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Three essays on tropical forest economics: the case of Gabon

Marie-Luce Bia Zafinikamia

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THREE ESSAYS ON FOREST ECONOMICS. THE CASE OF GABON.

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Résumé

Cette thèse est une réflexion sur le développement des pays riches en ressources forestières. Elle est menée à travers l'étude du Gabon, un pays d'Afrique centrale particulièrement abondamment doté en forêt tropicale. Les deux principaux axes de réflexion autour desquels s'articulent les trois chapitres constitutifs de ce travail sont : la question du rôle du commerce international du bois tropical dans le développement du pays - notamment de son incidence sur l'industrialisation du secteur du bois-, le deuxième axe concerne la redistribution des bénéfices de la production et de l'exploitation forestière à l'échelle nationale et locale.

La présente dissertation s'organise en trois essais : le premier étudie la mesure concernant l'interdiction d'exporter des grumes - du bois non transformé- au Gabon. Le deuxième s'intéresse aux relations entre les concessions forestières et les populations locales des villages environnants. Enfin, le troisième et dernier chapitre analyse les conséquences de la stratégie de développement par les exportations à l'échelle locale, en étudiant la mise en place de la culture de l'hévéa et la conversion des agriculteurs en producteurs de caoutchouc naturel.

Commerce international, restriction des exportations et développement industriel

Ce chapitre se concentre sur une politique de gestion forestière particulière : l'interdiction des exportations de grumes consiste à prohiber l'exportation de bois rond. Cette restriction peut être totale, ce qui signifie qu'aucun bois rond n'est autorisé à l'exportation (comme au Gabon) ou partielle en n'autorisant qu'un certain volume de bois à être

exporté(en utilisant des quotas d'exportation ou en interdisant certaines espèces d'arbres à l'exportation).

La présente discussion est centrée sur les forêts tropicales, mais il est important de garder à l'esprit que l'interdiction d'exporter des ressources forestières à des fins de développement national et de conservation n'est pas spécifique aux pays en voie de développement. Il s'agit plutôt d'une option qui peut être considérée comme stratégie de développement d'un État qui redoute l'épuisement des ressources et (ou) leur mauvaise allocation. A cet égard, rappelons que les premières interdictions d'exportation de grumes ont été appliquées en Amérique du Nord, au Canada et aux États-Unis au début du XXe siècle.

La Fédération de Russie et récemment la Biélorussie sont deux autres cas notables de recours la mesure d'interdiction d'exportation des grumes dans des régions de forêts tempérées. Dans les pays riches en forêts tropicales, les exemples sont plus récents : Thaïlande en 1989, Indonésie en 1992, Ghana en 1994, Cameroun en 1999 et Gabon en 2010. Le premier objectif d'une telle politique est de protéger une industrie du bois naissante à l'échelle nationale en lui permettant de se développer, dans un premier, en lui octroyant l'avantage d'obtenir la ressource première à un plus bas coût que ses concurrents internationaux. C'est une politique commerciale couramment utilisée malgré ses nombreux détracteurs. Elle fait l'objet de débats houleux et soulève des controverses parmi les universitaires mais aussi entre les décideurs politiques. Le but de la restriction des exportations de bois rond est donc double : favoriser le développement économique par l'industrialisation et protéger les ressources forestières en entravant ou en prévenant la déforestation. Le consensus parmi ses détracteurs est que cette mesure n'atteint pas ses deux objectifs. De plus, la restriction des exportations a des effets pervers et crée des distorsions économiques qui peuvent nuire à l'économie nationale. Pourtant, les pays continuent d'adopter des interdictions d'exportation de grumes - partielles ou totales - dans le cadre de leur stratégie nationale de développement économique. De plus, les pays qui ont promulgué ces interdictions il y a des années voire des décennies ne les lèvent pas. Cet article donne un éclairage sur ce paradoxe apparent en faisant une revue de la littérature et une analyse des conséquences de cette interdiction au Gabon. Ce pays a une très faible densité de population, un faible taux de déforestation et son secteur fores-

tier est principalement investi par des opérateurs étrangers. Les résultats ne permettent pas de conclure que l'interdiction d'exporter des grumes est un succès : l'impact de ces politiques publiques doit se mesurer sur une échelle de temps plus longue. Ils suggèrent cependant, à ce stade, que cette mesure produit des effets significativement positifs d'un point de vue notamment de la conservation.

Toute la difficulté de cette analyse consiste à trouver des données secondaires fiables, ce qui constitue un défi commun à la plupart des études réalisées dans les pays en développement. J'utilise les données de la Direction Générale des Douanes du Gabon pour analyser l'évolution de l'exportation de bois du Gabon de 2004 à 2015. Les jeux de données donnent le volume et la valeur de toutes les exportations du produit du bois pour chaque mois de chaque année. Les produits exportés sont classés selon leur niveau de transformation, allant du niveau de non-transformation, au niveau de transformation le plus sophistiqué. Cet ensemble de données permet de percevoir les éventuels changements significatifs entre les périodes qui précèdent la mesure et celles d'après. J'exploite aussi différentes sources d'information, à savoir les résultats de deux rapports les plus du Ministère des Eaux et Forêts du Gabon sur les ressources forestières d'une part, et la capacité industrielle du Gabon d'autre part.

Méthode d'analyse et données

La décision de restreindre ou de stopper complètement les exportations de bois rond est une politique de gestion forestière visant à améliorer l'économie nationale, il est naturel de considérer la pertinence de cette décision du point de vue du Gabon au lieu d'adopter une vision macroéconomique internationale sur la question. Ainsi, je n'essaie pas de mesurer une perte ou un gain global en termes de bien-être. Dans la première section, j'évaluerai l'effet de la mesure sur l'environnement en examinant les changements dans la production de grumes et la crise forestière. La deuxième section se concentre sur l'effet de la mesure sur l'industrialisation en examinant l'impact sur la production et les exportations de bois traité.

Résultats

Evolution de la production de bois brut

J'effectue dans un premier temps une analyse graphique des données et dans un second temps j'utilise différentes formes de spécifications de régression linéaires afin de mesurer l'impact de la mesure.

J'utilise les exportations en équivalent bois brut comme une variable dépendante lorsque je contrôle le rôle d'autres variables explicatives.

Il ressort de l'analyse que la mesure d'interdiction n'a pas eu pour conséquence la surexploitation des ressources. En second lieu malgré l'interdiction, les recettes d'exportation n'ont pas connu de chute sévère et ont rapidement retrouvé un niveau similaire à celles prévalant avant la mesure et, finalement, les sciages ont supplanté l'exportation de grumes en volume et dans les revenus.

L'analyse révèle aussi que, les prix internationaux des bois tropicaux varient en fonction des espèces de bois. Dans le cas du Gabon, la principale espèce produite et exportée est l'Okoumé (*Aucoumea klaineana*), qui représente près de 50% des exportations de grumes et devrait couvrir 60% de la production totale de bois. L'Okoumé est originaire de la région de l'Afrique Equatoriale et elle est de loin la meilleure des essences pour la fabrication de contreplaqué. Même si l'Okoume est présent dans le sud du Cameroun, au nord du Congo et également en Guinée équatoriale, le Gabon reste le principal producteur de la région et fournit les deux tiers de la production mondiale d'Okoumé. L'Okoumé a permis au Gabon de se placer sur un marché de niche lucratif et a sans doute contribué à construire la notoriété commerciale du pays sur le marché international du bois. Cependant, les années 80 et 90 ont vu l'accroissement de l'utilisation d'autres essences pour la production de contreplaqué et le remplacement du contreplaqué par d'autres panneaux de bois.

Les effets des prix internationaux sur la production de bois sont mitigés. Cela dépend de l'élasticité-prix globale de la demande et de la disponibilité du substitut. Ceci est reflété plus généralement par l'effet ambigu des prix internationaux des grumes sur la déforestation.

