber café/*ndukani sya mutandao*
☐ Community center/*vandu va kukomania andu oonthe*
☐ Education center/ *vandu va kusomea*
☐ *Cooperative society /kithiini kya ushirika*
☐ Through the mobile phone/*simuni yakwa ya kwoko*
☐ Other, please specify / *vandu vangi, weta niva:*

s. What source do you prefer getting agriculture service information from (select ONE OPTION ONLY)? /*weendeawa ni kukwata mauvoo ma uimi ata? nyuva kuma vaa itheo kindu kimwe* (Code: M21)

☐ Internet/*mutandao*
☐ Over the phone/*simuni ya kwoko*
☐ Per SMS/*utumani mukuvi kuma simuni*
☐ Meeting in person in group training /*kukomania umbanoni wa kisomo*
☐ Meeting in person individually/*kukomana na mundu mweene*
☐ Other? Please specify/ *undu ungi, weta nimwau:*

SECTION 4: Access to and usages of Nafis and/or AgriProFocus platform/*kukwata na kutumia mauvoo kuma kya kyama kya selikali kya uimi (Nafis) kana kyama kya usyaaisya wa mausyao ma uimi(AgriProFocus)*

a. Have you been able to get agricultural advice from any of these two services?/*waakwata mautao ma uimi kuma syamani ithi ili?*

Nafis (The National Farmers Information Service)/*kyama kya selikali kya mauvoo ma uimi* (Code: M22_1)	☐Yes / *ii* ☐No / *ayie* ☐ Not aware/*ndyisi*
AgriProFocus/ *kyama kya usyaaisya wa mausyao ma uimi* (Code: M22_2)	☐Yes / *ii* ☐No / *ayie* ☐ Not aware/*ndyisi*

DO NOT answer the following section if you are have answered NO or NOT AWARE above /*ndukasungie makulyo aa me vaa nthi ethiwa wasya ayie vaa yiulu.*

b. How did you mainly ACCESS the service (You can select MULTIPLE options)*?/wa kwatie mauvoo kuma syamani ithi ata*

Nafis (The National Farmers Information Service)/ *kyama kya selikali kya mauvoo ma uimi* (Code: M23_1)	☐ A computer using Internet myself /*kutumie kombuta yakwa yina mutandao* ☐ A computer using Internet with the help of somebody/*kutumia kombyuta ndetheewe ni mundu ungi* ☐ Interacting with an advisor on Internet (chatting)/*kuneenania na mutaalamu kwisila mutandao* ☐ Interacting with an advisor over the phone/*kuneenania na mutaalamu kwisila simuni* ☐ Interacting with an advisor through SMS on my phone /*kwisila utumani mukuvi wa simu nina mutaalamu* ☐ Through an organized training/*kwisila umbanoni muvange* ☐ Through direct advice from Nafis extension officer/*kwisila ovisa wa selikali kya mauvoo ma uimi* ☐ Other? Please specify and their role:/*vandu vangi,weta niva*
AgriProFocus/ kyama kya usyaaisya wa mausyao ma uimi (Code: M23_2)	☐ A computer using Internet myself / *kutumie kombuta yakwa yina mutandao* ☐ A computer using Internet with the help of somebody/*kutumia kombuta ndetheewe ni mundu ungi* / ☐ Interacting with an advisor on Internet (chatting)/*kuneenania na mutaalamu kwisila mutandao* ☐ Interacting with an advisor over the phone/*kuneenania na mutaalamu kwisila simuni* ☐ Interacting with an advisor through SMS on my phone/kwisila *utumani mukuvi wa simu nina mutaalamu simuni yakwa* ☐ Through an organized training / *kwisila umbanoni muvange* ☐ Other? Please specify ad their role:/*undu ungi,weta nimwau*

c. If you used Nafis for your farming activities, for what purpose specifically (You can select MULTIPLE options)*?/ethiwa niwatumiie kyama kya selikali kya mauvoo ma uimi (Nafis) maunduni maku ma uimi,watumiie kwika ata?* (Code: M24)

☐ Agricultural production information and agronomic practices /*maunduni ma uimi museo*
☐ Economic management of the farm/maunduni ma kusuvia muunda nesa
☐ Marketing management*/maunduni ma uthoosya museo*

d. If you used AgriProFocus, for what purpose specifically (You can select MULTIPLE options)*?/ethiwa niwatumiie kyama kya usyaaisya wa mausyao ma uimi (AgriProFocus),watumiie kwika ata?* (Code: M25)

☐ Agricultural production information and agronomic practices / *maunduni ma uimi museo*
☐ Economic management of the farm / *maunduni ma kusuvia muunda nesa*
☐ Marketing management/ *maunduni ma uthoosya museo*

e. Are you satisfied with the information provided from each platform (0=very dissatisfied; 1= dissatisfied; 2=either or; 3=satisfied; 4=very satisfied)/*niwianiawa na mauvoo ala manenganawe ni syama ithi ili(o=ndimwianie ona vanini,1=ndimwianie,2=ovau katikati,3=nimwianie,4=nimwianie vyu)*

Nafis / *kyama kya selikali kya mauvoo ma uimi* (Code: M26_1)	0	1	2	3	4

AgriProFocus/ *kyama kya usyaaisya wa mausyao ma uimi)* (Code: M26_2)	0	1	2	3	4

f. Have you used any other platforms accessible via Internet not mentioned in this survey? /*waatumia nzia ingi ya kukwata mauvoo ma nima kwisila mutandao eka ithi syi vaa makulyoni aya?* (Code: M27)

☐Yes / *ii*
☐No / *ayie*

g. If yes, kindly provide the name of the platform /*ethiwa wasya ii ni meva* (Code: M28)*:*_____

h. Has someone else from your household filled in this survey?/*ve mundu ungi wa nyumba yaku unasungia makulyo aya?* (Code: M29)

☐Yes / *ii*
☐No / *ayie*

i. Can we meet again? This is optional! ONLY fill in your contact details if you want to meet again / *nukwitikila tukomane ingi? ethiwa nukwitikila nengane isyitwa na namba sya simu vaa itheo*

Your name */witawa ata:*

Phone number /*namba ya simu:*

Thank you for your help and cooperation!

Nuseo nundu wa ngwatanio yaku nzeo

Appendix 9A: Open questions: Interviews with small-scale female farmers in Machakos county

Please ask the following:

1. Do you consider yourself the main decision-maker in the household? Y / N
2. Do you consent to provide information? Y / N

I. Asset base

1. Division of labour

Please describe your day: Tasks and responsibilities / similar labour conditions between W/M/Y (in terms of agricultural and non-agricultural activities, who handles income/finances?)

a. What do you do during the day from when you get up until when you go to bed?
b. How would you describe yourself to me? (private and professionally)
c. What does your week look like?
d. How does your spouse's work differ from yours? Can you describe your spouse's day?
e. What would you say that takes up most time during the days?
f. Has it become more difficult today to get access to different resources? If yes, which and why?

Sketch of the farm: Please sketch a map of all the plots that your household used throughout the past 12 months. This drawing should indicate a sketch of the farm, including intercropping and the seasonality when different crops appear in plots. It also includes ponds or grazing areas owned by the household. This is to be done with both the male and female respondent together.

2. Household decision-making

Management of household assets and benefits (Ask to specify in terms on time)

a. Who manages what household tasks?
b. Who manages what agricultural activities on the farm?

3. Access and control: productive assets

Rights/claims/control over assets (related to the sketch at the beginning)

a. Land ownership (own land and own land use; renting out, renting in; 'pure' sharecropping in; 'pure' sharecropping out; 'cost-sharing' sharecropping in; 'cost-sharing' sharecropping out; communal land; borrowed land in; borrowed land out)
b. Land title (Government title; Customary tenure [no written title: inherited, family, or clan land]; No title; Leased in from government; Private lease)
c. Who in the household owns the land and the plot(s)?
d. Who made the majority of agricultural decisions for this subplot/crop?
e. Has this changed over time? Is it negotiable?

4. Claiming rights, participation in decision making

Decision-making around assets (access to land, knowledge and services, centres/cooperatives …)

a. Do you know what rights you have as a Kenyan citizen? E.g. right to education, health…

b. Do you know what rights you have as a Kenyan woman? E.g. right to land, natural resources, information, education…

c. Are you aware of the Kenya Constitution? If yes, how did you get access to this information?

d. If yes, are you aware of what is written in the Kenya Constitution on land and access to land? If yes, what does it mention?

e. Would you like to have access to land? If yes, is this something that is something that is negotiable with your spouse? If no, why not?

f. Are you aware of the National Gender and Development Policy? If yes, what do you know about it? Has it enabled you to get better access to different assets/resources?

II. Decision-making

1. Household decision making

How are decisions made and by who? Who is included in the decisions?

a. Who made the final decisions regarding these agricultural production decisions on these subplots/crops in the previous seasons (related to the skis), i.e. What crops and trees to plant; Land Preparation; Inputs to be used; Planting; Weeding; Crop management; harvesting, post harvesting and processing, use of products and use of income from crop sales)?

b. Who made the final decisions regarding livestock management and activities, i.e. watering, feeding, veterinary services, grazing, breeding, production of milk products, use of milk products, slaughtering, production and use of other products, e.g. eggs, honey, use of income, sale or use of animal, income from sale of animal?

2. Access to control: productive assets

a. Who is considered to be the owner of the home?

b. When decisions were made regarding the following aspects of farm or household life in the last 12 months, who was it that normally had the final say in the decision, i.e. major farm investments (machinery, infrastructure, irrigation), buying, selling or renting land, engagement in non-farm activity, engaged in salary/wage employment, major HH expenditures, HH food expenditures, minor HH expenditures, how to spend own money?

III. Awareness and Innovation

1. Division of labour

a. Do you make use of any indigenous knowledge? If yes, what type of knowledge and how do you use it?

b. It indigenous knowledge important to you? If yes, why? If no, why not?

c. Who is the household uses it mostly? Why?

2. Household decision-making with regards to sustainable agricultural land management practices

a. What agricultural practices are you aware of (e.g. agroforestry, terraces, mulching, cover crops, ridging, composting, zai pits, irrigation, water harvesting, livestock manure management, used of crop residues, IPM, improved cooking stoves, biogas, solar, drought tolerant crops…)?

b. Have you decided to plants trees? If yes, why? Who takes the final decision? Who purchases the seeds?

c. In the past 12 months, did you use [practice] on the plots that you manage (or jointly manage)? If yes, what plots/crops/subplots?

d. If no, did you previously use [practice] on plots that you manage? Why did you stop using the practice?

e. What is the source of information for the practices?
f. Benefits/disadvantages from the practices
g. Are there practices that you would like to adopt?
h. If you would like to adopt practice why have you not done so? OR If you would not like to adopt practice why not?
i. Are there any relationships between these values and productivity? Between these values and farm and or plot level innovation?

3. Access and control: productive assets

a. Which climate shocks have significantly affected your household (income or livelihood) during the last 5 years? E.g. Floods, droughts, storms/strong winds, erratic rainfall, frost, cold spells, heat waves, fires…
b. When was this? And who did the shock affect?
c. What immediate actions did your members of your household take? And who took the action?
d. Did you have to sell any assets to cope with the shock?
e. Who owned the asset that was sold?
f. Who in the household was the most affected? Why?
g. If you have observed, or believe that you will be affected by, climate changes, have you made any changes to protect yourself, your family, or your community? This can include any agricultural, livestock, or livelihood changes? If no, why have you not made any changes?
h. If yes what changes have you made?
i. Do you plan to make any (additional) changes to protect against changes in climate over the next 5 years? If yes, what changes do you plan to make? If no, why do you not plan to make any changes?
j. Are there any changes you would like to make but are not able to in the near future? If yes, what change(s) would you like to make
k. Why are you not able to make this (these) change (s)?

IV. Knowledge and information

1. Division of labour / Type of trainings received in the last year on farming

a. What type of trainings have you received this year?
b. From what organisation have you received trainings?
c. Have these trainings been adequate and relevant to you? I.e. have you been able to use the advice and if yes, how?

2. Household decision-making (sources of information)

a. Did/do you have access to different sources of [information]? If yes, what? E.g. weather forecast, crop and livestock management, pest and disease management, post-harvest handling
b. Possible to use this information? If yes, how? In no, why not?
c. Did you share or discuss this information with others outside of your household?
d. Did you share or discuss this information with other members of your household?
e. Have you borrowed from any source the last 12 months (cash or in kind)?

3. Access and control: productive assets

a. Did you have access to agricultural and/or climate information in the last 12 months? E.g. Extension officers, NGOs, community meetings, cooperatives, CSOs, MBOs, Religious groups, seed and input companies, family members, neighbours, radio, TV, the internet, teachers, schools, agricultural shows, newspaper/bulletin, cell phone, FFS/demo days, indigenous knowledge)

b. What are the most useful sources of agricultural and/or information?
c. What information would you like to receive that you are not currently receiving?
d. To use have access to and can use a mobile phone? And a computer?
e. Do you use the mobile phone to access knowledge? Do you use a computer to access knowledge? If yes, what type of knowledge (for farming activities, household related activities, etc.)?

4. Access to services

a. Have you met with an extension agent within the past 12 months? If yes, was the extension officer female or male?
b. What type of extension activities did you participate in most during these meetings? E.g. T&V, FFS, 1 to 1 advice, demo day, FO meeting, community meeting
c. How frequently did you meet with an extension agent in the past 12 months?
d. Is the information you've received relevant to you? If yes, why?
e. During your most recent meeting with an extension agent, to whom did the extension agent give information/ advice?
f. During the most recent meeting with the extension agent, from which organization did the extension agent come from? E.g. government, NGO, cooperative, private, religious groups, contact/local farmer, agri. research org, financial institution
g. During your most recent visit with the extension agent, did you have to pay a fee for services? If yes, how much?
h. If you did not meet with an extension agent during the last year, why?

5. Claiming rights, participation in decision-making

IV.5.1. Access to finance

a. Did your household attempt to borrow from any source (cash or in kind) in the last 12 months?
b. If no, why did your household not try to obtain a loan in the last 12 months? E.g. no need for a loan, cannot pay the money back, no access
c. If your household wanted to borrow cash or in kind in the last 12 months, would you have had access?
d. From which sources did members of your household attempt to borrow from in the last 12 months?
e. Who in the household attempted to borrow? Who made the decision to borrow?
f. What was the main reason member wanted to borrow?
g. Was member successful in obtaining a loan?
h. If no, why was member not able to borrow? E.g. Inadequate collateral, bad credit history, have outstanding loan, past history of default with lender
i. Who made the decision about what to do with the money/ item borrowed? How was the credit used?
j. If more credit had been available from this source, would your household have used it?

IV.5.2. Access to resources

a. In the past 12 months, did your household borrow food or other goods from neighbours, shopkeepers, or other sources?
b. Who provided the food or other goods in the last 12 months? E.g. Friends, non-household family members, shopkeepers, traders, landlords
c. Who made the decision to borrow food or other goods in the last 12 months?
d. In the past 12 months, how often did you borrow food or other goods (from any source)?

e. Who was responsible for paying back the in-kind loan?
f. Would you have borrowed more food or other goods if it were available?

IV.5.3. Access to insurance

a. Have you purchased index-based or crop insurance for the plots that you manage?
b. Do you currently have other types of insurance? If yes, what type of insurance have you purchased? E.g. life, health, crop, livestock, property, funeral
c. Why did you not purchase insurance? E.g. not available, no need, not aware, don't understand insurance, no funds, previous bad experience, cultural belief/superstitions

V. Institutions and governance

1. Division of labour and access to water and energy

a. What were your main energy sources for cooking over the last year? Does it differ per rain seasons, i.e. dry vs. rainy season?
b. What were the main sources of domestic water over the last year? How far is the water (source) from the home? (travel time in minutes)
c. Who collects the water from the source? How many minutes per week is spent collecting water from the source? How would you describe the quality of the water source?

2. Access and control to public services

a. Is there a group in your community? E.g. Agricultural/Livestock/Fisheries producer's group (including marketing groups), Water group, VSLA group, forestry/tree group, local community groups, religious groups, credit/micro finance, youth groups, marketing/income generating groups…
b. Are you a member of any of these groups?
c. Why are you not a member of any group/or excluded from some groups?

3. Claiming rights, participation in decision-making

a. How much influence do you have in making decisions in these groups? I.e. No influence; Influence on very few decisions; Influence on some decisions; Influence on most decisions; Influence on all decisions
b. Do you feel comfortable speaking up in this group to give your opinion or offer suggestions? I.e. No, not at all, Yes, but with a great deal of difficulty, Yes, with a little difficulty, Yes, fairly comfortable, Yes, very comfortable
c. What activities does this group engage in?
d. Who belongs to this group? I.e. Men only, women only, both men and women
e. What are the benefits of being a member of this group?

VI. Personal values

Statement	1	2	3	4	5
I actively seek out advice about agricultural practices for my farm.					
If spouses (males and females) make household agricultural decisions together, their livelihood will improve (agricultural productivity, food security, income etc.).					
Everyone in the community should show respect for cultural traditions relating to agricultural practices.					

It is important to challenge oneself and to learn and try new things.					
It is important to help and assist those who do not have the resources to make agricultural changes themselves.					
I highly value new agricultural information, technology, and weather information.					
We need to protect natural resources because they are important for our livelihoods.					
Members of the community should work together to improve the community (maintaining common areas, infrastructure, etc.).					
Traditional solutions and methods for agriculture will help to resolve all the problems we face.					
I am often one of the first people in my community to try new practices on my farm.					
Religious teachings will help us to meet any challenges we face in life, including changes in climate.					
When making agricultural decisions, I am most concerned about generating income.					
I am willing to accept agricultural advice from outside sources.					
I make my own agricultural decisions without worrying about what other people say.					
I have an active role in community-decision-making.					