J'utilise le PIB par habitant du Gabon pour contrôler l'incidence de la conjoncture économique nationale en générale. La relation devrait être positive, en supposant que cette croissance stimule la production de bois. Cependant, l'utilisation du PIB par habitant comme variable explicative de l'exploitation fait écho à l'hypothèse de la «courbe de Kuznets environnementale» qui prédit une relation positive entre le revenu par habitant et les pertes environnementales jusqu'à un certain niveau de développement. Une fois atteint ce niveau, la relation négative entre la croissance par habitant et les pertes environnementales devient négative. Le raisonnement sous-jacent est que la demande des gens les plus riches pour la qualité de l'environnement est plus élevée. La littérature sur le sujet ne conclue pas toujours sur l'existence d'une courbe environnementale de Kuznets et les résultats varient d'une région à l'autre. Enfin, j'utilise également le PIB des deux principaux partenaires commerciaux, à savoir la Chine et la France, afin de capter l'effet de la demande internationale qui est positif.

L'industrialisation de la filière

Le deuxième objectif de la mesure est de pousser plus avant l'industrialisation. Elle s'inscrit dans un plan macroéconomique plus large visant à diversifier l'économie, connu sous le nom de «Plan Stratégique Gabon Emergent» (PSGE). Le Code forestier introduit en 2001, a été le premier document juridique reflétant l'aspiration du gouvernement à intensifier l'utilisation commerciale de la forêt à travers la promotion de la transformation domestique. L'article 228 du code forestier impose une augmentation graduelle du niveau national de transformation du bois car «le taux de transformation de la production locale devrait atteindre 75% dans la décennie suivant la promulgation de la loi actuelle». Malgré la volonté sans équivoque des autorités de poursuivre l'industrialisation, la part moyenne de la transformation des grumes dans le pays n'était que de 27% en 2009 (OIBT, 2009) de l'exportation totale. L'atteinte des taux cibles de traitement de 75%, puis de 100%, était et reste très improbable.

Un passage de la production de grumes à la production de bois transformé s'est produite puisque les exportations de grumes ont été interdites. Des études antérieures montrent que la première transformation, en particulier les sciages, est moins rentable que

l'exportation de grumes et que seule la production de contreplaqué est économiquement aussi lucrative que l'exportation de grumes (Terheggen 2010b, Karsenty 2013). Mais les barrières élevées à la production de contreplaqués (pour l'UE), prescrites par les avantages concurrentiels des transformateurs chinois et imposées par des normes européennes de plus en plus strictes pour les produits du bois, limitent les options de production de contreplaqués au Gabon.

Au cours de la première année qui a suivi l'interdiction, la rareté des grumes a conduit à un prix relativement élevé des grumes sur le marché domestique, ce qui est le résultat inverse de ce que les modèles théoriques prédisent : l'effet attendu principal de l'interdiction est théoriquement d'augmenter le différentiel de prix entre le prix du marché international des grumes et le marché local. L'interdiction ne parvient pas à déclencher la baisse attendue du prix des grumes - ce qui signifie qu'elle n'a pas offert aux producteurs locaux la subvention attendue.

conclusion

La théorie prédit que l'interdiction d'export de grume finit inévitablement dans par la surexploitation des ressources. L'expérience indonésienne a prouvé qu'un qu'une telle stratégie peut effectivement entraîner des dommages environnementaux irréversibles, ce qui pourrait entraîner par une surexploitation et une récolte illégale à long terme (Dudley 2004, Karsenty 2013, Piketty et Karsenty 1996). Au Gabon, l'histoire est différente et l'interdiction a contribué à réduire la production de grumes. Compte tenu de l'épuisement attendu du pétrole au cours de la prochaine décennie, l'interdiction apparaît comme une décision judicieuse pour protéger la ressource forestière en tentant de bâtir une industrie de transformation du bois efficace. Ce deuxième objectif n'a pas été atteint. Il serait prématuré de parler de l'échec de la mesure d'interdiction d'exporter des grumes au Gabon, mais les défis à venir pour que la politique conduite à l'émergence d'une industrie nationale du bois compétitive sont tels qu'ils posent la question de leur faisabilité.

Exploitation forestière et investissements étrangers dans les forêts du bassin du Congo : Analyse des interactions avec les populations locales

Il est ici question de la nature des interactions entre les sociétés forestières étrangères et les communautés forestières au niveau des villages environnants. La qualité de ces interactions est évaluée à travers les perceptions des villageois, en utilisant l'ensemble de données d'une enquête auprès des ménages mise en œuvre au Gabon entre août et novembre 2012. L'hypothèse de base est que les interactions entre les sociétés forestières et les populations locales dépendent de deux critères principaux : la nationalité de l'entreprise (c'est-à-dire l'origine de son capital) et son niveau d'engagement dans l'adoption de pratiques d'exploitation durables. En utilisant la méthode de la double différence comme méthode comparative, l'effet de nationalité est mesuré par la comparaison des entreprises forestières chinoises avec les non-chinois tandis que la différence dans les pratiques d'exploitation est mesurée par le niveau d'achèvement du plan de gestion durable. Les résultats montrent que la présence d'une société d'exploitation forestière est généralement préoccupante, quelles que soient sa nationalité ou le niveau de réalisation de son plan de gestion durable.

A travers une étude menée dans 16 villages du Gabon et impliquant 314 ménages, nous cherchons à déterminer s'il y a une véritable différence de pratique entre les investisseurs chinois et ceux d'autres nationalités et si cette différence existe est-elle ressentie par les populations locales sur leurs activités journalières? Par ailleurs, nous cherchons également, à partir des mêmes données, à aborder la question de l'efficacité du volet social du processus d'aménagement forestier. Le plan d'aménagement forestier pré-requis indispensable pour toute activité d'exploitation forestière, doit comprendre une analyse socio-économique. Le but est d'identifier les possibles impacts de l'activité sur les populations locales vivant à proximité de la zone exploitée et de prévoir des mesures d'atténuation et de compensation de ces effets. Il paraît vraisemblable que l'activité d'une entreprise ayant finalisé un plan d'aménagement validé par les autorités compétentes aura à priori moins de conséquences négatives sur les villages environnants que celles des entreprises

n'ayant pas encore finalisé leur plan d'aménagement. En jumelant ces deux analyses, nous cherchons à mettre en parallèle le facteur nationalité et celui de l'implication dans le processus d'aménagement sur l'impact économique et social de l'exploitation forestière.

La gestion des forêts au Gabon

Le Gabon se caractérise par sa faible densité de population et l'inégalité de la répartition de cette population entre les zones urbaines et les zones rurales. La population totale du Gabon est d'environ 1, 5 millions d'habitants dont la grande majorité vit en zone urbaine (85% de population vit en ville et presque la moitié dans la capitale Libreville). La densité de population varie entre 250 et 300 habitants par km^2 en ville et 6 habitants par km^2 en zone rurale (Wily and Faure 2012) . Il en résulte que le ratio de terres arables par habitant est l'un des plus élevé du continent. Paradoxalement, l'agriculture est un secteur assez étroit qui ne contribue que marginalement à l'économie du pays et les importations de denrées alimentaires de bases représentent une part significative du total des importations du pays. La faiblesse de la densité de population, et la proportion élevée de terre par habitant pourrait amener à croire que la question foncière n'est pas un sujet au Gabon. Ce qui est vrai dans une certaine mesure car à l'inverse de la plupart des pays d'Afrique où la pression démographique raréfie la disponibilité des terres arables, le Gabon n'est pas confronté à un problème de manque de terre à proprement parler. Pourtant, dans ce pays essentiellement constitué de forêt, la question de l'accès à la forêt et à ses ressources par les différents acteurs se pose de façon aiguë et parfois conflictuelle. Les choix de distribution de la forêt vont être déterminants pour la pérennité des ressources forestières, la viabilité des systèmes d'exploitation, ainsi que pour l'économie au sens large. L'exploitation forestière constitue l'une des principales sources de revenu national (hors secteur pétrolier) et le gouvernement souhaite développer l'industrie du bois au niveau national. Les opportunités économiques qu'offrent les plantations agro-industrielles telles que l'huile de palme ou l'hévéa sont invoquées par les autorités pour justifier l'octroi de larges superficies de forêt à de grands groupes agro-industriels. Parallèlement, au niveau local, les populations villageoises tirent des activités qu'elles mènent en forêt l'essentiel de leur revenu. A mesure que l'exploitation commerciale de la forêt se développe, il est in-

évitable que surviennent des interférences entre les entreprises et les populations locales quant à l'accès à la forêt. L'arrivée d'un exploitant occupant une surface relativement étendue à proximité de villages implique, au minimum, une reconfiguration de l'espace disponible pour leurs activités villageoises et a fortiori des conséquences sur le quotidien des habitants.

Le code forestier de 2001 : vers l'exploitation commerciale des forêts du Gabon

Le Gabon a fait le choix de la nationalisation des forêts, en d'autres termes l'Etat est le seul propriétaire des forêts et le seul à pouvoir octroyer un droit d'usage à une personne physique ou morale «Toute forêt relève du domaine forestier national et constitue la propriété exclusive de l'Etat »(article 13 du Code Forestier 2001).

Il n'est donc pas possible d'être propriétaire d'une forêt mais uniquement d'avoir un permis d'exploitation, ce qui est clairement disposé par l'article 14 du Code Forestier (un article dispose seul le contrat stipule). Dans ce même article, il est ajouté que « [...] toutefois, en vue d'assurer leur subsistance, les communautés villageoises jouissent de leurs droits d'usages coutumiers » ce qui signifie que les communautés villageoises n'ont pas à solliciter un permis d'exploitation pour ce qui est des activités qu'elles mènent en forêt pour leur subsistance. Les droits d'usage coutumiers regroupent notamment les activités agricoles, la chasse, la pêche, la cueillette, le ramassage de bois à des fins domestiques (construction d'habitat ou bois de chauffe). Le Domaine Forestier Permanent de l'Etat regroupe donc l'intégralité des forêts du Gabon et se distribue en 3 domaines : Les forêts domaniales classées (aires protégées, parc naturels)- ces forêts n'ont pas vocation à être exploitées à des fins commerciales. Les forêts domaniales productives enregistrées. Ces forêts sont, soit déjà allouées à un opérateur qui les exploite à des fins commerciales, soit en attente d'allocation. Le domaine forestier rural est réservé à l'usage coutumier que font les communautés villageoises de la forêt (articles 12). Le principal problème de cette classification est l'absence de limites clairement définies permettant une distinction sans équivoque entre le domaine forestier rural et les forêts domaniales productives. Les droits d'usage coutumiers sont reconnus et listés par le code forestier mais il reste évasif

quant à la délimitation de la part qui revient aux communautés villageoises. Dans le cas où émerge un conflit portant sur les limites de la concession (ou de la zone d'exploitation attribuée à une entreprise par les autorités) et la forêt que les communautés villageoises revendiquent comme étant la leur (domaine rural), le texte de loi ne donne pas de réponse (Wily and Faure 2012). L'article 258 stipule que « les textes de classement d'une forêt ou les plans d'aménagement d'une forêt de production, doivent prévoir une zone suffisante à l'intérieur de laquelle les populations riveraines peuvent exercer leurs droits d'usages coutumiers », aucune indication de distance ou de superficie n'est précisée pour définir la « zone suffisante » réservée aux populations riveraines. Le code forestier de 1982 était à cet égard beaucoup plus explicite car il prévoyait une zone tampon de 5 km entre la limite des concessions et les abords des villages les plus proches (article 22 de code forestier 1/82). Cette limite zone de 5 km fait encore largement partie des revendications des communautés villageoises même si elle ne leur est plus aujourd'hui explicitement garantie par le texte de loi. Par ailleurs, l'entreprise qui s'est vue octroyer un permis d'exploitation bénéficie d'un droit enregistré et les limites de sa concession font l'objet d'une documentation légale ce qui n'est pas le cas des communautés villageoises. En effet, les droits coutumiers qui sont ceux des communautés villageoises ne font pas l'objet d'un enregistrement légal, ce qui affaiblit la position des communautés villageoises en cas de conflit.

Le code forestier de 2001 crée le statut de CFAD. La CFAD permet d'exploiter une surface qui varie entre 50 000 et 200 000 ha sachant qu'un même titulaire ne peut pas posséder une surface supérieure à 600 000 ha. Les CFAD représentent environ 10 ha de la totalité des forêts productives du Gabon. Les CFAD doivent faire l'objet d'un plan d'aménagement qui doit être validé par le Ministère des Eaux et Forêts avant que l'exploitation ne puisse effectivement commencer. Les entreprises ont 3 ans entre le moment de l'octroi de la concession et la présentation du plan d'aménagement pendant lesquelles elles n'ont le droit d'exploiter qu'une partie de la concession qui leur a été accordée sous le régime d'une CPAET. Après la validation du plan d'aménagement, l'entreprise peut commencer à exploiter la concession qui lui a été accordée en suivant la rotation qui a été définie dans le plan d'aménagement. Les CFAD sont généralement exploitées sur une période variant de 25 à 30 ans et en fonction d'un système de rotation annuel où seul

1/25 ou 1/30 de la concession est exploité par année. Ces zones d'exploitation annuelles sont appelées les Assiettes Annuelle de Coupe. Elles suivent une succession déterminée dès le commencement de l'exploitation de la CFAD.

Méthodologie : La double différence standard

Cadre théorique

Pour effectuer ce travail comparatif en produisant les résultats les plus robustes possibles nous avons choisi d'utiliser la méthode dite de la Différence des Différences ou en anglais « Difference In Differences » (DID). C'est une technique d'évaluation d'impacts de plus en plus largement utilisée en économie appliquée pour l'appréciation des effets des politiques publiques et de leur efficacité. Cette méthode est particulièrement pertinente dans une configuration où il est possible d'identifier des sous-groupes au sein d'une population homogène. Il s'agira alors d'identifier les sous-populations qui constitueront le groupe traitement. Ce groupe sera sujet à l'influence du phénomène dont on veut connaître les effets. Il faudra ensuite déterminer un groupe contrôle qui sert de référence contrefactuelle sur la base de laquelle vont être confrontés les indicateurs de différences avec le groupe traitement. Pour formaliser le modèle général, nous reprendrons ici les notations utilisées par Athey et Imbens 2006 et reprises dans la présentation de Reda and Calfat 2010 pour formuler la méthode.

Pour que cet estimateur donne puisse être une estimation fiable (c'est-à-dire non biaisée) des effets du dispositif, il faut nécessairement que certaines hypothèses soient respectées :

- Hypothèse de non sélection

Pour que l'estimation des effets ne soit pas biaisée, le groupe et la période auxquels appartient le ménage doivent être des variables aléatoires. La procédure de sélection doit être aléatoire pour éliminer tout biais de sélection.

- Hypothèse d'indépendance

Les autres facteurs susceptibles d'influencer l'évolution des indicateurs choisis doivent être les mêmes pour tous les N ménages de l'échantillon c'est-à-dire l'ap-

partenance à un groupe ou à une période ne doit pas changer les conditions dans lesquelles évoluent les ménages

— Hypothèse d’homogénéité de la population ou Constance des effets

Les sous-groupes doivent être homogènes, c’est-à-dire qu’ils doivent présenter les mêmes caractéristiques pour garantir que les effets attendus dans le temps se manifestent.

Ces hypothèses sont les garantes d’une estimation non biaisée des effets dans le cadre d’une DID standard. Il faut noter que les deux premières conditions de non sélection et d’indépendance sont plus que nécessaires pour que l’estimation soit fiable. Le respect de ces hypothèses a permis de définir les critères d’éligibilité des villages choisis pour l’étude et la constitution de l’échantillon. La partie qui suit décrit l’application de la DID au cas de l’exploitation forestière au Gabon.