1= Strongly Disagree; 2= Somewhat disagree; 3= Neither agree nor disagree; 4 = Somewhat Agree; 5= Strongly agree

Statements	**1**	**2**	**3**	**4**	**5**
I compete with my neighbours to see who can have a better farm.					
One of the problems with people today is that they challenge authority too often.					
It is important to have protection of one's own property rights.					
My community is welcoming to new agricultural ideas and practices.					
Co-operation with others usually works.					
Being a farmer is an important part of my identity.					
When making agricultural decisions, I am most (very) concerned about food security.					
I am capable of improving my life and the lives of members of my household.					
The land use and agricultural changes that I have implemented will help me to reduce my vulnerability to climate change.					

I trust members of my community to help me in times of need.					
The livestock changes that I have implemented will help me reduce my vulnerabilities to climate changes.					
I trust my family to help me in times of need.					
It is important to me to be able to pass my farm/land on to my children.					
I feel a very strong connection to the land that I farm.					
Men and women should have equal roles in agricultural decision-making					

1= Strongly Disagree; 2= Somewhat disagree; 3= Neither agree nor disagree; 4 = Somewhat Agree; 5= Strongly agree

Appendix 9B: Semi-open questionnaire: Interviews with small-scale female farmers in Machakos county

Please ask the following:

3. Do you consent to provide information? Y / N

I. Module 1: Socio-Economic Data

1. Name of person:

2. Age:

3. Education level/attainment

☐ None

☐ Primary

☐ Secondary

☐ Tertiary

☐ College

☐ University (Bachelor)

☐ University (Masters)

☐ University (PhD)

4. Civil status:

☐ Married

☐ Single

☐ Divorced

☐ Widowed

5. Children **Y / N**

a. If yes, number of children:

6. Religion

☐ Christianity

☐ Islam

7. Member of a social organization **Y / N**

a. If yes, what organisation(s)/group(s)

☐ GR1: Agricultural producers group ☐ GR7: Other micro-finance group

☐ GR2: Fisheries producers group
☐ GR3: Livestock producers group
☐ GR4: Water group
☐ GR5: VSLA group
☐ GR6: Marketing/income generating group
☐ GR8: Forestry/tree group
☐ GR9: Local community group
☐ GR10: Religious group
☐ GR11: Youth group
☐ GR12: Other

b. How many times per week are you with each group?

	Nr of days	**Nr of hours**	**Means to get there**	**Distance in minutes**
GR1				
GR2				
GR3				
GR4				
GR5				
GR6				
GR7				
GR8				
GR9				
GR10				
GR11				
GR12				

c. Why did you choose to become a member of this/these organisation(s)?

	Choice of organisation
GR1	
GR2	
GR3	
GR4	
GR5	
GR6	
GR7	
GR8	
GR9	
GR10	
GR11	
GR12	

d. Benefits / Disadvantages

	Benefits	**Disadvantages**
GR1		

GR2		
GR3		
GR4		
GR5		
GR6		
GR7		
GR8		
GR9		
GR10		
GR11		
GR12		

e. How much influence do you have in decision making in these groups?

☐ No influence

☐ Influence of very few decisions

☐ Influence on some decisions

☐ Influence on most decisions

☐ Influence on all decisions

8. State your primary occupation

☐ Unemployed ☐ Teacher

☐ Farmer ☐ Civil servant

☐ Full time housewife ☐ Other

☐ Small enterprise / Business

a. Why do you consider [the choice] as primary occupation (e.g. full time housewife)? Is at an obligation from the husband, per habit…)

9. Farm experience (years):

10. Farm size:

11. Farm enterprise

☐ Mixed cropping ☐ Mixed farming

☐ Sole cropping ☐ Other

II. Module 2: Access to services, knowledge and information

1. Access to (specify what):

☐ A source of capital_____

☐ Financial institution_____

☐ Legal institution_____

☐ Educational institution_____

☐ Technical devices_____

☐ Transportation means_____

☐ Agricultural inputs_____

2. Are you aware of and what is the source of information in the following practices / dimensions (4=Yes, fully; 3=Yes, but still need support; 2=I've heard of it, don't use the practice; 1=No, never heard of it):

Dimensions	**Awareness**	**If yes, source of information (4 or 3)**
Improved agricultural practices	1 – 2 – 3 – 4	
Agroforestry	1 – 2 – 3 – 4	
Livestock management	1 – 2 – 3 – 4	
Forestry management	1 – 2 – 3 – 4	
Coffee management	1 – 2 – 3 – 4	
Fruit management	1 – 2 – 3 – 4	
Agricultural marketing	1 – 2 – 3 – 4	
Rainwater harvesting	1 – 2 – 3 – 4	
Soil and water conservation management	1 – 2 – 3 – 4	
Biogas	1 – 2 – 3 – 4	
Solar energy	1 – 2 – 3 – 4	
Irrigation	1 – 2 – 3 – 4	
Crops for drought	1 – 2 – 3 – 4	
Crop prices	1 – 2 – 3 – 4	
Seed management	1 – 2 – 3 – 4	
Credit availability and terms	1 – 2 – 3 – 4	
Family planning and nutrition	1 – 2 – 3 – 4	
Managing income and Earning school fees	1 – 2 – 3 – 4	
Division of tasks between women and men	1 – 2 – 3 – 4	
Crop storage methods	1 – 2 – 3 – 4	
HIV and AIDS	1 – 2 – 3 – 4	
Environmental concerns	1 – 2 – 3 – 4	
Access to land / title deeds	1 – 2 – 3 – 4	

3. Which ones (of the ones you are aware of) have you adopted / using (A = Adopted; NA = Not adopted)?

Dimensions	**Adopted / using**	**Satisfied?**	**No, why not? If yes, why?**
Improved agricultural practices	A / NA	Y / N	
Agroforestry	A / NA	Y / N	

Livestock management	A / NA	Y / N	
Forestry management	A / NA	Y / N	
Coffee management	A / NA	Y / N	
Fruit management	A / NA	Y / N	
Agricultural marketing	A / NA	Y / N	
Rainwater harvesting	A / NA	Y / N	
Soil and water conservation management	A / NA	Y / N	
Biogas	A / NA	Y / N	
Solar energy	A / NA	Y / N	
Irrigation	A / NA	Y / N	
Crops for drought	A / NA	Y / N	
Crop prices	A / NA	Y / N	
Seed management	A / NA	Y / N	
Credit availability and terms	A / NA	Y / N	
Family planning and nutrition	A / NA	Y / N	
Managing income and earning school fees	A / NA	Y / N	
Division of tasks between women and men	A / NA	Y / N	
Crop storage methods	A / NA	Y / N	
HIV and AIDS	A / NA	Y / N	
Environmental concerns	A / NA	Y / N	
Access to land / title deeds	A / NA	Y / N	

4. What sources of information do you have access to?

☐ Public extension officers
☐ NGOs
☐ Community meetings
☐ Cooperatives
☐ CSOs
☐ MBOs
☐ Religious groups
☐ Seed and input companies
☐ Family members
☐ FFS
☐ Personal computer
☐ Neighbours
☐ Radio
☐ TV
☐ Internet
☐ Teachers
☐ Schools
☐ Agricultural shows
☐ Newspaper / bulletin
☐ Personal cell phone
☐ Demonstration days
☐ Other_____

5. What are the issues in accessing extension services (and hence adopting certain practices)?

☐ Poor communication skills
☐ Unavailability of extension agent
☐ Rift between extension agent and yourself

☐ Administrative issues / bottlenecks (e.g. agent do not have means)

☐ Late delivery of agricultural inputs

☐ 'Man-know-man' problems

☐ Lack of collateral for granting loans

☐ Lack of time to attend extension meetings/trainings

☐ Inadequate supply of farm inputs

☐ Not in a position to take such decision

☐ Apathetic attitude on the part of the extension agents

☐ Insensitivity on the part of the government

☐ Financial constraint in purchasing inputs

☐ Lack of cooperation among farmers

☐ Other

6. What are the reasons behind these issues do you think (e.g. traditions, lack of finance, religion, lack of communication, etc.…)?

III. Module 3: Social status & access

1. Who in the household takes decisions about investments for:

- ***a.*** Agricultural expenses **Husband / Myself / Son / Daughter / Other family member**
- ***b.*** Forest expenses **Husband / Myself / Son / Daughter / Other family member**
- ***c.*** Livestock expenses **Husband / Myself / Son / Daughter / Other family member**
- ***d.*** Household expenses **Husband / Myself / Son / Daughter / Other family member**
  - ***i.*** Has it been always the case? **Y / N**
  - ***ii.*** Why?

2. Who in the household is the formal owner of:

- ***a.*** Agricultural land **Husband / Myself / Son / Daughter / Other family member**
- ***b.*** Forestry land **Husband / Myself / Son / Daughter / Other family member**
- ***c.*** Livestock **Husband / Myself / Son / Daughter / Other family member**
- ***d.*** Household **Husband / Myself / Son / Daughter / Other family member**
  - ***i.*** Has it always been the case? **Y / N**
  - ***ii.*** Why?

3. What are the challenges for you not being able to take decisions or formally being the owner?

4. What are the risks you foresee with not being able to take decisions or formally being the owner of the different farm assets?

5. Excluded from any organisation / cooperative? **Y / N**

a. If yes, why?

6. What are the (pre-)conditions for becoming a member of the different organisations?

IV. Module 4: Means for access to services, knowledge and information

1. What is required / do you need, to get access to the following.

Dimension	Requirements / means	Have access to resource / service / membership?	If no, why not?
Land (ownership)			
Nearby and clean water facility			
Firewood			
Food			
A bank account			
Purchasing agricultural inputs			
Taking a loan			
A computer			
Power / electricity			
Market			
Transportation means			
Higher education			
School fees			
Member of a cooperative			
Selling of crops			
Selling of fruits			
Selling of coffee			
Selling of timber			

2. Are there means that you need that you do not have access to? Y / N

a. If yes, which?

b. Why?

V. Module 5: Relevance of delivery and type of agriculture you wish to develop

1. Met with extension agent / agricultural officer? **Y / N**

a. Frequency of contact with extension agent

☐ Once per week

☐ Once per month

☐ Once in six months

☐ Once per year

☐ Rare

☐ Never

b. From which organisation?

☐ Government ☐ Religious groups

☐ NGO ☐ Contact / local farmer

☐ Cooperative ☐ Agricultural research organisation

☐ Private ☐ Other

☐ Financial Institution

c. What agricultural subjects where you taught in?

Dimension	**Specify type**
Agriculture	
Livestock	
Health and nutrition	
Income management	
Credit management	
Family planning	
Women's rights	
Legal access to title deeds	
Land preparation and management	
Business development	
Other	

d. Was it as per your demand or pre-set by the organisation that taught you?

☐ Yes, from this organisation:

☐ No, from this organisation:

e. Who decides about the subjects that are taught?

☐ The teaching institution

☐ Yourself (per demand)

f. Have there been any positive effects from the service delivery? **Y / N**

☐ Provided improved access to farm inputs

☐ Decreased production costs

☐ Provided access to subsidized farm inputs and equipment

☐ Increased income and revenue

☐ Increased production and output levels

☐ Provided access to loan and credit facilities

☐ Provided solutions for better storage conditions for excess production

☐ Increased access to marketing facilities

☐ Increased my technical know-how

☐ Decreased pest and disease issues

☐ Other

g. Have there been any negative effects from the service delivery? **Y / N**

☐ Provided unimproved access to farm inputs

☐ Increased production costs

☐ Provided decreased access to subsidized farm inputs and equipment

☐ Decreased income and revenue

☐ Decreased production and output levels

☐ Not provided access to loan and credit facilities

☐ Not provided solutions for better storage conditions for excess production

☐ Decreased access to marketing facilities

☐ Decreased my technical know-how

☐ Increased pest and disease issues

☐ Other

h. Kindly evaluate the quality of services in the following table.

Service quality dimensions	**1=Very satisfied; 2=Satisfied; 3=Undecided; 4=Dissatisfied; 5=Very dissatisfied**
Timeliness of service delivery	1 – 2 – 3 – 4 – 5
Accuracy of the service	1 – 2 – 3 – 4 – 5
Relevance to your needs / situation	1 – 2 – 3 – 4 – 5
Ease / facilitation of understanding	1 – 2 – 3 – 4 – 5
Problem solved	1 – 2 – 3 – 4 – 5
Able to disseminate information to other farmers	1 – 2 – 3 – 4 – 5
Overall satisfaction with services	1 – 2 – 3 – 4 – 5

i. Are the officers generally female (F) or male (M)? **F / M**

j. Do you have a preference? **Y / N**

k. If yes, why? (E.g. more active and responsive, no cultural bias, explains better, same training and equal, present information better, present material better, visit groups more frequently, comes better prepared…)

l. What did the agent teach you?

m. Have you adopted the practices? **Y / N**

n. Yes, why?

o. No, why not?

2. What type of trainings would you like to receive?

Dimension	Specify type	Reason why
Agriculture		
Livestock		
Health and nutrition		
Income management		
Credit management		
Family planning		
Women's rights		
Legal access to title deeds		
Land preparation and management		
Business development		
Other		

3. What are the most important income generating activities on the farm?
4. What is your role at the farm (according to you)?
5. What type of agriculture would you like to develop on the farm that you haven't developed yet (e.g. poultry farming, goat farming, beef or dairy farming, coffee farming, farm diversification…)?
6. Why haven't you?

VI. Module 6: Adequacy of content

1. Classify the preference of following sources of extension services (1=highest preference / most effective; 13=lowest preference / least effective)

Source of information	Score
Individual visits on farm (individual trainings)	
Demonstration days	
Field visit to other farms	
Agricultural show	
Group trainings	
Television program	
Office call	
Radio program	
Video tape	
Leaflets and posters	
Farmer Field Schools	
Newspaper / bulletin	
Information on-line (internet)	

2. How has the three (3) highest ranked sources of information supported you?

☐ Motivates me to adopt new technologies

☐ Supports me to acquire needed knowledge

☐ Supplies me with information about agricultural service

☐ Improves farm output (agricultural productivity)

☐ Serves as a link between my farm and the government

☐ Enables to show improved technologies

☐ Teaches me to improve family livelihood

☐ Helps me to strengthen my role in decision-making (in the household)

☐ Support me to analyse present and future scenarios

☐ Provided employment

☐ Provided increased income

☐ Supported my and my spouse in equal decisions making and division of tasks

☐ Providing and improving social amenities/comforts

☐ Other

3. What **type of information** would you like to receive that you are **currently not receiving** (i.e. how to get access to; (i) demonstration of improved technologies, (ii) distribution of subsidized improved seeds, (iii) agricultural knowledge, (iv) provision of loans and credit facilities, (v) distribution of fertilizers at subsidized rates, (vi) improved farm inputs, (vii) provision of veterinary services, (viii) nutrition and health care, (ix) provision of marketing facilities, (x) means to facilitate farm operations…?

4. In what aspect would this provide you with additional support ***(cf. example above)***?

VII. Module 7: Personal development and well-being

1. Time use

Dimension	**Classification**
<u>a. Working hours:</u> Kindly report your working hours per day on the following (threshold max. 8 hours / day)	
Crop farming	
Kitchen gardening	
Selling of crops	
Forestry and horticultural activities	
Livestock related activities	
Household maintenance, care of children and members of the household	
<u>b. Sleeping hours:</u> Kindly report your number of sleeping hours per day (threshold 8 hours / day)	
Number of sleeping hours	
<u>c. Personal development:</u> Kindly report on the number of hours per day you have for personal development (e.g. attend classes, attend social forums, hairdresser, shopping, time for yourself; resting for instance, family visits, etc.…)	
Number of 'personal development' hours	

2. Education

Dimension	**Classification**
<u>a. Literacy:</u> Kindly report your literacy levels to the following	
Can you read and write in: - Your local language	Y / N

- Kiswahili - English	Y / N Y / N
How many years of schooling have you attended?	
<u>b. Educational qualification:</u> Kindly report your education level (Insufficient education <6 years of schooling rom any source)	
Formal education	Institution: Degree:
Non-secular institutions, i.e. Non-formal education	Institution: Degree:
<u>c. Knowledge:</u> Kindly report your knowledge level (In the case of Bhutan, threshold set at 19) (5=very poor knowledge; 4=poor knowledge; 3=average knowledge; 2=good knowledge; 1=very good knowledge)	
Knowledge of the Constitution	1 – 2 – 3 – 4 – 5
Knowledge on rights	1 – 2 – 3 – 4 – 5
Knowledge of HIV and AIDS transmission	1 – 2 – 3 – 4 – 5
Knowledge on nutrition and health	1 – 2 – 3 – 4 – 5
Knowledge of traditions	1 – 2 – 3 – 4 – 5
<u>c. Values:</u> Kindly report your values (In the case of Bhutan, threshold set at 4) (3=always justifiable; 2=don't know; 1=never/sometimes justifiable)	
Killing	1 – 2 – 3
Stealing	1 – 2 – 3
Lying	1 – 2 – 3
Creating disharmony in relationships	1 – 2 – 3
Sexual misconduct	1 – 2 – 3

3. Living standards

Dimension	**Classification**
<u>a. Household income:</u> Kindly report on your average household income per month (Bhutan's case, threshold set at mean per person per month in Poverty Analysis Report)	
Average monthly income	
<u>b. Assets:</u> Kindly report your if you own the following:	
Appliances / technical devices	o Mobile phone o Personal computer o Fixed land-line o Radio o TV o Bicycle o Refrigerator o Washing machine o Colour television o Other

Livestock ownership	o Cows o Bulls o Calves o Poultry o Pigs o Goats o Sheep
Land ownership	o (Personal) formal title deeds o Other
<u>c. Housing quality:</u> Kindly report your if you own the following:	
Type of roofing	o Corrugated Galvanized Iron o Concrete brick o Stone o Other
Type of toilet	o Pit latrine with sceptic tank o Other
Number of persons per room	

4. Family and security

Dimension	Classification
<u>a. Family:</u> Kindly report your contentment levels with the family situation to the following (1=agree; 2=neutral; 3=disagree).	
Are you satisfied with your family situation?	1 – 2 – 3
<u>b. Victim of a crime:</u> Kindly report on the following:	
Have you been victim of a crime during the last 12 months?	Y / N
Has any member of your family been victim of a crime during the last 12 months?	Y / N
<u>c. Community relationships:</u> Kindly report on the following (1=very strong/most of them 2=somewhat/some of them; 3=weak/none)	
Sense of belonging	1 – 2 – 3
Trust in neighbours	1 – 2 – 3
<u>d. Social support:</u> Kindly report on the following (Case of Bhutan: 10% of household income; three days per week for volunteering)	
Amount of money you donate per month	
Amount of days you are volunteering per month	

5. Psychological well-being

Dimension	Classification
<u>a. Life satisfaction:</u> Kindly report your contentment levels to the following (1=very satisfied; 2=satisfied; 3=either or; 4=dissatisfied; 5=very dissatisfied).	