Conception de l’évaluation

Nous avons appliqué la méthode de la double différence standard pour mettre en évidence les éventuelles différences liées aux effets sur les populations de l’activité forestière des entreprises à capitaux chinois. Pour ce faire nous partons du double postulat que les entreprises chinoises se démarquent par des pratiques différentes des autres entreprises du même secteur d’activité et que ces différences se manifestent par un impact différent sur les populations rurales. Le premier critère évalué est donc celui de la nationalité. Outre la nationalité, l’un des facteurs explicatifs d’une différence notable au niveau des conséquences de l’exploitation forestière sur les populations locales est le degré d’avancement dans le processus d’aménagement forestier. C’est pourquoi la comparaison sur le critère de la nationalité sera complétée par une comparaison entre des exploitations qui en sont à différents niveaux d’avancement dans l’aménagement forestier.

Nous comparons donc dans un premier temps des villages situés à proximité d’une concession chinoise à ceux situés à proximité d’une concession non chinoise, puis dans un second temps des villages situés non loin d’une concession dont le plan d’aménagement est en cours d’élaboration à ceux proches d’une concession dont le plan d’aménagement a été validé. Les groupes qui sont proches d’une concession chinoise et ceux proches de la

concession n'ayant pas achevé son plan d'aménagement constitueront les groupes test de notre évaluation. Les sociétés étant déjà établies au moment de l'étude, il était impossible de collecter les données concernant les villages étudiés (traitement ou contrôle) avant qu'elles ne s'implantent pour les confronter à celles après qu'elles se sont implantées. Il en va de même pour l'évaluation des différences liées au degré d'avancement dans le plan d'aménagement : nous n'avions pas de données concernant les villages avant que la concession ne commence son activité. Le système de d'exploitation suivant une rotation quinquennale sur la superficie des concessions a offert une solution à cet obstacle méthodologique. Cette organisation de l'exploitation des concessions forestières permet d'identifier des villages qui sont proches voire limitrophes de concessions forestières sans qu'ils soient pour autant impactés par l'activité de cette concession, étant situés loin de l'AAC. Ce sont ces villages qui ont constitué l'échantillon du groupe contrôle. Par opposition les villages situés à proximité de l'AAC ont constitué le groupe témoin.

Resultats

Effet de la nationalité de l'entreprise

La population des villages proches des concessions chinoises et proches des concessions européennes ont des caractéristiques sociales et démographiques très similaires. La différence double brute calculée sans tenir compte des autres variables n'est significative qu'à un niveau de 10%. Les résultats suggèrent qu'être proche d'une concession chinoise est également perçu comme une menace et comme une opportunité, ce qui n'est pas impossible : cela reflète la perception mitigée de la population. L'effet des opinions divergentes devrait être lissé lors du contrôle des variables socio-démographiques après appariement.

En effet, l'ajout des variables de contrôle socio-démographiques à l'estimation de la régression linéaire, fait apparaître une corrélation entre le fait d'être proche d'une entreprise chinoise et une perception plus élevée de la menace. Ce résultat est seulement significatif au niveau de 10% pour cent.

Le coefficient de temporalité capture l'effet de l'exploitation forestière (indépendamment de la nationalité) sur les variables d'intérêt. Ce coefficient est significativement

positif au niveau de 1% pour la variable de résultat « opportunité ». Cela reflète les espoirs d'emploi que l'arrivée d'une entreprise provoque habituellement. Dans le même temps, il est également associé à une insécurité plus élevée mais le coefficient est moins important.

Le coefficient de nationalité capture l'effet de nationalité qui n'a rien à voir avec les activités d'exploitation forestière. Il montre qu'il y avait significativement moins de conflits liés à la terre dans les villages près de la concession chinoise *avant même que l'exploitation ne commence*. Seul le coefficient de la différence double est significativement positif pour la variable de résultat « menace ».

Les groupes de discussion et la cartographie participative effectuée lors de la collecte de données apportent des preuves supplémentaires très utiles pour mieux comprendre ces résultats. Les villageois près des concessions chinoises ont tendance à être plus préoccupés par la rareté de la viande de brousse résultant de la déforestation et du comportement agressif des éléphants. Cela confirme, dans une certaine mesure, l'hypothèse selon laquelle les concessions chinoises, parce qu'elles exploitent un plus grand nombre d'espèces, auront probablement un taux de défrichement relativement plus élevé que les concessions européennes.

En confrontant les résultats de l'analyse des données à ceux des groupes de discussion, il apparaît que les attentes les plus élevées en termes d'opportunités d'emploi ont en fait totalement disparues lorsqu'une concession chinoise s'installe.

Effet du plan de gestion durable

La mesure de l'effet du plan de gestion durable (indépendamment de la nationalité) contient des résultats intéressants. L'estimation des première et seconde différences sans variables de contrôle ne montre pas de différence significative .

Mais lors de la mesure du coefficient de la double différence et en ajoutant les variables sociodémographiques, il apparaît que le plan de gestion durable est très significativement associé à un niveau plus élevé de perception des menaces .

Les données qualitatives aident à faire la lumière sur ce résultat apparemment contre-intuitif. La partie sociale du plan d'aménagement implique que les représentants de la

concession voisine rencontrent et échangent avec les représentants de la population locale, à savoir le chef du village et un groupe de villageois les plus âgés. Cette confrontation suscite plus de suspicion et la peur d'être dépossédé parmi les villageois. Paradoxalement, dans le village où une délégation de l'entreprise forestière est venue parler avec la population, les villageois sont beaucoup plus anxieux quant à leur accès à la forêt, leur capacité à continuer la chasse et la pêche, etc. Lorsque la société n'a pas encore approché les villageois, sa présence est moins tangible, moins concrète donc moins menaçante.

Les conflits fonciers ne se produisent pas réellement plus, mais quand la présence de l'entreprise est manifeste, les répondants sont plus enclins à signaler les conflits fonciers avec les concessionnaires.

Cependant, en faisant une cartographie participative, il semble que les compagnies forestières qui ont un plan de gestion durable finalisé n'empiètent pas sur les zones d'activités des villages.

Cela souligne deux faits importants. Le premier, le processus d'élaboration d'un plan de gestion permet au concessionnaire de connaître les limites des zones d'activités des villageois. En fait, les concessions avec un plan d'aménagement approuvé sont plus respectueuses de l'accès à la terre des villageois parce qu'elles ont interagi avec la population locale au moins une fois. Deuxièmement, ce résultat confirme l'échec notoire des compagnies forestières à assurer certains bénéfices à la population et à convaincre les villageois que l'accès à la terre et aux ressources leur est garanti.

Conclusion

Cette enquête contribue à mettre en évidence la façon dont les différentes pratiques d'exploitation pourraient être vécues au niveau microéconomique par la population locale. Les estimations de double différence suggèrent que les concessions chinoises sont perçues davantage comme une menace que les autres. La relation entre le plus haut niveau de perception de la menace et la nationalité ne peut être fiable qu'à 90% du point de vue statistique. Mais les données qualitatives complétant l'analyse statistique permettent de conclure que la principale différence entre les opérateurs chinois et les autres est le taux nettement plus élevé de coupe en forêts. Le mode opératoire des investisseurs chinois

pourrait changer au fil des ans, alors que le taux de croissance de la Chine a commencé à ralentir - étant donné que le principal marché des opérateurs chinois est la Chine. Par ailleurs, les sociétés forestières chinoises ont créé une Union afin de montrer leur volonté d'améliorer leurs pratiques. L'intention manifeste des gouvernements gabonais et chinois de resserrer leurs liens commerciaux prédit que les opérateurs chinois seront présents dans la forêt gabonaise pendant encore plusieurs années. Plusieurs mois de travail sur le terrain pour la collecte de données montrent que la relation entre les concessions et la population locale est minimale et improductive. La présence d'une concession est inquiétante, même lorsque l'entreprise est établie assez loin du village et n'interfère pas avec l'activité des villageois. L'absence totale de toute forme de répartition économique entre le concessionnaire et les populations locales est encore plus alarmante. Un système de certification international tel que le Forestry Stewardship Council (FSC) avec la contribution d'ONG influentes telles que le WWF a été promu sur principe du consentement libre, préalable et informé : le CLIP commande une consultation avec la population locale *avant* de commencer l'activité (qu'il s'agisse de foresterie, d'exploitation minière ou de toute autre chose). La manière dont les aspects sociaux de la gestion durable sont menés dans la forêt gabonaise est loin d'être un mené selon les règles d'un CLIP.

Production agro-industrielle et distribution des revenus : le cas de la plantation de caoutchouc au Gabon

Le Gabon n'échappe pas à la conversion des terres dans les autres pays à revenu intermédiaire dotés de forêts tropicales. Parmi les différentes activités de développement agricole nécessitant la conversion des terres forestières (expansion agricole, élevage de bovins, culture du quinoa, plantation d'huile de palme, culture du cacao), la plantation d'hévéa ou la plantation de caoutchouc naturelle est la plus courante au Gabon. La plantation d'huile de palme et la culture du cacao existent mais sont toutes deux marginales comparées à l'hévéa. En outre, la culture de l'hévéa a une histoire plus longue et est plus ancrée au Gabon, en particulier dans la partie nord du pays (province de Woleu-Ntem). Le point commun entre la production de telles plantations de cultures commerciales

et l'exploitation forestière est que les deux induisent le développement économique par l'augmentation des recettes d'exportation. Cependant, contrairement à l'exploitation forestière industrielle, la plantation de caoutchouc entraîne la déforestation car elle consiste à convertir des forêts et les terres boisées en plantations d'hévéas. La deuxième différence majeure entre ces deux activités est l'impact sur la population locale. La culture du caoutchouc est en fait très intensive en main-d'oeuvre alors que l'exploitation forestière est essentiellement intensive en capital. En conséquence, la répartition des revenus économiques entre profit et salaire diffèrent d'un secteur à l'autre. En outre, le modèle de production en expansion consiste à externaliser une partie de la production aux agriculteurs locaux, ce qui se traduit par une inclusion plus complète des populations locales dans le développement du secteur. Ce chapitre met l'accent sur la seconde différence et donne un aperçu de la manière dont les travailleurs et les producteurs locaux participent et profitent de la production de caoutchouc.

L'idée de construire un secteur agro-industriel fort et compétitif au Gabon est née au milieu des années 60. Les conditions climatiques, la disponibilité des terres et la perspective d'une demande internationale croissante de caoutchouc naturel ont conduit le gouvernement à mettre en œuvre un vaste programme visant à stimuler l'hévéaculture dans l'intention de devenir un producteur important de caoutchouc dans la sous-région. Trente ans après le lancement du premier projet de production de caoutchouc, la culture du caoutchouc est toujours à l'ordre du jour du gouvernement. Cependant, le cadre institutionnel et l'ampleur du projet ont changé. L'entreprise unique du secteur appartenait à l'État et est devenue privée après avoir été achetée par le groupe belge Siat. En 2013, le gouvernement a conclu un accord avec Siat, qui a été autorisé à entreprendre une expansion significative de sa zone de plantations de caoutchouc tandis que la multinationale basée à Singapour, Olam, a obtenu 50 000 ha de terres pour la plantation de caoutchouc. La volonté du gouvernement gabonais de faciliter l'accès des entreprises privées à la terre couplée au volume croissant d'IDE au Gabon se traduit par un nouveau modèle de développement où les multinationales jouent un rôle prépondérant dans la production de cultures de rente appartenant autrefois à l'Etat.

Le processus de collecte de la sève des hévéas (qui après avoir été transformée en usine devient du caoutchouc naturel) est connu sous le nom de saignage. Le saignage

ne peut être fait que par les travailleurs car il n'y a pas de mécanisation de ce travail. La production de caoutchouc dépend quasi linéairement de la productivité du travail. Le moyen simple pour une entreprise d'augmenter sa provision d'intrants est d'acquérir de nouvelles terres, d'embaucher plus de saigneurs (collecteurs de caoutchouc naturel) et de les former (le processus d'écoute nécessite un apprentissage et une formation). Cette option entraîne des coûts supplémentaires pour l'entreprise car elle doit fournir des repas et un logement aux travailleurs qui viendraient sur les sites de la plantation (qui sont situés loin des centres-villes). Cette option a pour avantage de faciliter le suivi et le contrôle de la production.

La deuxième option consiste à convertir le statut des propriétaires fonciers locaux ou des agriculteurs locaux, pour qu'ils cultivent leurs parcelles non plus pour l'agriculture, par exemple, mais pour y faire pousser des arbres d'hévéa. Dans ce cas, le suivi de la production est laissé aux producteurs eux-mêmes. Ils devront également supporter les coûts de production. Le principal avantage de cette option est d'augmenter la superficie de la plantation sans avoir à subir le processus administratif et coûteux d'acquisition de nouvelles terres.

Du point de vue des saigneurs, le fait d'être employés assure un revenu fixe et garantit les besoins de base. C'est aussi une source stable de revenu pour le ménage et qui peut être plus facilement couplé avec une autre source de revenus, tels que ceux provenant de l'agriculture. D'un autre côté, devenir un sous-producteur pourrait générer une augmentation considérable des revenus, mais cela signifie également supporter le risque de fluctuation des prix et de la production.

La question est donc, dans le contexte actuel d'expansion de la production de caoutchouc, de savoir lequel de ces deux modèles co-existants est, à long terme, plus bénéfique pour la population locale.

Données et Evolution

Les données ont été collectées entre octobre et novembre 2012. La majorité des chiffres de production et des prix proviennent des enregistrements SIAT. En outre, des groupes de discussion avec les travailleurs sur les plantations SIAT et les cultivateurs sous-traitants

dans quatre villages autour de Mitzic et Oyem ont été mis en oeuvre. Les données concernant la production à la fois de la celle des plantations industrielle et de la celle des villageois proviennent du registre SIAT. Pour la période 2006-2012, la production annuelle de caoutchouc Siat-Gabon a augmenté et la totalité de la production est exportée principalement vers l'Europe et les États-Unis. La contribution des petits planteurs à la production totale de caoutchouc est en 2012 de 15% de la production annuelle totale. L'évolution de la superficie cultivée des villageois entre 2006 et 2012 a augmentée de façon constante du fait de l'inscription de nouveaux planteurs et de la maturation des hévéas. La production par hectare montre une augmentation constante de la productivité SIAT sur la période tandis que la productivité des planteurs a connu un ralentissement entre 2008 et 2012.

Résultats et Conclusion

La société SIAT bénéficie d'une position de monopole après l'achat d'une entreprise publique officielle.

Il détermine le revenu à la fois du travailleur et du sous-producteur avec une fonction objective implicite visant la maximisation du profit, d'où l'équivalence des deux statuts en termes de revenus.

Au cours de la flambée des prix du caoutchouc entre 2009 et 2011, dans le pays voisin Cameroun, le caoutchouc naturel a été acheté à 850 CFA (1,3 euro), la différence de prix importante entre le prix SIAT et le prix Cameroun a conduit les producteurs à vendre leur production au Cameroun autant qu'ils le pouvaient. Ceci va à l'encontre du contrat (ou de l'accord implicite) avec SIAT stipulant que la société est le seul acheteur. Au-delà des tensions politiques et sociales induites par cet épisode, il a révélé à quel point le prix d'achat de SIAT était très inférieur au prix du marché.

En réalité, en termes de revenus monétaires, être un cultivateur ou un travailleur sont deux statuts équivalents, de sorte que le choix d'être l'un ou l'autre est la conséquence de facteurs sociaux plus que d'un arbitrage économique. La grande majorité des travailleurs de SIAT sont de jeunes hommes célibataires et sans enfants et sont des migrants venant du Cameroun ou de la Guinée équatoriale ; ils travaillent et vivent dans la plantation. Les sous-producteurs sont eux des originaires de la région et sont en général chef de famille.