Health	1 – 2 – 3 – 4 – 5
Occupation	1 – 2 – 3 – 4 – 5
Standard of living	1 – 2 – 3 – 4 – 5
Family	1 – 2 – 3 – 4 – 5
Work-life balance	1 – 2 – 3 – 4 – 5
b. Emotional balance, positive emotions: Kindly report on the following (1=never 2=rarely; 3=sometimes; 4=much; 5=very much).	
Compassion	1 – 2 – 3 – 4 – 5
Generosity	1 – 2 – 3 – 4 – 5
Forgiveness	1 – 2 – 3 – 4 – 5
Contentment	1 – 2 – 3 – 4 – 5
Calmness	1 – 2 – 3 – 4 – 5
c. Emotional balance, negative emotions: Kindly report on the following (1=never 2=rarely; 3=sometimes; 4=much; 5=very much).	
Selfishness	1 – 2 – 3 – 4 – 5
Jealousy	1 – 2 – 3 – 4 – 5
Anger	1 – 2 – 3 – 4 – 5
Fear	1 – 2 – 3 – 4 – 5
Worry	1 – 2 – 3 – 4 – 5

6. Health

Dimension	**Classification**
a. Self-reported health status: Kindly report your health levels to the following (1=very poor; 2= poor; 3=fine; 4=good; 5= excellent)	
Objective health	1 – 2 – 3 – 4 – 5
Nutrition state	1 – 2 – 3 – 4 – 5
b. Healthy days within the last month: Kindly report number of healthy days	
Number of days (out of 30.5)	
c. Long-term disability: Kindly report your levels to the following.	
Longstanding illness lasted > 6 months?	Y / N
If yes, has the illness restricted your daily activities? (1=never 2=rarely; 3=sometimes; 4=much; 5=all the time)	
d. Mental health: Have you recently (scale from 0 to 3):	
1. Been able to concentrate on what you're doing?	o Better than usual o Same as usual o Less than usual o Much less than usual
2. Lost much sleep over worry?	o Not at all o No more than usual o Rather more than usual o Much more than usual

3. Felt that you are playing a useful part in things?	o More so than usual o Same as usual o Less so than usual o Much less than usual
4. Felt capable of making decisions about things?	o More so than usual o Same as usual o Less so than usual o Much less than usual
5. Felt constantly under strain?	o Not at all o No more than usual o Rather more than usual o Much more than usual
6. Felt you couldn't overcome your difficulties?	o Not at all o No more than usual o Rather more than usual o Much more than usual
7. Been able to enjoy your normal day-to-day activities?	o More so than usual o Same as usual o Less so than usual o Much less than usual
8. Been able to face up to your problems?	o More so than usual o Same as usual o Less so than usual o Much less than usual
9. Been feeling unhappy or depressed?	o Not at all o No more than usual o Rather more than usual o Much more than usual
10. Been losing confidence in yourself?	o Not at all o No more than usual o Rather more than usual o Much more than usual
11. Been thinking of yourself as a worthless person?	o Not at all o No more than usual o Rather more than usual o Much more than usual
12. Been feeling reasonably happy, all things considered?	o More so than usual o Same as usual o Less so than usual o Much less than usual

Appendix 10: Regression analyses

Test 1: Probit regression, internet use for men and women above or equal to 18 years of age in five main economic activities in rural Kenya

Command line: [probit freq age agefemme genre marital1 marital3 marital4 marital5 marital6 marital1femme marital3femme marital4femme marital5femme marital6femme education1 education3 education1femme education3femme status economicact1- economicact4 subregion1- subregion44]

note: subregion44 omitted because of collinearity

Appendix 10 Table 1: Probit regression, internet use for men and women above or equal to 18 years of age in five main economic activities in rural Kenya.

Variables	Coefficient	Std. err.	p
Age men	-.0021813	.0001095	0.000
Age women	.0012122	.0001588	0.000
Gender	.0492201	.0101795	0.000
Divorced (ref.: monogamous)	-.2063378	.0195999	0.000
Polygamous (ref.: monogamous)	-.0288648	.0052785	0.000
Never married (ref.: monogamous)	.1954344	.0050174	0.000
Separated (ref.: monogamous)	-.2522977	.0134043	0.000
Widowed (ref.: monogamous)	-.1624298	.0141062	0.000
Divorced women (ref.: monogamous)	-.0171674	.0257663	0.505
Polygamous women (ref.: monogamous)	-.0658003	.0070534	0.000
Never married women (ref.: monogamous)	-.0042453	.008362	0.612
Separated women (ref.: monogamous)	.0290812	.0190654	0.127
Widowed women (ref.: monogamous)	-.0094576	.0155693	0.544
Currently attending (ref.: never attended)	1.192525	.0087119	0.000
Previously attended (ref.: never attended)	.4560455	.0056772	0.000
Currently attending women (ref.: never attended)	-.2634504	.0114682	0.000
Previously attended women (ref.: never attended)	-.2045261	.0067018	0.000
Relationship status (0=household head; 1=spouse)	-.0400598	.0034617	0.000
Full time student (ref.: worked for pay)	-.5510964	.0102209	0.000
Homemaker (ref.: worked for pay)	-.6052448	.004308	0.000
Family agriculture holding (ref.: worked for pay)	-.6230813	.0024422	0.000
Family business (ref.: worked for pay)	-.3778976	.0030064	0.000
Dependent variable: Internet use (0=never use internet; 1=use internet)			
Number of observation = 7,336,099 Pseudo R^2 (McFadden) = 0.0910 ***p < 0.01 **p < 0.05 *p < 0.1 Controlling for 44 counties in Kenya			

Test 2: Probit regression, internet use for men and women above or equal to 18 years of age in five main economic activities in rural Kenya

Command line: [probit freq age agefemme genre marital1 marital3 marital4 marital5 marital6 marital1femme marital3femme marital4femme marital5femme marital6femme education1 education3 education1femme education3femme status statusfemme economicact1 economicact2 economicact3 economicact4 economicact1femme economicact2femme economicact3femme economicact4femme subregion1- subregion44]

note: subregion44 omitted because of collinearity

Appendix 10 Table 2: Probit regression, internet use for men and women above or equal to 18 years of age in five main economic activities in rural Kenya.

Variables	Coefficient	Std. err.	p
Age men	-.0024805	-.0001102	0.000
Age women	.0016251	.0001603	0.000
Gender	.1079998	.010769	0.000
Divorced (ref.: monogamous)	-.2048573	.0195753	0.000
Polygamous (ref.: monogamous)	-.0231109	.0053071	0.000
Never married (ref.: monogamous)	.1977409	.0050603	0.000
Separated (ref.: monogamous)	-.2510099	.0133899	0.000
Widowed (ref.: monogamous)	-.1632635	.014087	0.000
Divorced women (ref.: monogamous)	-.0217431	.0258056	0.399
Polygamous women (ref.: monogamous)	-.0670933	.0070723	0.000
Never married women (ref.: monogamous)	-.0178369	.0085811	0.038
Separated women (ref.: monogamous)	.0207442	.0191281	0.278
Widowed women (ref.: monogamous)	-.0003737	.0155768	0.981
Currently attending (ref.: never attended)	1.226251	.0090102	0.000
Previously attended (ref.: never attended)	.4640782	.0056921	0.000
Currently attending women (ref.: never attended)	-.3384991	.0128656	0.000
Previously attended women (ref.: never attended)	-.2192897	.0067401	0.000
Relationship status (0=household head; 1=spouse)	-.1887753	.0132951	0.000
Relationship status women (0=household head; 1=spouse)	.1631974	.0137834	0.000
Full time student (ref.: worked for pay)	-.593661	.0135482	0.000
Homemaker (ref.: worked for pay)	-.5319731	.0107954	0.000
Family agriculture holding (ref.: worked for pay)	-.5859848	.0031343	0.000
Family business (ref.: worked for pay)	-.3354117	.0038486	0.000
Full time student women (ref.: worked for pay)	.1121496	.0207593	0.000
Homemaker women (ref.: worked for pay)	-.1318861	.0119192	0.000
Family agriculture holding women (ref.: worked for pay)	-.1015234	.0049181	0.000
Family business women (ref.: worked for pay)	-.1197035	.0061475	0.000
Dependent variable: Internet use (0=never use internet; 1=use internet)			
Number of observation = 7,336,099 Pseudo R^2 (McFadden) = 0.0914 ***p < 0.01 **p < 0.05 *p < 0.1 Controlling for 44 counties in Kenya			

Test 3a: Probit regression, internet use for men above or equal to 18 years of age in five main economic activities in rural Kenya

Command line: [probit freq age marital1 marital3 marital4 marital5 marital6 education1 education3 status economicact1 economicact2 economicact3 economicact4 subregion1-subregion44 if gender==0 (where 0 is men)]

note: subregion44 omitted because of collinearity

Appendix 10 Table 3: Probit regression, internet use for men above or equal to 18 years of age in five main economic activities in rural Kenya.

Variables	Coefficient	Std. err.	p
Age	-.0024595	.000111	0.000
Divorced (ref.: monogamous)	-.1991755	.0195803	0.000
Polygamous (ref.: monogamous)	-.0207973	.0053485	0.000
Never married (ref.: monogamous)	.1953362	.0050788	0.000

Separated (ref.: monogamous)	-.2487317	.0133969	0.000
Widowed (ref.: monogamous)	-.1636576	.0140885	0.000
Currently attending (ref.: never attended)	1.221677	.0091606	0.000
Previously attended (ref.: never attended)	.4586813	.0060437	0.000
Relationship status (0=household head; 1=spouse)	-.1882066	.0133017	0.000
Full time student (ref.: worked for pay)	-.5926902	.0135635	0.000
Homemaker (ref.: worked for pay)	-.5294061	.0108117	0.000
Family agriculture holding (ref.: worked for pay)	-.5865886	.0031639	0.000
Family business (ref.: worked for pay)	-.3336735	.0038644	0.000
Dependent variable: Internet use (0=never use internet; 1=use internet)			
Number of observation = 3,079,739 Pseudo R^2 (McFadden) = 0.0823 ***p < 0.01 **p < 0.05 *p < 0.1 Controlling for 44 counties in Kenya			

Test 3b: Probit regression, internet use for women above or equal to 18 years of age in five main economic activities in rural Kenya

Command line: [probit freq age marital1 marital3 marital4 marital5 marital6 education1 education3 status economicact1 economicact2 economicact3 economicact4 subregion1-subregion44 if gender==1 (where 1 is women)]

note: subregion44 omitted because of collinearity

Appendix 10 Table 4: Probit regression, internet use for women above or equal to 18 years of age in five main economic activities in rural Kenya.

Variables	**Coefficient**	**Std. err.**	**p**
Age	-.000784	.0001215	0.000
Divorced (ref.: monogamous)	-.2333087	.0168477	0.000
Polygamous (ref.: monogamous)	-.0924492	.0048429	0.000
Never married (ref.: monogamous)	.1843941	.0069868	0.000
Separated (ref.: monogamous)	-.2325212	.013701	0.000
Widowed (ref.: monogamous)	-.1631701	.0066967	0.000
Currently attending (ref.: never attended)	.8964396	.0095415	0.000
Previously attended (ref.: never attended)	.2553672	.0048422	0.000
Relationship status (0=household head; 1=spouse)	-.0270263	.0036473	0.000
Full time student (ref.: worked for pay)	-.4835415	.0157418	0.000
Homemaker (ref.: worked for pay)	-.6704468	.0051488	0.000
Family agriculture holding (ref.: worked for pay)	-.6879719	.0038765	0.000
Family business (ref.: worked for pay)	-.4567712	.0048451	0.000
Dependent variable: Internet use (0=never use internet; 1=use internet)			
Number of observation = 4,256,360 Pseudo R^2 (McFadden) = 0.0747 ***p < 0.01 **p < 0.05 *p < 0.1 Controlling for 44 counties in Kenya			

Appendix 11: Demographics of Machakos county

Characteristics of agricultural production systems

The characteristics of the agricultural production systems in Machakos county are presented in Table 1 of this Appendix. The agricultural system is essentially composed of small-scale farms, with a standard farm size varying from 0.5 to 2 acres per household (Table 1, Dimension (A)) (Orodho 2006). According to the 2009 census data, there are on average four individuals per household, composed of two children and two adults. Each household generally farms on one smaller plot in the highlands and a medium plot in the lower lands (Orodho 2006; Ngugi et al. 2011). There are two types of agricultural systems, with a majority of subsistence agriculture and a minority of irrigated agriculture (Table 1, dimension (B)) (Orodho 2006).

The agricultural-ecological zone (AEZ) is classified as semi-arid in the county (Dimension (C), Table 1) (Kalungu et al. 2013). The area has a bimodal rainfall distribution pattern composed of long rains in March/April and the short rains in November/December (Wambugu et al. 2011). The annual rainfall varies from 550 to 700 mm per year (Ngugi et al. 2011), where the hilly parts of the region receive 800–1200 mm of rainfall per year (Wambugu et al. 2011). Temperature ranges from 20.2 Celsius to 24.6 Celsius, with an average temperature of 22.1 degrees Celsius. The lowland area is characterised by vast plateaus and hills, with bush-land type vegetation.

The main crop systems in the highlands are coffee and banana production systems, intercropped with legumes (Orodho 2006) (Dimension (D), Table 1). Livestock farming and crops adjusted for a more semi-arid climate are present in the lowlands (drought resistant maize varieties, beans, pigeon peas, cow peas, green grams, sorghum, cassava, millet, intercropped with papaya, fodder and timber trees). The major staple food crops in the county are; maize, sorghum, millet, beans, cowpeas, green gram, sweet potato, cassava (Dimension (E), Table 1).

Moreover, it was possible to extract the ownership of livestock per gender (i.e. female versus male household heads) from the population and housing census data (2009). The average farming household in rural Machakos county owns one indigenous cow, four goats and four indigenous chicken. Results show that, apart from cattle, differences in ownership between female and male household heads is not significant[167]. According to (Orodho 2006), there is some rabbit and pork rearing in the county as well (Dimension (F), Table 1).

The land system in the area are public government land, trust land, community land and private land (Ministry of Lands of Kenya 2009) and land tenure systems are based on two types; freehold land, i.e. private land, and trust land. According to the Constitution of Kenya any individual in Kenya (women and men) have the equal right to purchase and own land (Dimension (G) and (H), Table 1) (National Council for Law Reporting 2010).

Appendix 11 Table 1: Characteristics of the agricultural production system in Machakos county

Machakos county	
(A) Land: field distribution	0.5-2acres / household (on average 4 persons per household) One small plot in the highlands (most people) One medium plot in the lowlands (most people)

[167] These figures are the same at National level.

(B) Major agricultural systems	Subsistence agriculture (Rain-fed agriculture; Irrigation agriculture)
(C) Agricultural-ecological zone	Semi-arid **Annual rainfall:** 550-700mm **Altitude:** 700m to 1700m / coffee/banana belt at 1450-1600m **Soils:** Acrisols, Alfisols, Andasols, Ferrasols and Vertisols
(D) Main crops	**Highlands:** Coffee/banana (some maize, beans, sweet potato, pumpkin and tree crops, e.g. mango, macadamia) **Lowlands:** Maize, beans, pigeon peas, cow peas, green grams, sorghum, cassava, millet (intercropping with papaya, fodder and timber trees)
(E) Major staple food crops	Maize, sorghum, millet, beans, cowpeas, green gram, sweet potato, cassava
(F) Livestock	≈ 1 indigenous cattle per household Median for cattle ownership, female household heads: 0 Median for cattle ownership, male household heads: 1
	≈ 4 goats and indigenous chicken per household; some have pig and rabbit rearing Median goat and chicken ownership, female household heads: 2 and 3 respectively Median goat and chicken ownership, male household heads: 2 and 3 respectively
(G) Land systems	Public[168] (Government) land, Trust land[169], Community land[170] and Private land[171]
(H) Land tenure[172] systems	Freehold land (private land) and Trust land
(I) Role of women in farming and vice versa	Bi-functional: • As business activity: considered as 'farm managers' but not ultimate decision-makers (if non-widowed) – Carry out most of productive activities for coffee, food crops and livestock production. Men help occasionally during crop season (delivering harvest) and generally in

[168] *"Public land comprises all land that is not private land or community land and any other land declared to be public land by an Act of Parliament."* (Ministry of Lands of Kenya 2009, p.13).