L'objectif initial de Hevegab était d'impliquer les agriculteurs locaux dans la production de caoutchouc afin de stimuler le développement régional en créant une spécialisation dans une activité de culture d'exportation. Depuis que l'entreprise n'est plus détenue par l'État, un autre modèle est à l'œuvre et sa stratégie ne favorise pas en premier lieu le développement local.

Introduction

Since the second half of the 20th century , there is increasing concern with environmental issues. Despite their plurality and their different nature, all these issues (climate change, water supply, arable land availability etc.) have at core the recurring question of the ecologic sustainability of the current production systems, in the broader sens of that term. Therefore, the exploitation of both exhaustible and renewable natural resources rightly received particular attention. Within that global context, deforestation¹ of tropical forest became a matter of international interest.

International Institutions and forest protection

The focus is de facto on tropical forest as temperate forest, or the remaining temperate forest of the world are no longer being deforested. Tropical forest constitute 50% of the world forest cover. Before the eighteenth century, temperate forest of North America, Europe and Asia were subject to massive deforestation. Between 1700 and 1950 this deforestation declined continuously until it stabilized at almost zero at the end of the twentieth century (FAO, 2012). Approximately 800 million ha of forest were cleared during that time (Williams, 2006). Tropical forest had the reverse evolution ; they were almost unexploited until the eighteenth century then underwent an increasing deforestation. Deforestation of tropical forest reached its climax during the post second World War period ; between 1950 and 1995, 500 million hectares of forest disappeared (Williams, 2006). This deforestation occurred mainly in the Amazonian and Southeast Asian forest (Brazil, Costa Rica, Indonesia, Malaysia, Thailand are few examples) and, in a smaller

1. the definition of deforestation used here and throughout the chapters is the one of **Forest Ressources Assessment (FRA)** : "*Deforestation refers to change of land cover with depletion of tree crown cover to less than 10 percent*".

extent, in West Africa (Ghana, Nigeria).

Facing this alarming situation, the international community through the United Nations, built a supranational institutional framework in charge of promoting sustainable forest management and surveilling international tropical forest products trade. In 1985, the **United Nations Conference on Trade and Development (UNCTAD)** sponsored the **International Tropical Timber Agreement (ITTA)**. The **International Tropical Timber Organization (ITTO)** was established under this agreement and is until today the only international institution exclusively dedicated to tropical forest monitoring. The initial **ITTA** was renewed in 1994 and in 2006² but the purpose remained to *"promote the expansion and diversification of international trade in tropical timber from sustainably managed and legally harvested forest and to promote the sustainable management of tropical timber producing forest"*³. In a related development, **Timber-Procurement Policies (TPP)** has significantly contributed to the promotion of sustainable forest practices (by limiting illegal logging and improving forest products traceability). The European **Forest Law Enforcement, Governance and Trade (FLEGT)**, the American Lacey Act⁴ or Australia's Illegal Logging Prohibition Act are the **TPP** - amongst others - that have been discussed the most. Recently, the focus of the discussion around tropical forest has shift as forest conservation is now included in the broader topic of climate change. This is reflected by the nature of the newest international instruments. While aiming at tropical forest protection they are oriented towards controlling carbon emissions.⁵ The consciousness about tropical forest protection conveyed by national governments or global institutions but also NGOs⁶ working on the field, have arguably contributed to the reduction of deforestation. The rate of deforestation in tropical forest has reduced by 100% from 200 ha between 1980 and 1995 to 100 ha between 1995 and 2010. However, the current state of tropical forest management leaves room for further improvement.

2. This last agreement came officially in force in December 7th, 2011

3. see the original version of the treaty on United Nations site <https://treaties.un.org/>

4. Amended in 2008 to include more plants species

5. redd and REDD+. Kyoto protocol as well, even if it is not especially designed for forestry

6. International NGOs such as **World Wild Fund for Nature (WWF)** or **Wildlife Conservation Society (WCS)** who do not only raise awareness about forest conservation but also found and carry projects aiming at reducing deforestation

Forest, trade and development

The whole complexity of tropical forest economics lies in the different and overlapping interests at stake. These forest are located in different nations across the world. Ultimately, the governments of these nations are in charge of the policies and laws regarding the management of their forest land within the boundaries of their countries. The economics of tropical forest therefore stems from the national (sometimes regional) characteristics such as demography, sources of national growth, political situations, law enforcement capacity of the governments, access to forest resource conditions and so on. Most of the tropical forest of the world are located in developing or emerging countries. The highest rates of tropical deforestation in the last fifteen years are observed in Nigeria, Ghana, D.R Congo, Central African Republic, Indonesia, Vietnam, Philippines⁷ which all are classified as countries with low or medium human development(UNDP, 2017). These countries are dealing with (extreme) poverty, unemployment, sometimes political unrest or even wars. They must generate growth to lift their population off poverty. Even relatively richer countries such as Brazil, Malaysia or Costa Rica also have high rates of deforestation since forestry is an important sector of their economies and a large source of employment. The exploitation forest resource is an obvious way to alleviate poverty, they could be either used locally or exported : the international demande for tropical forest products is such that exportation is often favored.

Comparative advantage

The overriding external factor determining tropical forest fate is undoubtedly international trade. Trade and renewable resource management, considered as an emerging field of research decades ago (Bulte and Barbier, 2005), is now of crucial importance for global economy.⁸ On the other hand, international trade theories have been formulated since the industrial revolution era. The key concept of international specialization is the well know comparative advantage. This concept was developed by Ricardo in his theory of

7. Data from FRA 2010 compiled by Mongabay <http://www.mongabay.com/>

8. A renewable resource is one that regenerates naturally or by human activity and can thus, provides a stock of which a positive quantity can indefinitely be extracted without compromising the resource(Clark, 1990). According to this definition forest is a renewable resource.

comparative advantage developed in 1817⁹. Ricardo's theory advocates in favor of free trade in response the protectionist corn law established by the British authorities at the time. The concept of comparative advantage, which is the very corner stone of the international trade theory, is a static concept and is as such, undapted when it comes to forest economics : renewable resource modelling requires a dynamic model as time is a crucial parameter.

Yet, even if it is not always stated explicitly, comparative advantage and its validity are the underlying rationale when promoting trade or criticizing its counterpart -protectionism. Yet, conservation or development-related policies *are*, to different extents, trade restrictive. In fact, the debate of the benefits of free trade versus the ones of protectionism is embodied in the reflection on natural resources management as most of these resources are tradable, which forces us to think the relevance of trade theories.

Global Welfare

In history, both developing countries and developed countries have, at some point in time, established a protection of some kind¹⁰ this makes the concept of total free trade an abstract theoretical notion that hardly finds any concrete expression in the real world. Yet, trade restrictive policies (i.e. reducing free trade) are charged with reducing global welfare. The question then becomes : whose global welfare is being reduced ?

The two coexisting levels of interest, national and international, over world tropical forest participate to the sometimes conflicting nature of discussions around forest management. The international organization - UN, WB, WTO - are concerned with being the "welfare-keeper" at an international level -maybe. If so, their objective function integrates aggregated losses and surplus at the world level in order to maximize welfare. However, it is unrealistic to expect from a country to formulate its development strategy taking into account the world-global welfare. The concept is abstract from the point of view of a single nation. The improvement of world welfare can only be at best an additional argument to support a policy that, in the first place, serves the national interest. ([Goodland](#)

9. Principles of Political Economy and Taxation

10. The European Union's Common Agricultural Policy or the quotas imposed by the US government on sugar importations are some examples of protectionism by the developed countries

and Daly, 1996). Countries are sovereign in deciding how to use their resources . The management of forest resources is the prerogative of national states and remained within the legislation of national jurisdictions. Without denying the existence of a global welfare, as a concept nor as a (perhaps) computable value, I say that supranational approaches, such as the ones proposed by international trade theories, are not the appropriate tool to assess decision made at national level.

I choose to illustrate this point by studying the log export ban (LEB) in Gabon, a resource-industrialization strategy based on the rationale that more added-value, hence more growth, is ultimately better for national development. If one adopts a negative definition of the LEB, it is a *non-promotion* of a rent-based economy where the wealth only comes from resource extraction with all the negative externalities associated with it. In the case of Gabon, a country that economy's depends exclusively on natural resources exploitation, such policy might be wise.

Economic exploitation of forests and Distribution Benefits

When forest are not dedicated to conservation, the choice of allocation ranges from conversion of forest land into agricultural land or cash crops plantations (such as rubber, cacao or palm oil) or use forest land for timber harvesting. While number of studies have investigate the link between forest allocation choices and deforestation (Repetto and Gillis, 1988)(Deacon, 1995)(Barbier and Burgess, 2001), little work has been done on the link between these allocation choices and their consequences for local people. In most tropical countries and in Gabon in the instance, forest-dependent people do enjoy customary rights on forest according to national laws. As rightful landowners, the profits and rent coming from forest exploitation should benefit local people, yet it is barely the case. In a concern to provide more knowledge on that matter, I put a particular emphasis in studying the distribution of the benefits of forest exploitation, between the often foreign companies and local people. I study the case of commercial logging companies and agro-business companies.

Industrial timber logging

Industrial timber logging operates in rotations : the principle is to let the harvested forest grow, while harvesting another part of the concession. Forest economic rent stems from the "gift of nature" given by the first cycle of exploitation of primary forest ¹¹ as opposed to the following rotations. The accumulated biomass offered by several hundreds old trees yield benefits that cannot be provided by a younger forest or replanted forest. The crucial point is that this extraordinary stock of crude wood has not required any investment. In, the classical literature of forestry, the expected value of a forest land is resulting from the capitalization of the net revenues from timber harvested minus the afforestation cost. In his optimal forest rotation model, Faustmann proposes a calculation of forest value assuming *a cost of planting* because he models a plantation forest. This fundamental theory of forest valuation assumes a cost of planting, which doesn't exist in the case of primary tropical forest, hence the "gift of nature" or, in economic words, the rent. ¹²

Hartmann borrows from Faustmann formula the discounted calculation of the revenues and add a considerable contribution to forestland valuation by taking into account the forgone amenities when forest is exploited. Somewhat Hartman addresses the question of negative externalities by introducing an opportunity cost of harvesting. He calls it the "*value of the recreational and other services flowing from a standing forest*" ([Hartman, 1976](#)). What Hartmann calls the "other services flowing from a standing forest" is now referred to as the ecological services. Forest-dependent people are the first hurt by the disappearance or the restricted access to these services, as they are making their living out of them. The market fails to incorporate both of these fundamental elements, namely negative externalities and the forest economic rent. Indeed, prices only reflect the rarity of tropical log (i.e the marginal cost of extraction) and the need for tropical log (the

11. Defined by the [FRA](#) as a "Naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed."

12. In 1849, the german forester Martin Faustmann developed a theory of optimal forest rotation based on the valuation of the forest land using the interest rate to get the net present value of a forest. Amongst the many comments, notes and reviews of Faustmann original work I will mentionned the very pedagogical contribution of Peyron and Maheut ([Peyron and Maheut, 1999](#)). This formula is also referred to as the König-Faustmann formula for Gottlob König being the first to introduce discounting in order to calculate a Land Expected Value (LEV) - see the very good synthesis of Guillermo A. Navarro in ([Helles et al., 2013](#))

demand). The point is that the negative externalities and the economic rent are precisely where lies the share of the local people : they should, first of all, be compensated for negative externalities caused by logging activity and second, be paid their share of the forest rent as they are rightful landowners. Neither the legal framework nor the economic model in place allows this retribution.

Cash crops plantation

The other predominant use of forest land is cash crop plantations : palm oil and hevea in Gabon. These industries generate net deforestation as they substitute plantation to forest. The environmental harm, in terms of deforestation exceeds by far the damages caused by selective timber logging. Again, the value of the forgone forest for local people is not compensated. However, plantation creates much more employment than timber logging does which is a revenue distribution. In the case of hevea (like coffee or cacao) local farmers have the opportunity to produce for the plantation which triggers a dynamic in local economies. This asymmetry between timber logging and plantation crops is illustrative of the, apparently, persisting tradeoff between conservation and economic development.

The three following essays are concerned with Gabon forest. The heterogeneity of the countries and contexts does not allow to have unique model of forest land allocation nor forest land management. Therefore, external validity of country-specific research results is fragile. But the narrowness of the path to general results should not impede monographical research, as forest-related policies must be assessed withing their national context. However, highly specific, such knowledge may help formulating better policies by identifying the risks attached to some decisions and the pitfalls to avoid. The thesis is structured as follow : a first chapter analyzes log export ban policy and its outcomes, the second chapter investigates the link between logging company practices and their impacts on local population, finally the last chapter examine the situation of wokers or farmers in Hevea plantation.

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Chapitre 1

Trade Policy, Development and Forest Conservation

The case of Log Export Ban in Gabon

Abstract

Log Export Ban (LEB) is a commonly used trade policy despite its many detractors. It is a subject of heated debates and raises controversies amongst scholars but also between scholars and policy makers. The aim of restricting roundwood export is twofold, to foster economic development through industrialization and to protect forest resources by hampering, or preventing, deforestation. The consensus amongst its detractors is that LEB policy fails to achieve both of its objectives. Moreover, LEB is perverse and creates economic distortions making the country worse-off. Yet, countries continue to adopt log export bans - partial or total - as part of their national economic development strategy. Furthermore the countries that have enacted LEB years or decades ago do not remove them.

This paper shed some light on this apparent paradox with a comprehensive literature review and through an analysis of the LEB promulgated in Gabon in 2010. Gabon has a very low population density, a low deforestation rate and its forestry sector is predominantly run by foreign investors. Because of these specificities, LEB in Gabon might lead to a much better outcome than in other countries. Our results do not allow to concluding that LEB is a success, as six years of observation is not long enough to reach such a conclusion ; however they suggest that the policy potentially yield significant positive results.

Introduction

This chapter focuses on one particular forest management policy, the **LEB**. Log exports ban consists in forbidding roundwood -also called log - from being exported. This restriction can be total which means no roundwood at all is allowed for exportation (like in Gabon) or partial by authorizing only a certain volume through the use of export quotas or by banning certain species of trees from exportation.

The present discussion is centered on tropical forest but it is important to bear in mind that banning the exportation of forest resource for national development and conservation purpose is not developing countries specificity. Rather, it is an option that might be considered as a sound policy by a State fearing the exhaustion and/or the misallocation of their forest. In fact, the very first log export bans were enacted in Northern America, in Canada and USA at the beginning of the 20th century (See table 1 in Annexes). Russian federation and recently Belorussia are two others noticeable cases of LEB policies enactment in regions of temperate forest. Implementations of LEB in tropical forest-rich countries are more recent : Thailand in 1989, Indonesia in 1992, Ghana in 1994, Cameroon¹ in 1999, Gabon in 2010.

The first aim of such policy is to either strengthen an existing national wood industry or to develop an infant national wood industry.

Stopping the outflow of the raw material (untransformed wood)is beneficial to local producers. Indeed, they will acquire roundwood at a lower price than their foreign competitors who buy logs on the international market. The price differential between national and international log market is a subsidy to national wood industry competitiveness. Secondly, LEB is also believed to be a way to preserve forest from excessive logging. In the absence of any form of regulation, the revenue brought by roundwood on the international market might be significantly higher than the cost of harvesting, especially if that cost does not include negative externalities caused by deforestation. Logging activity might yields large profits. This is typically the case for primary forest given that primary forest accounts for 55% of the total forest of Gabon², 35% of the total forest of Congo basin and 60% of the world primary forest are located in tropical forest basins ([ITTO, 2011](#)).