[169] *"Trust land – (a) land which is in the Special Areas….and which was on 31st May, 1963 vested in the Trust Land Board by virtue of any law or registered in the name of the Trust Land Board; (b) the areas of land that were known before 1st June, 1963 as Special Reserves, Temporary Special Reserves, Special Leasehold Areas and Special Settlement Areas…; (c) land situated outside the Nairobi Area the freehold title to which is registered in the name of a county council or the freehold title to which is vested in a county council by virtue of an escheat…"* (National Council for Law Reporting 2010, pp.93–94).

[170] *"Community land refers to land lawfully held, managed and used by a specific community as shall be defined in the Land Act. Families and individuals within the community are allocated rights to use the land in perpetuity, subject to effective utilization. The ultimate ownership vests in the community."* (Ministry of Lands of Kenya 2009, pp.13–14).

[171] *"Private land refers to lawfully held, managed and used by an individual or other entity under statutory tenure. There are two type of rights of ownership; (1) Freehold tenure, individual 'absolute proprietorship' and (2) Leasehold tenure, which is the right to use land for a defined period of time in exchange for the performance of certain obligations."* (Ministry of Lands of Kenya 2009, pp.15–17).

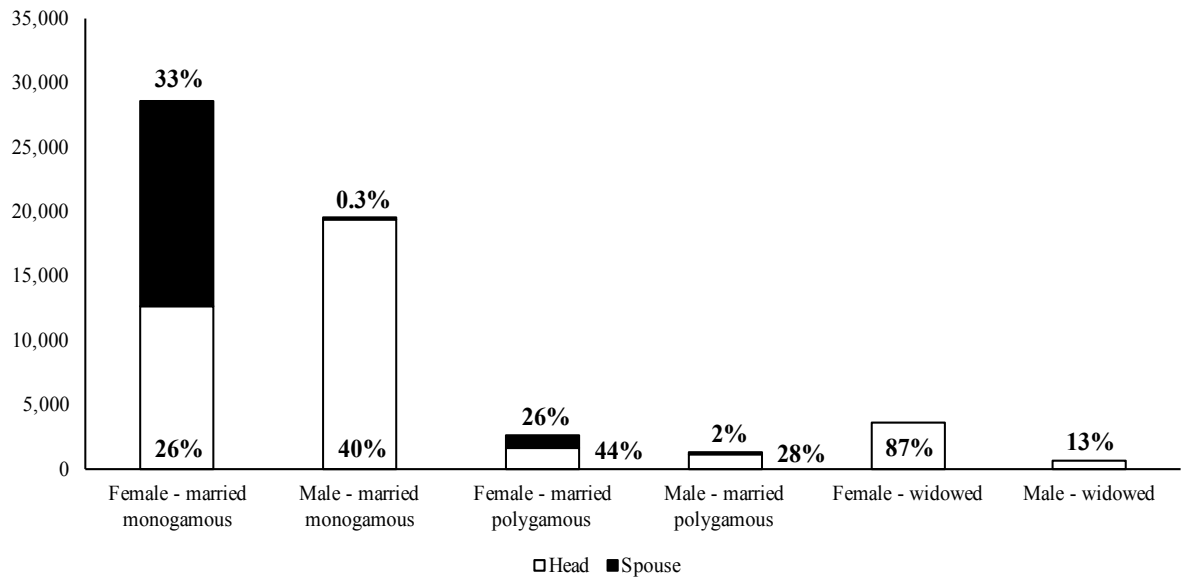
[172] *"Land tenure refers to the terms and conditions under which rights to land and land-based resources are acquired, retained, used, disposed of, or transmitted."* (Ministry of Lands of Kenya 2009, p.12).

	charge of decision-making for investments and outside activities, i.e. inputs purchasing. In wealthier farming households, the farmer household head hire labour, e.g. for coffee spraying and harvesting. This is otherwise done by the women. • As domestic activity: reproductive roles, taking care of the family and the household. They are considered as household managers. If non-widowed, they are not considered the household heads.
(J) Non-agricultural activities	• A larger number of men working outside the farm household (in public or private services) • Small business activities held by women (grocery shop, clothes shop, tailor, etc.) whilst in parallel working as farmers
(K) Farm extension service providers	• Public extension services • Private enterprises • Public and private research institutes • Local and international non-governmental organisations (NGOs) • Civil society based organisations (CSOs) • Farmer based organisations (FBOs), i.e. cooperative societies.

Sources: (Doss et al., 2011; Doss & Morris, 2000; Kenya National Bureau of Statistics, 2009a; Kenyan Ministry of Agriculture, 2012; Ministry of Lands, 2009; Orodho, 2006; Quisumbing, Brown, Feldstein, Haddad, & Pena, 1995; The Government of Kenya, 2010)**.**

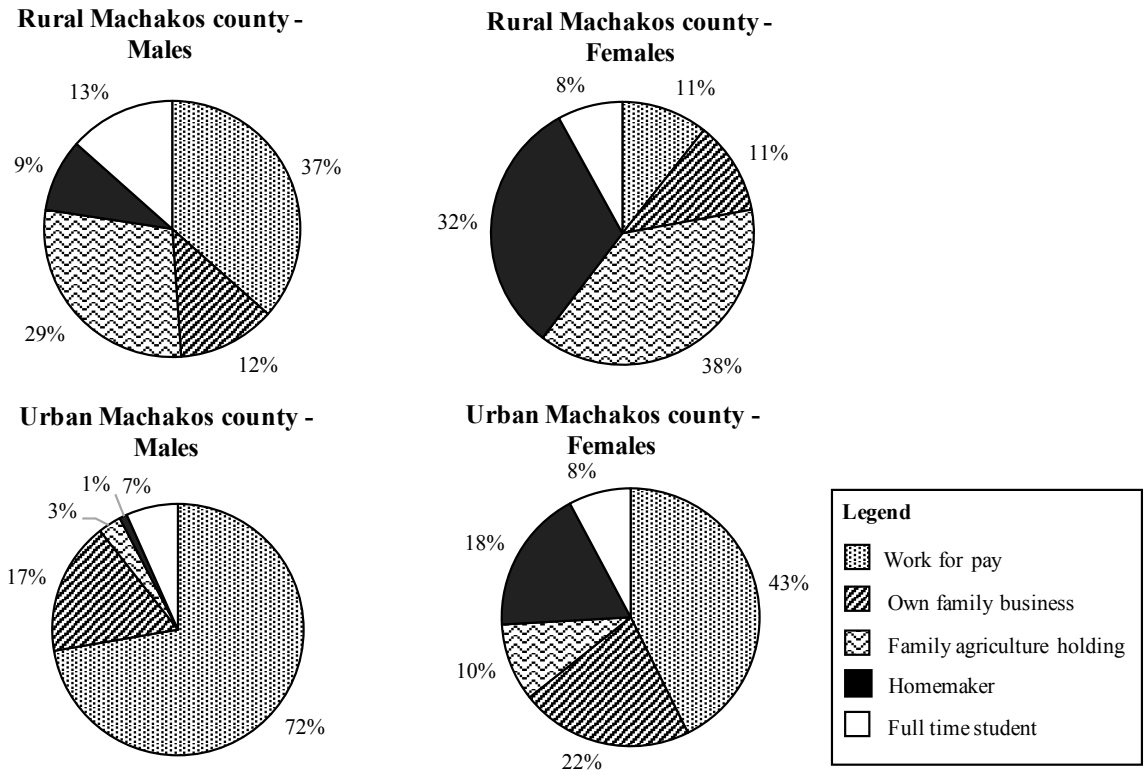
Per the literature (Doss 2001; Doss & Morris 2000; Quisumbing & Pandolfelli 2010) and governmental administrative documents (The Government of Kenya 2010), women have a key and bi-functional role in agriculture and so does farming to them (Table 1, Dimension (I)). Farming is a business/commercial activity generating revenue for the household. In this situation, women are perceived as the 'farm managers' but not, if non-widowed (and thus not the household head), as the ultimate decision maker.

Figure 1 of this Appendix presents the number of individual farmers per gender, relationship status (i.e. household head or spouse) and marital status (married monogamous, polygamous or widowed). It also shows the proportionate distribution of female and male household heads per marital status, above or equal to 18 years of age in rural Machakos county. Observations show that there is a relatively high number of married women (whether it is monogamous or polygamous households) that declare being household heads in the rural areas of Machakos county.



Appendix 11 Figure 1: Number of female and male farmers household heads per marital status and proportionate distribution of females and males per relationship status (n_{women}=34,911; n_{men}=21,257). (Source: PHC data, 2009).

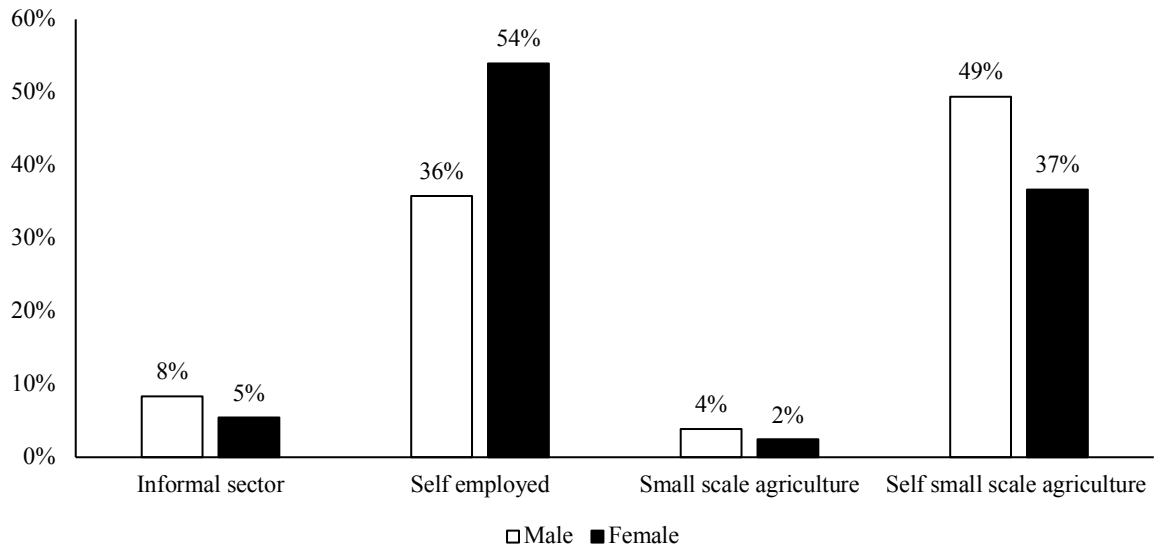
Agricultural households are not only confined to farming activities in the area (cf. Dimension (J), Table 1). A high number of individuals also have side businesses (mostly females) or where one of the adults, mostly males, work in towns whilst a larger number of women remain at the farm (Figure 2 of this Appendix). Indeed, out of the total number of men residing in Machakos county in 2009, 72 percent of men worked for pay in urban areas compared to 43 percent of women (PHC special data processing, 2009). Reversely, 38 percent and 32 percent of women in rural areas declared themselves as farmers or homemakers respectively, compared to 29 percent and 9 percent men.



Appendix 11 Figure 2: Proportionate number of women and men above or equal to 18 years of age per main economic activity and geographical area, Machakos county (n_{women}=281,318; n_{men}=253,076). (Source: PHC data, 2009).

Furthermore, according to the 2009 census data, there are in total 82,660 individuals above or equal to 18 years of age in rural Machakos declaring the farming is the main economic activity. It represents 30 percent of the active population in the area (i.e. there are 273,421 individuals in rural Machakos above or equal to 18 years of age). In this regard, the stated main employers for the individuals declaring the own agricultural holding as main economic activity are: (1) self-employed; (2) self-small scale agriculture; (3) employed in the informal sector; or (4) employed as casual labour in small scale agriculture. Figure 3 of this Appendix presents the main employers per gender for individuals above or equal to 18 years of age in rural Machakos county.

These observations point towards women's and men's different roles in agriculture and inversely; the role of agriculture per gender. As indicated in Table 1 of this Appendix (Dimension (I) and (J)) and from the PHC data 2009, farming has a dual and important role to women (as a business and as a social safety net). It also explains the proportionate higher number of female farmers in the county.



Appendix 11 Figure 3: The proportionate number of women and men farmers per main employer in rural Machakos county, individuals above or equal to 18 years of age (n_{women}= 51,916, n_{men}= 30,744). (Source: PHC special data processing, 2009).

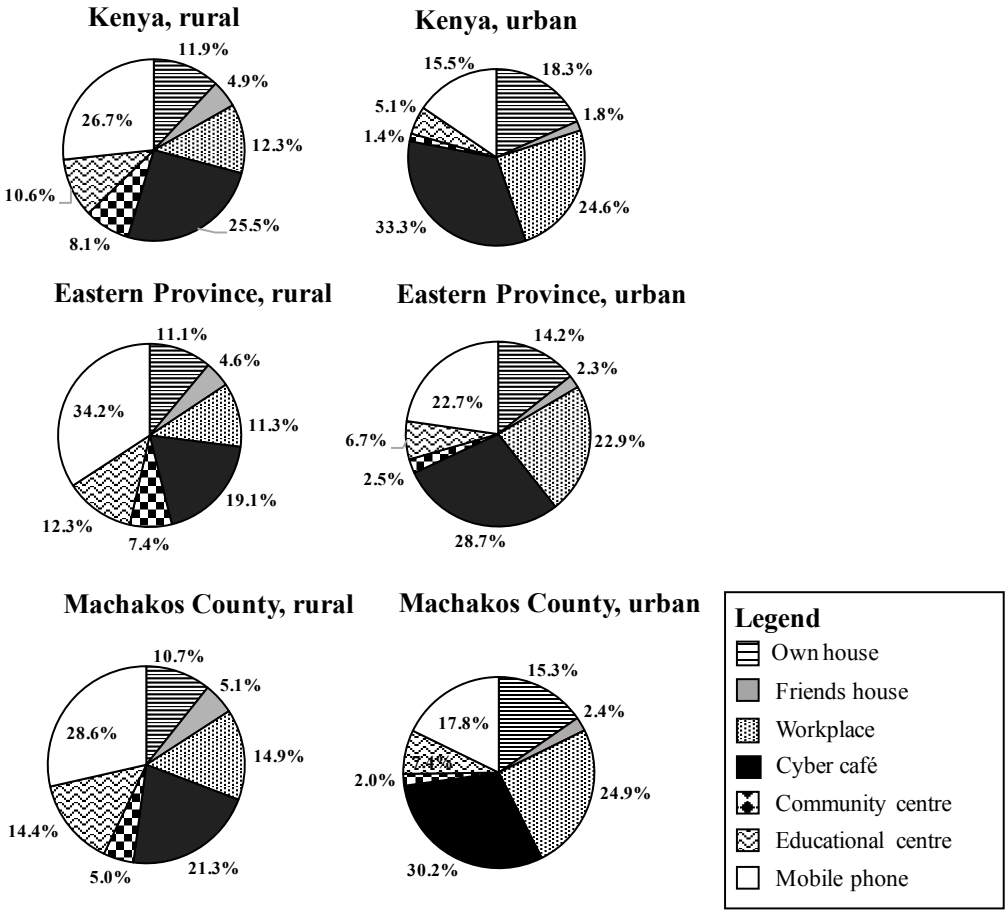
Different farm extension services providers are presented in Table 1, Dimension (K). Based on findings from the Agricultural Sector Development Strategy (ASDS) (The Government of Kenya 2010); the National Agricultural Sector Extension Policy (Nasep) (Ministry of Agriculture of Kenya 2012); and individual interviews with extension officers and staff working at Machakos Cooperative Union in (n=15), various extension organisations supply farmers with agricultural knowledge in the area. These are: (1) public extension services; (2) private enterprises; (3) public and private research institutes, e.g. Kenya Agriculture and Livestock Research Organisation (KALRO), Centre for Agriculture and Bioscience International (CABI), the World Agroforestry Centre (ICRAF); (4) local and international non-governmental organisations (NGOs), e.g. Action Aid, We Effect, Red Cross Kenya, World Vision, Plantwise; (5) civil society based organisations (CSOs), such as the Catholic Relief Services and (6) farmer based organisations (FBOs), for instance, Machakos Coffee Cooperative Union and respective 24 primary societies, e.g. Kasinga Farmers' Cooperative Society (FCS), Kaliluni FCS, Kakuyuni FCS, Ngomano FCS. To provide Kenyan farmers with technical knowledge, different farm advisory services methods are promoted (group approach, face-to-face interaction) in the ASDS and the Nasep documents (The Government of Kenya 2010; Ministry of Agriculture of Kenya 2012). One such method is agricultural knowledge dissemination and learning via ICTs.

Internet use in Machakos county

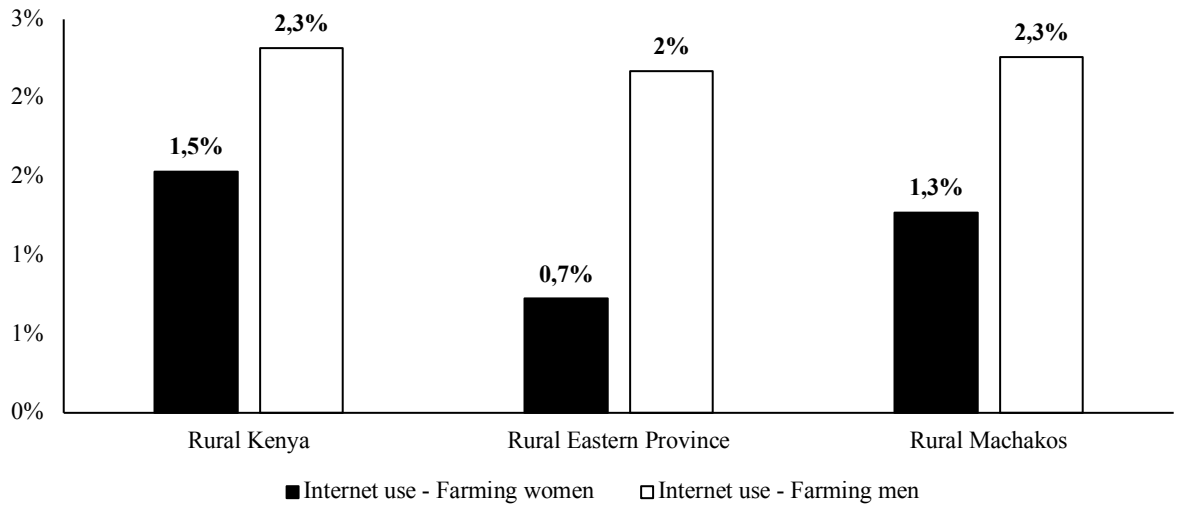
Results from the housing and population census show that internet services are used via different institutions in Machakos county (Figure 4 of this Appendix). These comprehend accessing internet from (1) the home; (2) a friend's house; (3) the workplace; (4) a cyber café; (5) a community centre; (6) and educational centre; or (7) via the mobile phone. The situation differs in rural and urban areas. In 2009, the level of access via collective points for internet use, especially via community or educational centres, is higher in rural areas, whatever the scale of observation, i.e. at national level, regional level, in the eastern Province, and in Machakos county.

Indeed, whether it is in rural Kenya, eastern province or Machakos county, a larger proportion of individuals report using internet services from their mobile phones, educational centres, community centres, or a friend's house. Observations show that internet use from a cyber café, the workplace or own house, is more frequent in urban areas. Using the internet services via community centres are particularly important in rural Machakos county, compared to rural Kenya or eastern province.

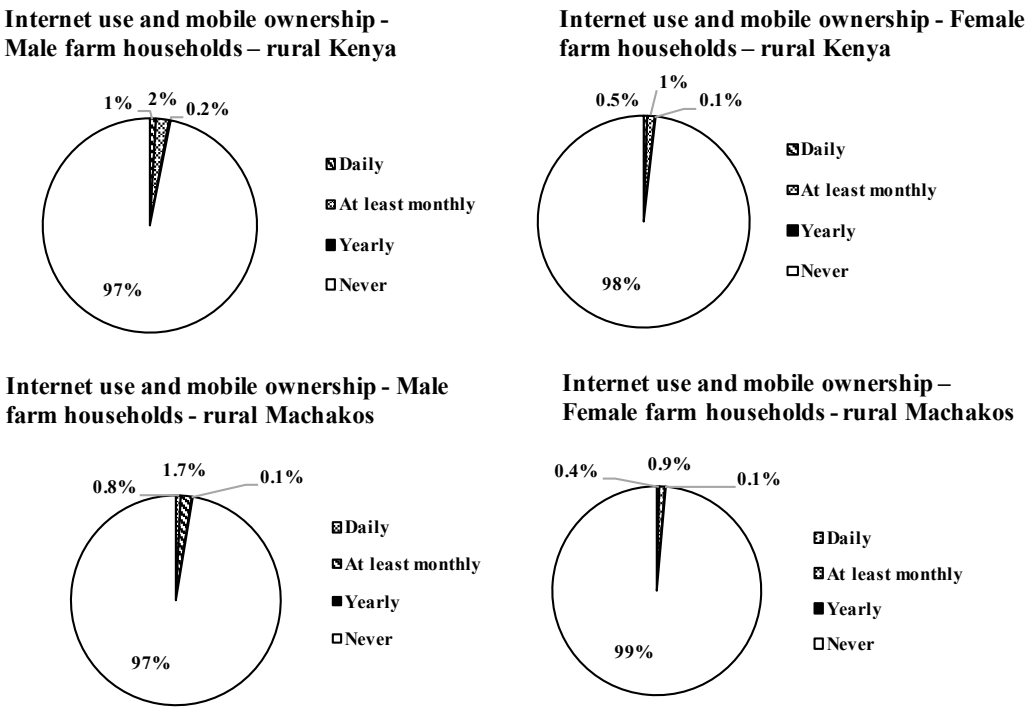
Moreover, Figure 5 of this Appendix shows that that there are some differences between women and men in the levels of internet use, yet not for the different observations of scale. In general, the proportion of women use internet less frequently compared to men. The frequency in internet use, i.e. daily, weekly, monthly and yearly does not differ between gender, implying that for these different frequencies, a larger proportion of men uses internet services compared to women. Besides, internet use and ownership of technological devices enabling internet access, in this case via the mobile phone (Figure 6) and the computer (Figure 7) per household heads working at the farm show that there is no major difference in rural Kenya and rural Machakos county. The levels of internet use and mobile ownership does not vary greatly between women and men for rural Kenya or rural Machakos either.



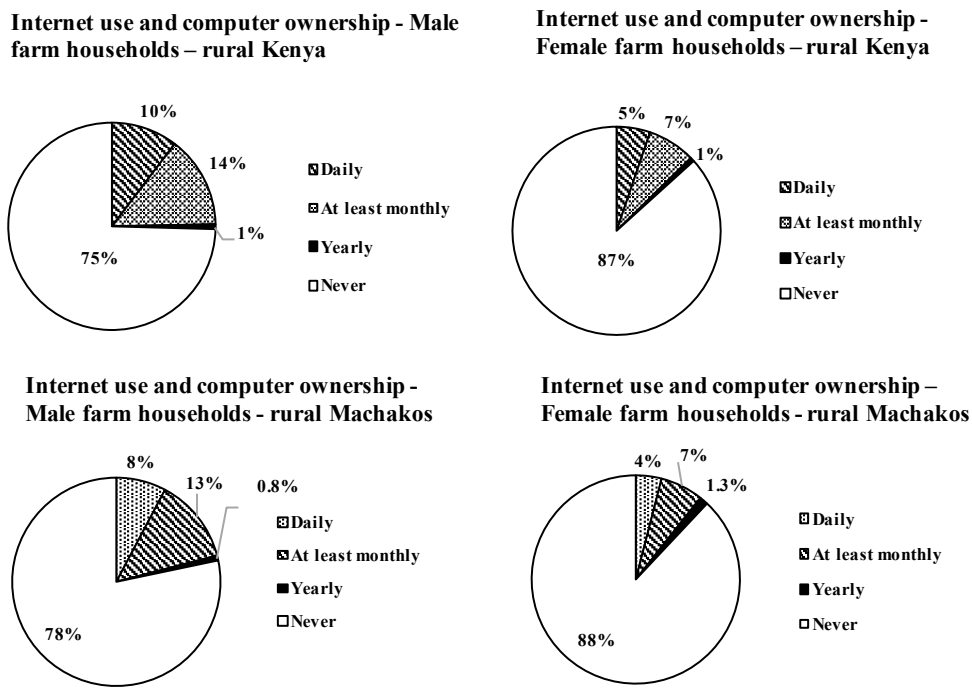
Appendix 11 Figure 4: Internet use locations in Kenya, Eastern Province and Machakos county in 2009, individuals over or equal to 18 years of age. n_{Kenya}=1,707,658; $n_{Eastern\ Province}$=137,891; $n_{Machakos\ County}$=38,696. (Source: PHC special data processing).



Appendix 11 Figure 5: Individual internet use per in rural Kenya, n_{males}= 57,979; $n_{females}$= 51,568, rural Eastern province n_{males}= 8,395; $n_{females}$= 3,827, and rural Machakos, n_{males}= 695; $n_{females}$= 661, for the working at own agricultural holding, over or equal to 18 years of age (Source: PHC special data processing).



Appendix 11 Figure 6: Levels of internet use and mobile ownership per gender in rural Kenya and rural Machakos for household heads above or equal to 18 years of age working at the farm. (Rural Kenya n_{males}=818,701; $n_{females}$= 428,239 and rural Machakos n_{males}=10,892; $n_{females}$=10,766) (Source: PHC special data processing, 2009).



Appendix 11 Figure 7: Levels of internet use and computer ownership per gender in rural Kenya and rural Machakos for household heads above or equal to 18 years of age working at the farm (Rural Kenya n_{males}=7,133; $n_{females}$=3,581 and rural Machakos n_{males}=129; $n_{females}$=75). (Source: PHC special data processing, 2009).

In general, female farm household heads declare using the internet to a lower extent via the mobile phone compared their men farmers, no matter the scale of observation. Moreover, findings point towards the fact that mobile phones are not necessarily used for accessing the internet.

Computers are used to a higher extent compared to mobile phones for entering into use with internet services, in spite the scale of observation. A smaller proportion of women farmers who declare owning a computer use internet services compared to men in rural Kenya and rural Machakos. One explanation to this could be that women use the internet from other collective spaces compared to men, which is analysed in Chapter 8.

Appendix 12: Gender equality objectives in National Frameworks of the Kenyan Government

National Framework	Gender equality objectives
National policies	
The National Gender Policy	• The Government established the Ministry of Gender, Children and Social Development in 2008. It is the national machinery promoting gender equality and women empowerment in Kenya. • The Ministry comprises of two technical departments: (a) the Department of Gender and Social Development and; (b) the Department of Children Services. The Ministry has three semi-autonomous government agencies: the National Commission on Gender and Development; the National Council for Children Services; and the National Council for Persons with Disabilities. • The Ministry's mandate, as per the Kenya Vision 2030, is to *"...provide services and coordination to the public on issues of gender, children and social development."* (Ministry of Gender of Kenya 2011, p.6). • The main action guideline and strategy that is used is gender mainstreaming. It is defined as *"the consistent integration of gender concerns into the design, implementation, monitoring, and evaluation of policies, plans, programmes, activities and projects at all levels."* (p. 24). • Affirmative action is also emphasised as a strategic tool for handling particular discriminations at a certain point in time. Affirmative action is defined in the policy as: *"A policy or programme of taking steps to increase the representation of certain designed groups seeking to redress discrimination or bias through active measures in education and employment. It is usually achieved through discrimination against other groups."* (p. 23). • It is recognised that women and men have different needs with the goal of configuring *"an enabling environment for the provision of gender sensitive services and meet the specific gender needs of women and men."* (p. 18).
The National Agricultural Sector Extension Policy (Nasep)	The Nasep vision states that: *"Kenyan agricultural extension clientele demand and access appropriate quality extension services form the best providers and attain higher productivity, increased outcomes and improved standard of living."* (Ministry of Agriculture of Kenya 2012, p.24). • The gender equality integration process is set based on five goals, achieved through extension sector providers: (1) disseminate gender-sensitive technologies and interventions; (2) influence the development of gender-sensitive technologies; (3) connect extension clientele to other stakeholders on education and awareness creation of various rights, followed by a change in attitudes on gender relations in the community; (4) influence gender mainstreaming in the curricula of schools and training institutions; and (5) target the youth in becoming farmers and agri-business entrepreneurs. • This should be achieved via the long-term goal of increasingly having a private-sector led and fully commercialised extension service; the promotion of pluralism in extension service delivery and; improved institution coordination.
The National ICT Policy[4]	The purpose of the Kenyan ICT policy is: *"to facilitate sustained economic growth and poverty reduction; promote social justice and equity; mainstream gender in national development; empower the youth and disadvantaged groups; stimulate investment and innovation in ICT; and achieve universal access."* (Ministry of Information and Communications 2006, p.2). The policy has a specific section on how to mainstream gender equality in ICT development in Kenya in ensuring that: • Women participate in ICT policy formulation and implementation.

	• ICT policies in various sectors are targeting the specific needs of women and in having gender specific activities using gender mainstreaming. • Moreover, the achievement of the ICT policy objectives also depends on the availability and adequacy of human resource capacity, referring to the citizens of Kenya. The Government will, accordingly, support the creation of possibilities (e.g. infrastructure) and assistance to acquire IT skills for women.
National Action Programmes	
The Agricultural Sector Development Strategy (ASDS) 2010-2020	The overall objective of the ASDS framework is to contribute to the agricultural sector's vision 2030 of a *"food secure and prosperous nation"* set by the Kenyan Government (The Government of Kenya 2010, p.ix). In this context: • Reducing gender inequality in the access to public services and income opportunities are important strategic factors for increased production and in achieving the ASDS vision (2010, p.94). • It is recognised that women are major actors in the agricultural sector. The Government has an objective of developing a gender policy for the agricultural sector, using gender mainstreaming to integrate their needs and concerns (2010, p.106). This document, although not a policy, is the Agricultural Sector Gender Mainstreaming Guide (ASGMG). • The aim is to incorporate gender equality variables and activities in any agricultural interventions at community level, via participatory approaches (2010, pp.106–107).
The ICT Master Plan 2014-2017/18	The vision of the ICT Master Plan is: *"Kenya as a regional ICT hub and a globally competitive digital economy."* (Ministry of Information and Communications of Kenya 2014, p.39). The framework follows five guiding principles for achieving the plan. One of those are: • *"Equity and non-discrimination – Equitable and non-discriminate availability of and access to ICTs across County Governments, urban and rural areas, gender, women, youth and disadvantaged communities."* (p. 39).
Gender guidelines	
The Agricultural Sector Gender Mainstreaming Guide (ASGMG)	• The overall aim of the guideline is to support the standardisation of gender mainstreaming within the agriculture sector. The document is referred to as a *"toolkit"* (Ministry of Agriculture and Ministry of Livestock Development of Kenya 2010, p.vii). It is referred to in the ASDS although not in the Nasep. • The objective is to mainstream gender equality activities into three main areas of Kenya's agriculture sector; (1) institutions; (2) programs and; (3) communities. Affirmative action, in the agriculture sector in Kenya is defined as a type of gender mainstreaming. *"This is an action taken on a temporary basis in favour of a disadvantaged group to help correct inequalities that have emanated from direct and indirect consequences of past discrimination. This is a form of gender mainstreaming."* (p. v). Affirmative action is thus used in particular cases, e.g. women have at least 1/3 representation in recruitment, promotion, and appointment at different levels within an organisation.

Appendix 13: Reported internet use locations and levels of education for women farmers in rural Kenya

Women farmers never attending school and internet use locations

Appendix 13 Table 1: Internet use locations of rural women farmers that have never attended school.

Internet use location	Median age of women farmers that do not access a computer and never attended school	Median age of women farmers that access a computer and never attended school
Community centre	47	57
Cyber café	56	51
Educational centre	49	56
Friend's house	50	58
Mobiles phones	46.5	51
Office/workplace	60	50
Own house	45	50.5
Overall median age	**49**	**51**
Total numbers	**640**	**164**

Source: PHC special data processing.

Women farmers previously attended school and internet use locations

Appendix 13 Table 2: Internet use locations of rural women farmers that have previously attended school.

Internet use location	Median age of women farmers that do not access a computer and previously attended school	Median age of women farmers that access a computer and previously attended school
Community centre	36	38
Cyber café	36	34
Educational centre	28	30
Friend's house	34	33
Mobiles phones	33	33
Office/workplace	41	38
Own house	33	40
Overall median age	**34**	**34**
Total numbers	**19,585**	**6,039**

Source: PHC special data processing.

Women farmers currently attending school and internet use locations

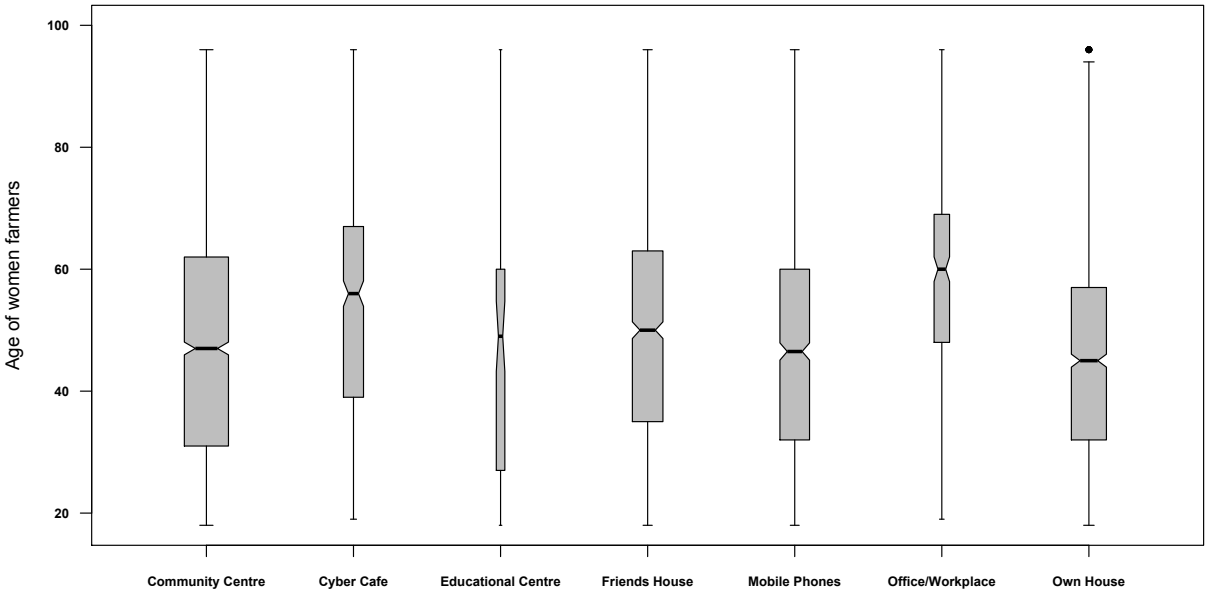
Appendix 13 Table 3: Internet use locations of rural women farmers that are currently attending school.

Internet use location	Median age of women farmers that do not access a computer and currently attending school	Median age of women farmers that access a computer and currently attending school
Community centre	30	23.5
Cyber café	28	28
Educational centre	24	25
Friend's house	35	30.5
Mobiles phones	28	29.5
Office/workplace	32	35
Own house	31	30
Overall median age	**30**	**29.5**
Total numbers	**625**	**453**

Source: PHC special data processing.

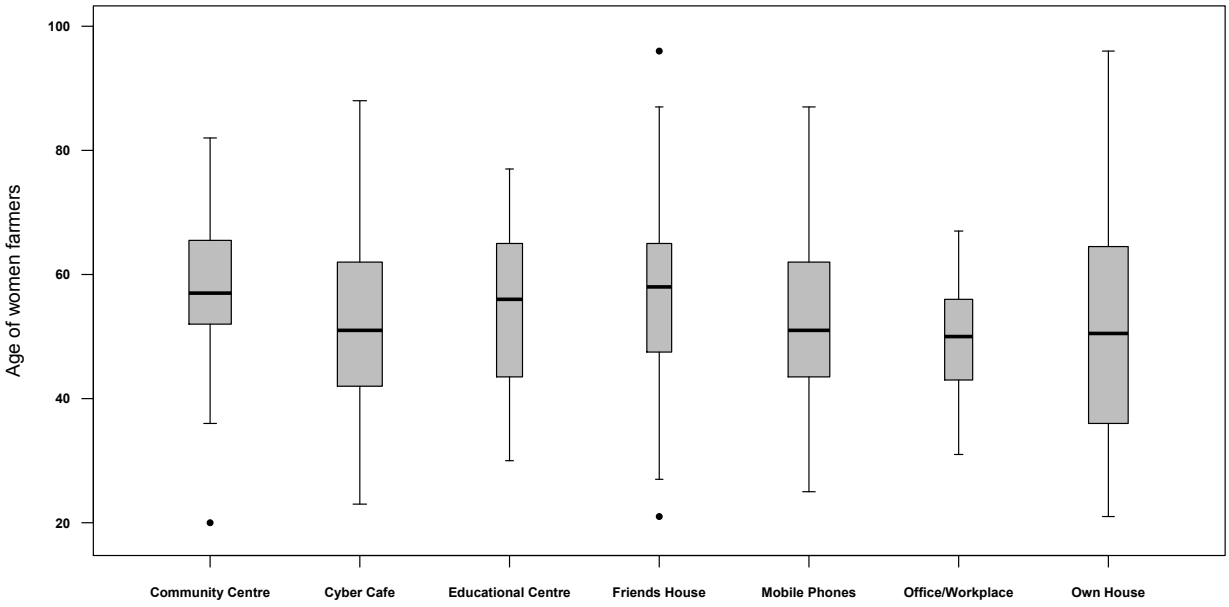
Appendix 14: Boxplot distributions of education, age and internet use locations of women farmers

Figure 1 of this Appendix reports on the internet use locations of women farmers who do not have access to a computer and who never attended school in rural Kenya in 2009. The overall median age is 49 years. For the women farmers who do not have a computer at home, the lowest median age relates to those who reported using the internet via the mobile phone (46.5 years of age). The highest median age corresponds to the women who report using the internet from the workplace (60 years of age).



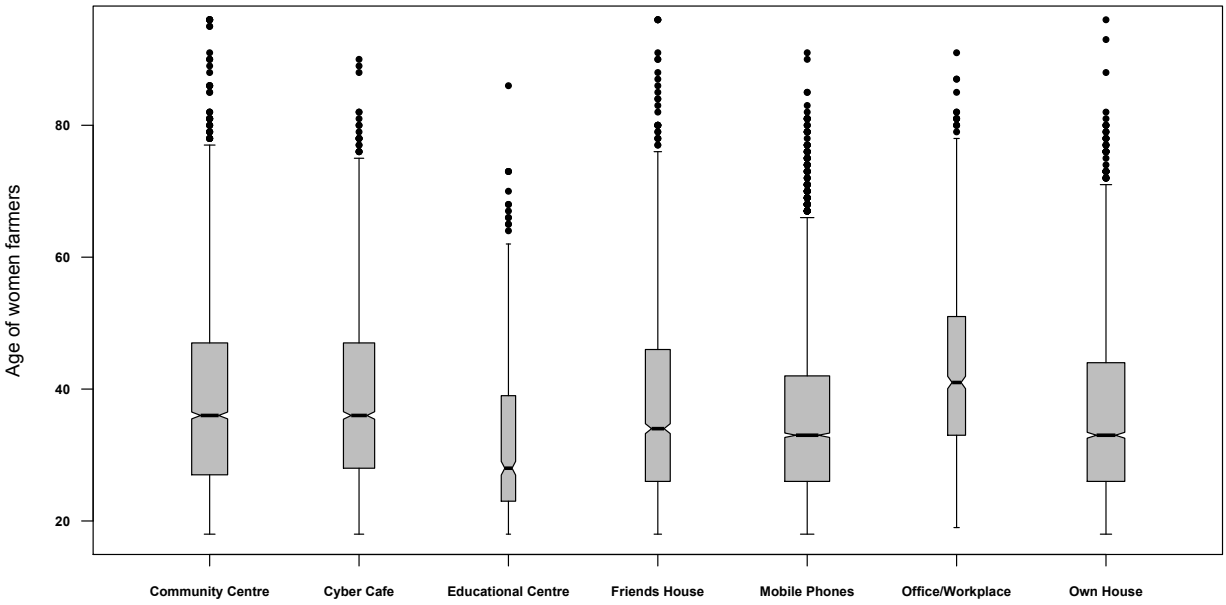
Appendix 14 Figure 1: Boxplot distribution of the median age for the number of women farmers in rural Kenya in 2009 who never attended school and who use internet services at different locations or via devices. The boxplot concerns only this group of women who do not have a computer at home. n=640. (Source: PHC special data processing).

Compared to Figure 1, Figure 2 presents the boxplot distribution of the reported internet use points for women farmers who never attended school and report having a computer at home. The overall median age is 51. Here, the youngest median age of 50 concerns the women who report using the internet from the workplace. The highest median age relates to the women using the internet from a friend's house (58 years old). Conclusions tell us that the age differences between these two groups are not evident.

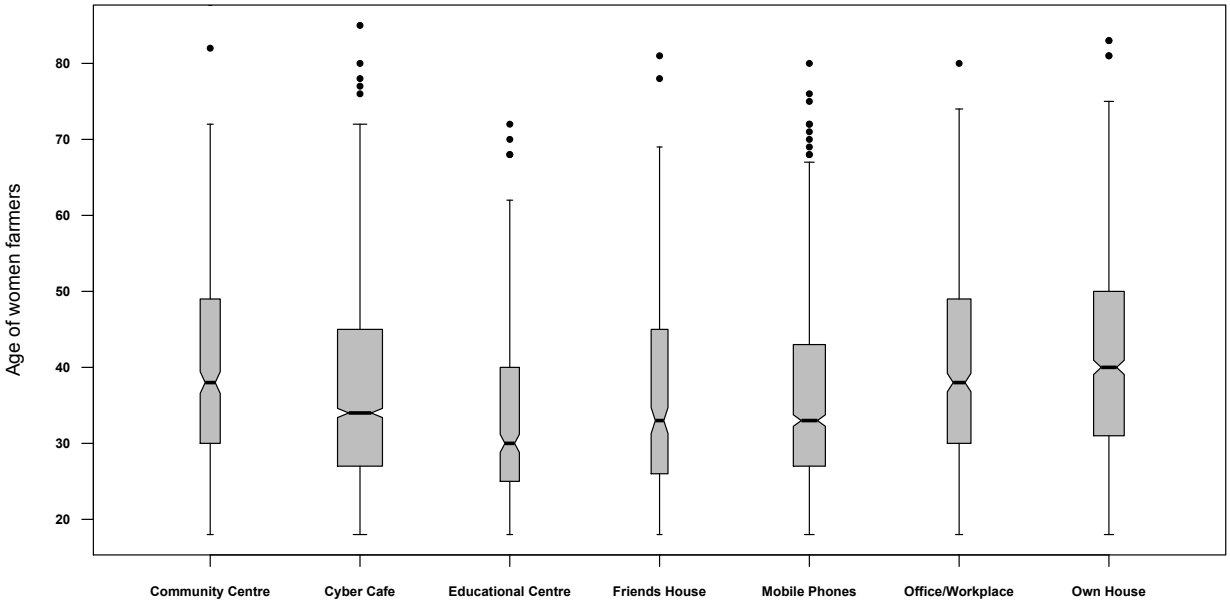


Appendix 14 Figure 2: Boxplot distribution of the median age of women farmers in rural Kenya in 2009 who never attended school and who use internet services at different locations or via devices. The boxplot concerns only this group of women who have a computer at home. n=164. (Source: PHC special data processing).

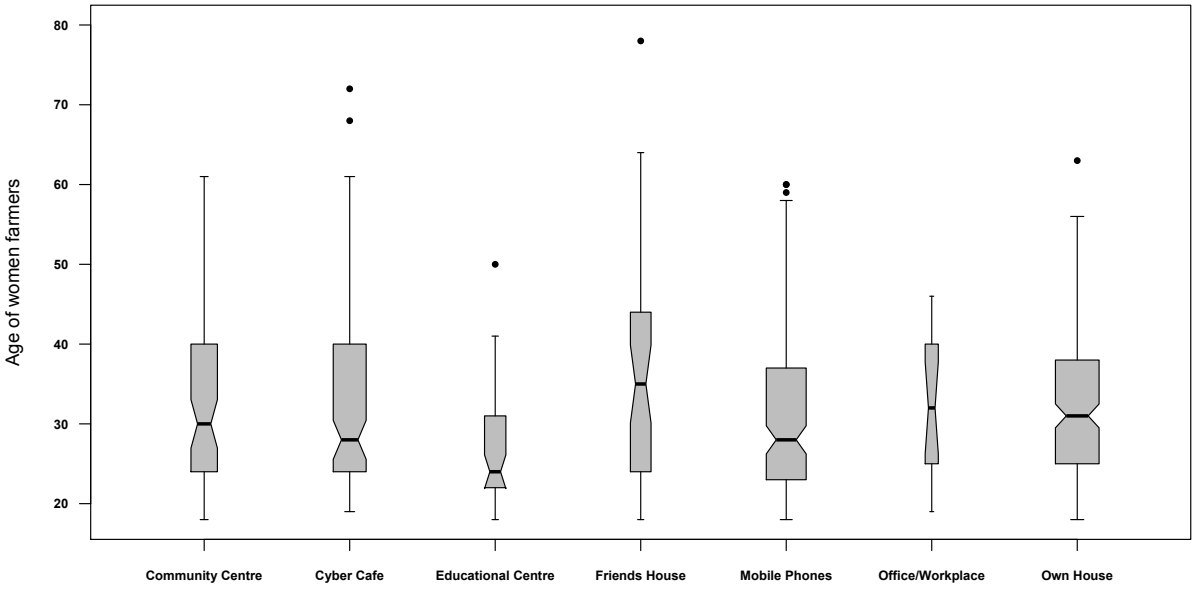
The overall median age of women farmers who previously attended school and do not have access to a computer is 34 (Figure 3). The highest median age of 36 concerns women farmers who report using the internet from a community centre and a cyber café, and the lowest median age of 28 concerns female farmers who say they go to an educational centre. The results are similar when it comes to women farmers who have a computer at home (Figure 4). Hence, findings show that there are differences between the overall median ages of women who never attended school and women who did previously attend school. Whether it is women farmers who report having a computer or not at home, they report using the internet either from a community centre, the cyber café, the mobile phone or the own house. Moreover, women farmers who previously attended school and do not have a computer at home, report that community centres are especially important with regard to use of the internet. This educational category is also the largest group of women farmers. Consequently, a strategic concern to ICT platform developers should be to target this group of women with their services via the reported internet use points.



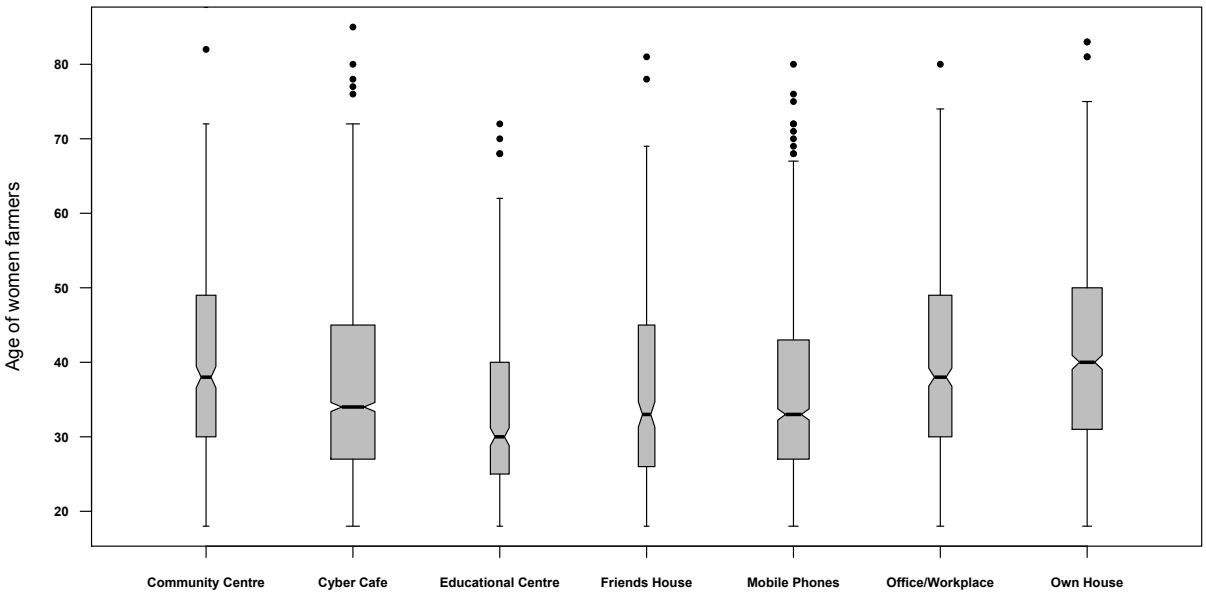
Appendix 14 Figure 3: Boxplot distribution of the median age of women farmers in rural Kenya in 2009 who previously attended school and who use internet services at different locations or via devices. The boxplot concerns only this group of women who do not have a computer at home. n=19,585. (Source: PHC special data processing).



Appendix 14 Figure 4: Boxplot distribution of the median age of women farmers in rural Kenya in 2009 who previously attended school and who use internet services at different locations or via devices. The boxplot concerns only this group of women who have a computer at home. n=6,039. (Source: PHC special data processing).



Appendix 14 Figure 5: Boxplot distribution of the median age for the number of women farmers in rural Kenya in 2009 who currently attending school and who use internet services at different locations or via devices. The boxplot concerns only this group of women who do not have a computer at home. n=625. (Source: PHC special data processing).



Appendix 14 Figure 6: Boxplot distribution of the median age of women farmers in rural Kenya in 2009 currently attending school and who use internet services at different locations or via devices. The boxplot concerns only this group of women who have a computer at home. n=453. (Source: PHC special data processing).

The overall median age of women farmers currently attending school, who report not having a computer at home, is 30 (Figure 5 of this Appendix). The lowest median age of 24 concerns women farmers who report attending an educational centre to use the internet. Using the internet at a friend's house corresponds to the highest median age of 35 years. Figure 6 of this Appendix shows similar results for the overall (29.5 years) and lowest (25) median ages. The latter

corresponds to women farmers attending an educational centre to use the internet. The highest median age of 35 concerns women using the internet from the workplace.

Appendix 15: Intra-household social status and internet use location

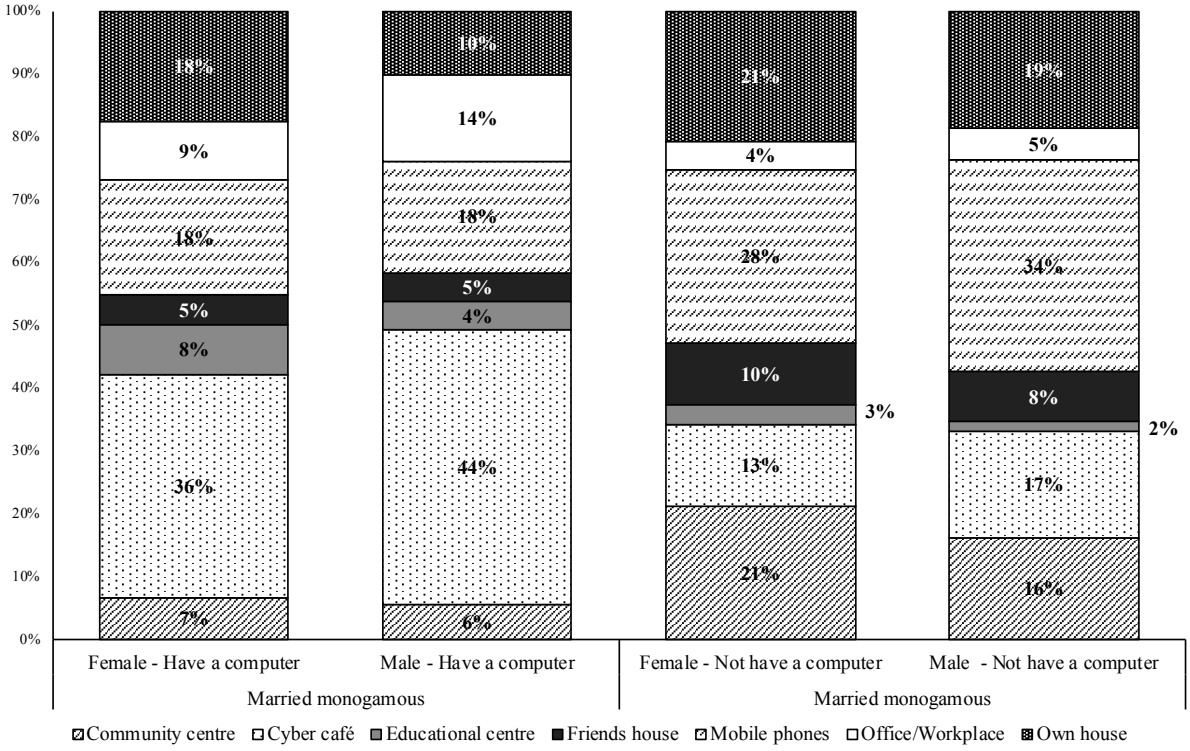
This dimension examines the intra-household social status of women and men farmers in respect of internet use locations, divided into two main categories:

(1) Marital status: married monogamous, polygamous or widowed.
(2) Relationship status: (i) female and male household heads, and (ii) relationship status per women farmers (household heads or spouses).

In this respect, analysis of the census data is presented in the following sections.

Marital status

Figure 1 of this Appendix shows the reported internet use locations of women and men farmers who are married in a monogamous setting and who report either having a computer at home or not.

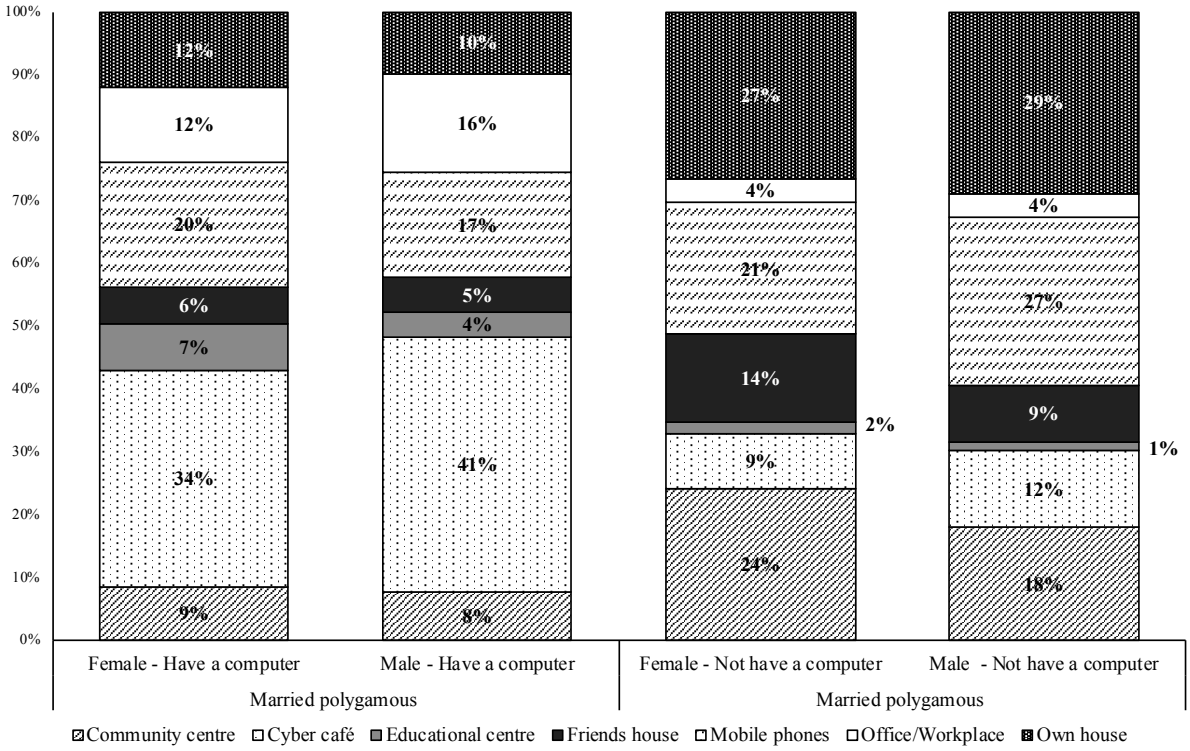


Appendix 15 Figure 1: Internet use location in rural Kenya in 2009 for women and men farmers over or equal to 18 years of age married monogamously. For households that have a computer: n_{women}=5,469, n_{men}=8,036 and for households that do not have a computer: n_{women}=19,453, n_{men}=17,995. (Source: PHC special data processing).

There are no substantial differences to report between genders for the two sub-groups (cf. Figure 1). A larger proportion of women farmers who report not having a computer at home, report using the internet from community centres, compared to men in the same category. Vice-versa, proportionately, more men farmers report using the internet from a cyber café.

Similar conclusions apply to women and men farmers who declare having a computer at home, although the internet use points differ from the first group (Figure 1). Here, a larger proportion of both female (36%) and male (44%) agricultural workers report using the internet from cyber cafés.

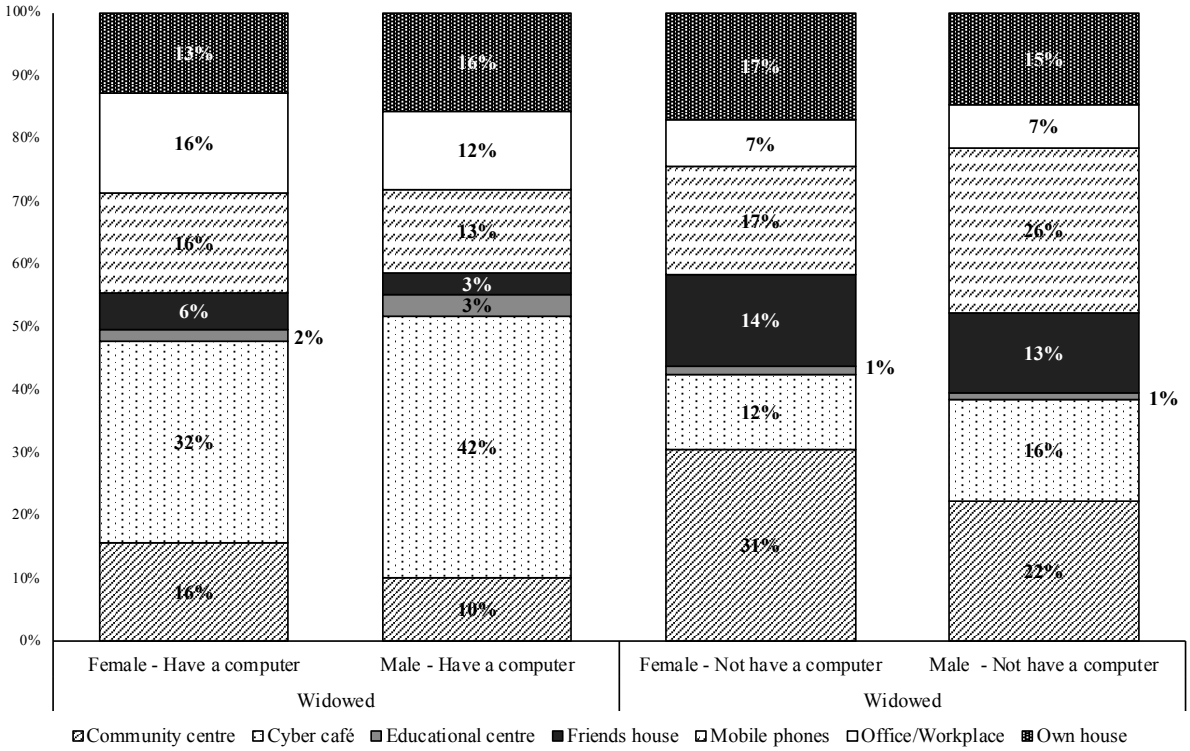
Women and men farmers married in a polygamous setting, using the internet from different locations or devices, are presented in Figure 2 of this Appendix.



Appendix 15 Figure 2: Internet use location in rural Kenya in 2009 for women and men farmers over or equal to 18 years of age married polygamously. For households that have a computer: n_{women}=528, n_{men}=692, and for households that do not have a computer: n_{women}=4,013, n_{men}=2,398. (Source: PHC special data processing).

For individuals who do not have a computer at home, a larger proportion of women married in a polygamous setting report using the internet from home compared to the other marital statuses (27%) (Figure 2). Using internet services from a community centre comes in second, at 24%. There are no significant differences between women and men here though. A larger proportion of male farmers also report using the internet from home (29%). There are no noteworthy variances in internet use locations between the proportion of women and men farmers that report having a computer at home either.

Figure 3 presents the number and proportion of female and male farmers who use internet services at different locations (or devices) and are widowed. As previously noted, the groups are divided into individuals who do, or do not have a computer at home. Results show that for both women and men farmers who do not have a computer at home, using the internet at a community centre is the main reported internet use location (31% for women and 22% for men). It is unclear here whether widowers are also part of the category of individuals who never received an education in this case. The differences are nonetheless not significant between women and men.

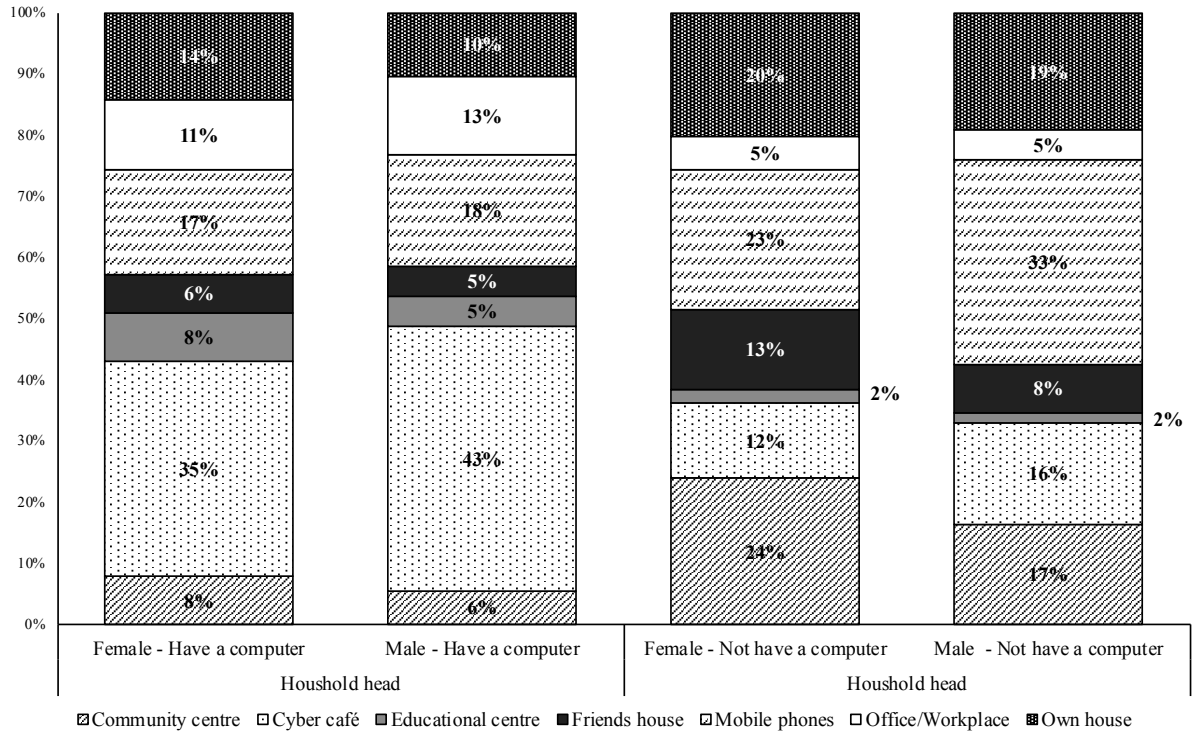


Appendix 15 Figure 3: Internet use location in rural Kenya in 2009 for women and men farmers over or equal to 18 years of age that are widowers. For households that own a computer: n_{women}=363, n_{men}=89, and for households that do not own a computer: n_{women}=2,253, n_{men}=320. (Source: PHC special data processing).

There are no major differences in the declared internet use locations between women and men farmers who report having a computer at home (cf. Figure 3). A larger proportion of women and men farmers report using the internet from cyber cafés. Use of internet services from a community centre still remains prevalent however, especially in the case of female farmers (at 16%).

Relationship status

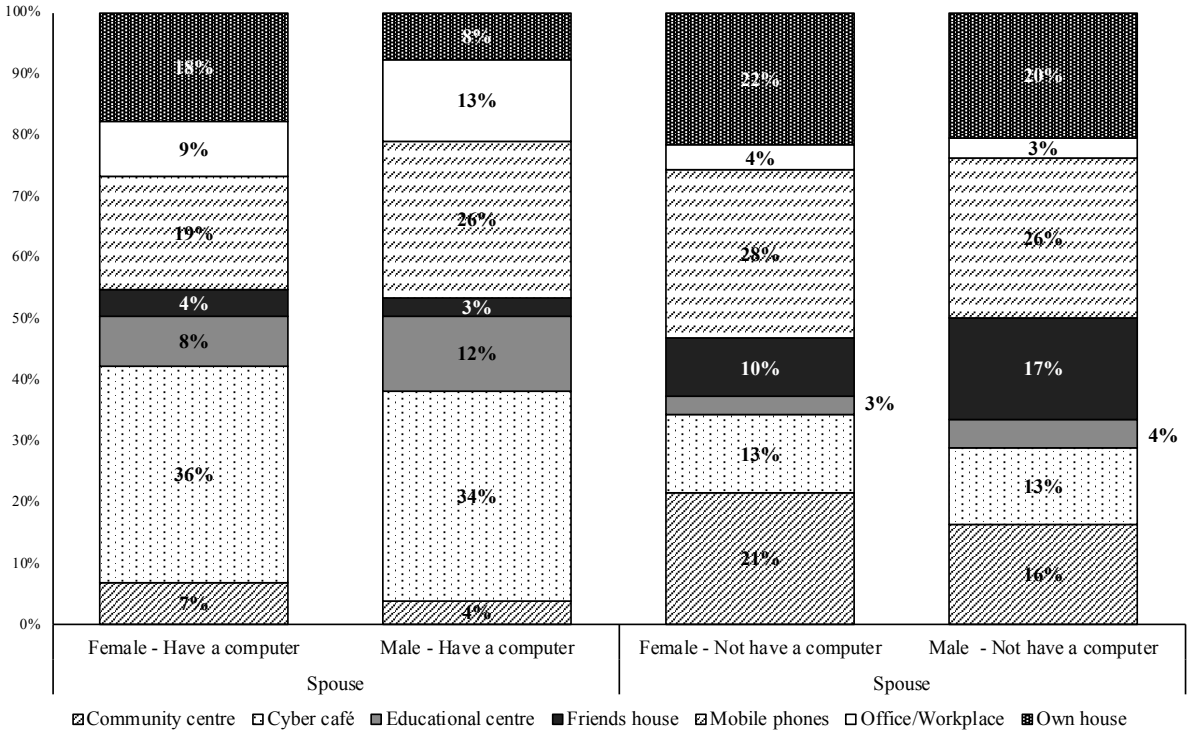
Figure 4 of this Appendix presents the reported different internet use locations for women and men farmers who say they are household heads, whether they have a computer at home or not.



Appendix 15 Figure 4: Internet use location in rural Kenya in 2009 for women and men farmers who reported that they were household heads over or equal to 18 years of age. For households that have a computer: n_{women}=2,113, n_{men}=9,625, and for households that do not have a computer: n_{women}=9,956, n_{men}=22,166. (Source: PHC special data processing).

For female farmers that do not have a computer at home, the main reported internet use location is the community centre (24%), and for men farmers, the mobile phone (33%) (cf. Figure 4). After that comes the mobile phone, for female farmers, 23% of whom report using the internet from this device. When there is a computer at home, the declared space for internet use is the cyber café for both women (35%) and men farmers (43%). As we can see, the differences between genders are not striking.

The locations of internet use per women and men farmers who say they are spouses are presented in Figure 5 of this Appendix.



Appendix 15 Figure 5: Internet use location in rural Kenya in 2009 for women and men farmers who reported that they were spouses over or equal to 18 years of age. For households that do not have a computer: n_{women}=16,749, n_{men}=245 and for households that have a computer: n_{women}=4,588, n_{men}=104. (Source: PHC special data processing).

Even though in numbers there are fewer men who report being spouses, on the whole there is not a wide divergence between the internet use locations of women and men farmers (i.e. proportionately between women and between men). When there is no computer at home, both female and male farmers report using the internet either from the cell phone or from a community centre. With a computer at home, both women and men farmers mainly report using the internet from a cyber café.

Appendix 16: The Gross National Happiness Index of Bhutan

The Index is based on a survey composed of 7,142 people, completed in all 20 districts of Bhutan (Ura et al. 2013). It is representative by urban and rural areas and by districts (dzongkhags). The survey was developed by the centre for Bhutanese Studies (CBS) and is based upon former GNH surveys. The survey build upon a pre-pilot questionnaire that was carried out in 2006 as well as on the GNH survey carried out in 2008 (represented nationally, not by district). The measure is composed of nine domains and the clustered indicators that were chosen based on five criteria.

1. The indicators should reflect the normative values of GNH articulated in official documents, e.g. the National Development Plan, and those embedded in the culture and traditions of the Bhutanese people
2. The indicators should relate to their statistical properties (each indicator should ensure robustness)
3. The indicators should reflect how happiness is increasing or developing/changing in various regions over time and amid different groups
4. The indicators have to be relevant for public action
5. The indicators should be understood by the Bhutanese citizens

As previously mentioned each domain has four indicators in exception of time use and living standards. Table 1 of this Appendix presents a summary of the domains and respective indicators.

Appendix 16 Table 1: The nine domains and indicators of the GNH index of Bhutan.

Domains	**Indicators**	**Specificities/indicator**
1. Psychological Well-being	Life satisfaction	Combines individuals' subjective assessments of their contentment levels with respect to health , occupation, family, standard of living and work-life balance (respondents asked how satisfied/dissatisfied they were in these five areas on a five-point Likert scale)
	Emotional balance; (1) positive and (2) negative emotions	Ten self-reported items per felt emotion. Positive emotions; (a) compassion; (b) generosity; (c) forgiveness; (d) contentment; (e) calmness. Negative emotions; (a) selfishness; (b) jealousy; (c) anger; (d) fear; (e) worry (respondents asked to rate the which extent they had felt these emotions during past weeks on a five point scale)
	Spirituality	Based on four questions; (a) self-reported spirituality level; (b) frequency in which they consider karma; (c) engage in prayer recitation; (d) meditate (all four indicators are run on a four-point scale)
2. Health	Self-reported health status	Self-reported proxy compared with objective health and nutrition states (five point scale from "excellent" health to "poor" health). Given one-tenth of the total weight for health and one-third as much weight as the other indicators (since it is a proxy)
	Healthy days	Number of healthy days over one month. Mean = 26 days and median = 30 days
	Long-term disability	Individuals ability to perform functional activities of daily living without any restriction, based on long-standing illness

		over last six months. If "yes", respondents asked on five-point scale of disability restricted daily activities.
	Mental health	Uses General Health Questionnaire (GHQ-12) developed by Goldberg – consists of 12 questions to give an indication of depression, anxiety, confidence and concentration levels (four-point Likert scale per question)
3. Education	Literacy	Said to be literate of the persons is able to read and write in any one language; English, Dzongka or Nepali. Also measures if person has attended ≥ 6 years of schooling
	Educational qualification	Two components: (a) formal education and (b) non-secular institutions (monastic schools/Non-Formal Education - NFE). Insufficient education: <6 years of schooling from any source
	Knowledge	Capture learning (inside or outside formal institutions). Five variables chosen; (a) knowledge of local legends and folk stories; (b) knowledge of local festivals; (c) knowledge of traditional songs; (d) knowledge of HIV and AIDS transmission; (e) knowledge of the Constitution (five-point scale, responses aggregated to create a maximum score of 25). Threshold set at 19 implying Bhutanese should have a good knowledge across the five variables.
	Values	Asked respondents if considered five destructive actions to be justifiable: (a) killing; (b) stealing; (c) lying; (d) creating disharmony in relationships; (e) sexual misconduct. Three-point scale *(cf. report for more information)*, combined into a composite indicator, taking values 1 to 5. Threshold set at four.
4. Culture	Language	Self-reported fluency in mother tongue on a four-point scale; "very well" to "not at all". High threshold set to main standards; set to "very well".
	Artisan skills	Asses peoples interest and knowledge in 13 arts and crafts; (a) weaving; (b) embroidery; (c) painting; (d) carpentry; (e) carving; (f) sculpture; (g) casting; (h) blacksmithing; (i) bamboo works: (j)goldsmithing and silversmithing; (k) masonry; (l) leather works; (m) papermaking. The threshold was set at one.
	Socio-cultural participation	Average number of day's people participates in socio-cultural activities over the last 12 months. Threshold set at 6-12 days per year.
	"Driglam Namzha" = Way of Harmony	Expected behaviour, more particularly in formal spaces and occasions (consuming, clothing, moving).Three-point scale, from "very important" to "not important". Two indicators; (a) perceived importance of "Driglam Namzha"; (b) perceived change in practice and observance during last few years. Threshold set at "important".
5. Time Use	Working hours	Includes (a) unpaid work; (b) voluntary work; (c) informal helps. Following categories classified as work; crop farming and kitchen gardening, business, trade and services, care of children and sick members of household, construction and repairs, craft related activities, forestry and horticultural activities, household maintenance, livestock related activities,

		processing of food and drinks and quarrying work. Eight hours per day is the legal limit, > if work more than eight hours per day, persons is identified as time deprived.
	Sleeping hours	Eight-hour sleep per 24 hours is the threshold.
6. Good Governance	Political participation	Based on two components; (a) possibility of voting in next election and (b) frequency of attendance in *zomdue* (community meetings). Threshold is set at "yes".
	Political freedom	Assess people's perceptions about the functioning of human rights; (a) freedom of speech and opinion; (b) the right to vote; (c) the right to join a political party of their choice; (d) the right to form *tshogpa* (association) or to be a member of the *tshogpa*; (e) the right to equal access and the opportunity to join public service; (f) the right to equal pay for work of equal value; (g) freedom of discrimination based on race, sex, etc. Threshold was set at "yes".
	Service delivery	For indicators; (a) distance from nearest health care centre (threshold: <1 hour walk); (b) waste disposal method (threshold: disposing trash either by burning, composting or municipal garbage pickup – considered as non-deprived); (c) access to electricity (threshold: "yes"); (d) water supply and quality (threshold: (i) safe drinking water; if piped water, considered a safe; (ii) perceived quality of water set a "good" or "very good", conditions are fulfilled).
	Government Performance	Subjective assessment of government's efficiency, testing people's perceptions of overall service delivery in the country. Respondents asked to rate performance of the government past 12 months on; (a) employment; (b) equality; (c) education; (d) health; (e) anti-corruption; (f) environment; (g) culture. Five-point scale, "very good" to "very poor". Indicator has a maximum value of 35 and minimum value of 7, Threshold of 28: public services have to be "very good" or "good" in at least five out of seven objectives.
7. Community vitality	Social support	Giving of time and money, i.e. volunteering and donating. Capturing total amount of financial resources donated in the past 12 months (donating) and amount of days donated in the past months (volunteering). Threshold: 10% of household income sufficient, three days per days for volunteering
	Community relationships	Measured by (1) Sense of belonging (threshold: "very strong") and (2) trust in neighbours (threshold: "some of then" or "most of them". Scale ranges from "very strong" to "weak".
	Family	Three-point scale; "agree", "neutral", "disagree" if people are satisfied with family situation. Threshold of 16 (18 is maximum score, 6 is minimum score)
	Victim of crime	Asked if victim of a crime during last 12 months ("yes" or "no"). Threshold set at "no".
8. Ecological Diversity and	Pollution	Perceived intensity of environmental problems, four-point scale from "major concern" to "minor concern". Conditional threshold, where an individual is insufficient is she/he has

Resilience (subjective indicators, given light weights, i.e. 10% of environmental domain each)		rated "major concern" or "come concern" on five of the seven environmental issues.
	Environmental responsibility	Measure the feelings of personal responsibility towards the environment; if they adopt eco-friendly approaches and if any deterioration in the current views of the environmentally aware citizens. Four-point scale from "highly responsible" to "not at all responsible". Threshold at "highly responsible"
	Wildlife	Information on damage to crops (rural areas). Two indicators: (1) damage as a constraint to farmers, "major constraint" to "not a constraint". Threshold set at "some constraint" or "major constraint"; (2) severity of damage (crop loss), "a lot" to "not at all". Threshold at "some" or "a lot". Reference from of past 12 months.
	Urban use	Positive and negative effects of rapid urbanizations (urban areas). Respondents asked to report on (a) worries about urban issues; (b) traffic congestion; (c) inadequate green spaces; (d) lack of pedestrian streets; (e) urban sprawl. Threshold: 1 of these issues as major threat or worry is sufficient.
9. Living Standards	Household income	Includes income earned by all individuals in a household from varied sources. Adjusted for in-kind payments. Absolute sufficient threshold was chosen: GNH data-adjusted poverty line by multiplying the national poverty line by 1.5 set at Nu. 14,200 per person (2007 data).
	Assets	Three major components: (a) appliances (mobile phones, fixed-line telephone, personal computer, refrigerator, colour television and washing machine ; (b) livestock ownership; (c) land ownership. Threshold applied at two levels: each of the three indicators and then an overall threshold.
	Housing quality	Good housing from (a) an individual perspective and (b) a community perspective. Three indicators; (a) type of roofing; (b) type of toilet; (c) room ratio. Thresholds set according to the Millennium Development Goals (MDGs); corrugated galvanized iron (CGI) or concrete brick or stone for roofing pit latrine with septic tank for toilet and two persons per room for overcrowding. Threshold is that all three conditions should be met.

Source: (Ura et al. 2013).

Weighting of happiness domains and indicators

The nine domains of GNH are equally weighted since they are of equal importance. Hence, *"none can be permanently ranked as more important than others but each might be particularly important to some person or some institution at a given point in time."* (Ura et al. 2013, p.127) All 33 indicators are (approximately) equally weighted in exception of the subjective and self-reported indicators (cf. Table 2 of this Appendix), i.e. self-reported health status (health dimension); governance performance and fundamental rights (governance); responsibility towards the environment and perceptions of ecological issues (ecological diversity and resilience). The subjective and self-reported indicators receive 10% weight of the dimensions. Further, the indicators estimated to be more objective and/or reliable have comparatively higher weights when domains combine subjective and objective indicators. There are equal weights between psychological well-being, time use and living standards. In the final three domains, i.e. education, culture and community self-reported indicators are weighted at 20% respectively whilst the other indicators are weighted at 30%. The self-based report indicators are: knowledge and values (education); speaking a native language and *Driglam Namzha* (cultural diversity and resilience); community relationships and family relationships (community vitality). *"In this way the weighting on the indicators tries to both preserve accuracy and also to prevent future GNH indices being too affected by changes in the frame of reference or changes in the aspirations of people that might affect their subjective or self-reported indicators"* (Ura et al. 2013, p.128).

Appendix 16 Table 2: Weights of each indicator

Domain	**Indicators**	**Weight**
Psychological well-being	Life satisfaction	33%
	Positive emotions	17%
	Negative emotions	17%
	Spirituality	33%
Health	Self-reported health	10%
	Healthy days	30%
	Disability	30%
	Mental health	30%
Time use	Work	50%
	Sleep	50%
Education	Literacy	30%
	Schooling	30%
	Knowledge	20%
	Value	20%
Cultural diversity and resilience	Artisan skills	30%
	Cultural participation	30%
	Language	20%
	Driglam Namzha	20%

Good governance	Political participation	40%
	Services	40%
	Governance performance	10%
	Fundamental rights	10%
Community vitality	Donation (time and money)	30%
	Safety	30%
	Community relationship	20%
	Family	20%
Ecological diversity and resilience	Wildlife damage	40%
	Urban issues	40%
	Responsibility towards environment	10%
	Ecological issues	10%
Living standard	Per capita income	33%
	Assets	33%
	Housing	33%

Source: (Ura et al. 2013).

Thresholds

The Bhutan GNH Index is defined by two types of thresholds; (1) sufficiency thresholds and; (2) one happiness threshold (Ura et al. 2013). The first type of threshold illustrates how much a person requires enjoying sufficiency for respective 33 cluster indicators. Put differently, the sufficiency threshold is based on how much that is needed to a person to be happy. Hence, each of the 33 cluster indicators has a sufficiency threshold. In order to set these sufficiency thresholds, different inputs have been used depending on the indicator. Certain use international standards, e.g. overcrowding in a house and maximum hours of work. Other have national standards, for instance in the case of income threshold, the sufficiency income is equivalent to 1.5 times the income poverty line for Bhutan. For other indicators however, there was not enough literature to set sufficiency thresholds. In this case, certain indicators depend on normative judgements.

Based on aforementioned statement, a second cut-off (sufficient happiness threshold) was developed that take into consideration variation amid people, based on their aspirations, personalities, materialistic needs (and access to), community as well as climatic circumstances (Ura et al. 2013). It implies that the second threshold enables diversity since the various indicator limits will not be equally significant as their relevance will vary per region. In reporting the GNH, the Bhutanese population were divided into four sub-groups and subject to three thresholds. The three limits refer to people that have reached sufficiency in 50%, 66% and 77% of the weighted indicators. Each individual has a 'personal profile' of achievements across the 33 cluster indicators.

In order to calculate the GNH Index, one threshold was chosen. To avoid a restricted policy focus as a result of a low threshold, the middle happiness threshold was selected at 66%, implying that the 'not-yet-happy' group included unhappy and narrowly happy people,

representing a total number of 41%. (cf. table 3 of this Appendix). Hence, that purpose is to assess how to increase the GNH by amplifying the sufficiency of these particular groups.

Such second threshold is referred to as the happiness threshold, which is defined across nine domains with respective 33 cluster indicators. (Ura et al., 2012).

Appendix 16 Table 3: Happiness thresholds

Happiness categories	**Definition of groups – Sufficiency in:**
Happy	**66%-100%**
Deeply happy	77%-100%
Extensively happy	66%-76%
Not-yet-happy	**0-65%**
Narrowly happy	50%-65%
Unhappy	0-49%

Source: adapted from (Ura et al. 2013, p.111).

ÉCOLE DOCTORALE
Agriculture, alimentation, biologie, environnement, santé (ABIES)

Titre : Économie politique des rapports de genre dans les technologies de l'information et de la communication du développement agricole. Le cas des plateformes de connaissances accessibles en ligne destinée aux agriculteurs au Kenya.

Mots clés : rapports de genre, conseil agricole, plateforme de connaissance, agricultrice, innovation, Kenya

Résumé : L'agriculture joue un rôle clé pour assurer la sécurité alimentaire dans les pays d'Afrique subsaharienne. Dans ces pays, le conseil agricole joue un rôle important dans les échanges de connaissances nécessaires aux agriculteurs pour garantir les rendements. Ces dernières années, les technologies de l'information et de la communication (TIC) ont permis le développement de nouveaux outils pour améliorer la portée et l'efficacité du conseil. Les gouvernements de ces pays sont cependant confrontés à des critiques concernant l'impact de ces outils, qui peuvent également contribuer à une fracture numérique touchant plus particulièrement les femmes qui travaillent dans les exploitations agricoles familiales.

Cette thèse de doctorat analyse les rapports de genre dont sont porteuses les plateformes de connaissances accessibles en ligne.

Ce travail s'appuie sur trois approches d'économique institutionnelle : l'économie féministe, la théorie de la régulation, et l'économie des services. Il présente un cadre méthodologique et conceptuel, développé pour analyser l'intégration des objectifs d'égalité des sexes dans les plateformes aux échelles macro, méso et micro. La conjugaison de différentes approches économiques institutionnelles a permis d'analyser comment les évolutions institutionnelles affectent l'inclusion des objectifs d'égalité des sexes dans l'intervention publique et dans le fonctionnement effectif des plateformes. Les résultats présentent des leviers d'action pouvant être pris en considération par les politiques et les concepteurs des plateformes, pour une tenir compte des rapports de genre dans ce système de vulgarisation agricole et éviter d'engendrer de nouvelles discrimination.

Title : Political economics of gender relations in information and communication technologies in agricultural development. The case of knowledge-based platforms for farmers in Kenya.

Keywords : gender relations, farm advisory service, knowledge-based platform, woman farmer, innovation, Kenya

Abstract : Agriculture plays a key role in ensuring food security in sub-Saharan African countries. Consequently, farm advisory services are necessary to adapt to different constraints in these countries. Lately, information and communication technologies (ICTs) have enabled the development of new tools, aimed at improving the scope and the effectiveness of services. Policy makers are however confronted with critical questions regarding their impact, which can contribute to a 'digital gender gap'. These issues particularly concern women farmers. This research analyses how ICTs take into account gender relations, and the situation of women farmers.

It is based on the case of Kenya. The work is based on three institutional economic research approaches: feminist economics, the French regulation theory, and economics of services. It presents a methodological and conceptual framework developed to analyse the articulation of gender relations in ICT platforms at macro-, meso-, and micro-level. Combining institutional economic approaches allowed to analyse how institutional developments affect the integration of gender equality in policy work. The results outline levers for action to be considered by policy makers and platform designers for the inclusion of gender equality dimensions, and thus women farmers'.