1. though only partially applied : since the LEB in Gabon, the exportation of rounwood in .

2. Data from [Global Forest Watch](#) accessed in May 2016

The idea is that trade might endanger forest conservation ; as long as there will be a rent coming from log exportation, there will be no incentive for private agents to halt logging.

An export ban comes across as an abrupt policy. It does not have the subtlety of an incentive based instrument such as a tax or the selectivity of a quota. Instead, it is a corner solution equivalent to a tax so infinitely high that any exporter is discouraged from selling abroad or a quota equal to zero. In theory, the achievement of first best imposes the use of two different instruments because there are two objectives to attain³ (i.e. the protection of the forest and the development of the national wood industry). Ideally, a government should use a specific policy to regulate forest harvesting (that would be a tax or a quota) and another designed to sustain the local industry (a subsidy). A straightforward explanation for the existence of LEB is that it is easy to implement. Tax might be hard to levy, quota difficult to monitor especially in countries where the administration functioning is flawed, weakened by corruption, mismanagement and all sort of governance failures. The mere fact that a policy can easily be implemented, and therefore is fully implemented could suffice to yield better outcome than a theoretically better policy that is weakly enforced. Later in the empirical part of this chapter I will come back to this aspect and see to what extent Gabon is subject to this principle of realism.

While adopting an empirical approach to the analysis of LEB, I will give a theoretical overview on the different aspects of the question in this chapter. This appears to be all the more useful that the vast majority of the literature on LEB is empirical case studies that do not explicitly refer to the theories they are taking their assumption from. The reflection on LEB is an interesting theoretical exercise because the subject is at the crossroads of at least three main theoretical corpus in economics namely : international trade theories, environmental economics and development economics.

In fact if one had to choose a theoretical framework within which the relevance of the LEB would be assessed it could be either of the aforementioned fields. That is probably one of the reason why there is no consensus on the matter. Because there *is no consensus* on the matter. From a international trade perspective, LEB is a strong trade barrier and is therefore welfare reducing. In the words of Kolstad " *the standard view of international trade is that any barriers to trade that a country may impose, either barriers to protect*

3. following the prescription of Tinbergen rule

domestic industries or subsidies to exports, can make the country only worse-off as a whole" (Kolstad, 2010). Most scholars tackling the question of the LEB from an international trade perspective are largely in line with this precept of traditional trade theory; however there are noticeable exceptions that will be mentioned later in this chapter in the brief literature review. The divergences with traditional trade theories stems from the specific nature of forests and their environmental value on the one hand and on the other hand crucial necessity to develop industry and stop dependence to natural resource exportation for many countries.

In fact the rational underpinning LEB is that exports of roundwood can only be profitable *for a given span of time*. As soon as the primary forest will be all exploited, foreign exchange revenues from roundwood exports are inevitably going to subside. The idea is to substitute, when it still time to do so, the rent coming from exports of primary forests roundwood with a production revenues derived from a wood industry in the country. By doing so, governments also expect a reduction of the deforestation rate.

Conservation remains central in the discussion regardless of which perspective is adopted on the matter. The interest of the different stakeholders (i.e national government, industrials, exporters etc.) might diverge in the short and middle run but in a long run, no one has interest in a severe forest depletion. As for all policies regarding tropical forest management, the duality between development and conservation is at the heart of the debate.

This chapter takes the form of an empirical case study of Gabon, a forest-rich country of Central Africa. Gabon was the main Central African exporter of tropical roundwood and the second largest exporter of Sub-Saharan African after Nigeria⁴ until the adoption of a LEB by the government in November 2009. The specific case of Gabon has not been studied yet. This article a contribution to a better knowledge on Gabon's present forest sector as well as a contribution on exports ban of natural resource in general. The literature review, mostly empirical, shows that the effects of an LEB vary from a country to another. The outcomes of the LEB depend on three main factors.

The first one is the size of the available stock of forest and the inflows and outflows. The inflows are the 'second growth' forest (which depends on the natural regeneration rate

4. ITTO 2011

of the forest) and the plantation forest. The second factor is the role played by forest in the country's economy. This role is typically measured by the contribution of the forestry sector to the overall growth which tends to (greatly) underestimate the real contribution of forest because of all the well-known intrinsic limitations of the GDP as an indicator. In the instance, it does not take into account the ecological services provided by the forest nor the crucial role it has for forest depend people. It is therefore a must to combine different indicators to get a better idea of the importance of the forest contribution to the economy, bearing in mind that many aspects of this contribution are clearly difficult to capture. The importance of forestry should also be considered relatively to other source of national revenue. Finally the structure of the forestry sector and the national market are determinant. If the market leans more toward monopolistic competition where few big companies lead the whole industry, the consequences of the LEB are not going to be the same as if the market is more competitive with smaller companies. The political power of the actor in the industry (i.e. the extent to which they can influence public policy) is also shaping what I referred to as the 'structure of the sector'.

My hypothesis is that the particularities of Gabon can make LEB a success when it has been a failure elsewhere. The volume of primary forest left in Gabon makes it worth it to try now to create a wood industry before the forest transition occurred and leave the country with secondary forest only, taking away the chance to benefit from the rent associated with primary forest exploitation and to transfer that rent to national producers in order to strengthen domestic industry. Gabon is an oil exporter, more than half of the export revenues are coming from oil exportations. Even in the aftermath of the recent oil choc the oil revenue continue to generate enough revenue to maintain Gabonese economy out of recession even without log export revenue. The main actors (i.e. the biggest companies) of Gabonese forestry sector are of foreign investors. Their practices, experience and technologies might allow them not to waste the raw resource, besides they could possibly transfer this knowledge locally, if they have the right incentives within the right legal framework.

The whole difficulty of this analysis was to find reliable secondary data, which is a common challenge to most of studies done in developing countries. I use the data of the Directorate General of Customs of Gabon (*La Direction Générale des Douanes et*

Droits Indirects du Gabon) to analyse Gabon's wood exportation evolution from 2004 to 2015. The data sets give the volume and the value of all the exportation of wood product for each month of each years. The products exported are classified by their level of transformation, ranging from the level of no processing at all, those are logs, to the most sophisticated level of processing, those are wooden furniture. This data set allows to compare if there are significant changes between the period before the LEB and the one after both in the structure exportations and revenues from exportations. I am also exploiting the results of different sources namely the results of the two most reports of the ministry of Forest and water (*Ministère des Eaux et Forêts*) of Gabon respectively on the forest resources and industrial capacity of Gabon.

The decision to restrict or completely stop exportations of roundwood is a forest management policy that can only be decided at a national level government can enact in a given country. It is natural to consider the relevance of this decision from Gabon's point of view instead of adopting a international macroeconomic view on the question. Thus, I am not trying to work out a global loss or gain in terms of global welfare. I will in the first section assess the LEB effect on environment looking at the change in log production and forest cove. The second section focuses on the effect of LEB on industrialization looking at the impact on processed wood production and exports. The third and last section are conclusive remarks and discussions. An export ban cannot be, by definition, a first best solution as it is a unique instrument used to attain two targets. However, very often Paretian first best are unattainable because of major obstacles. An abundant literature is addressing the subject⁵ The question then is a first best achievable? If not could LEB be a second best solution?

1.1 The Environmental impact of Log Export Ban

This part is addressing the environmental aspect of the policy using volume of roundwood extraction as the central variable for assessing impact on forest cover. I explain that, due to the externalities inherent to natural resource extraction process, timber harvesting

5. The "second best" as a concept has been discuss in much particular case in a wide range of different field in economy. It is probably in International trade, in order to justify interventionism that the notion of second best has been the mostly invoked.

demands regulation. Because timber is conveyed from to final markets through international global value chain, this regulation is necessarily affecting free trade. Secondly, I make literature reviews on LEB in order to identify the possible negative effects of log export ban and I analyze Gabon's data to see if Gabon's is subject to these negative effects.

1.1.1 Log exportation and international trade

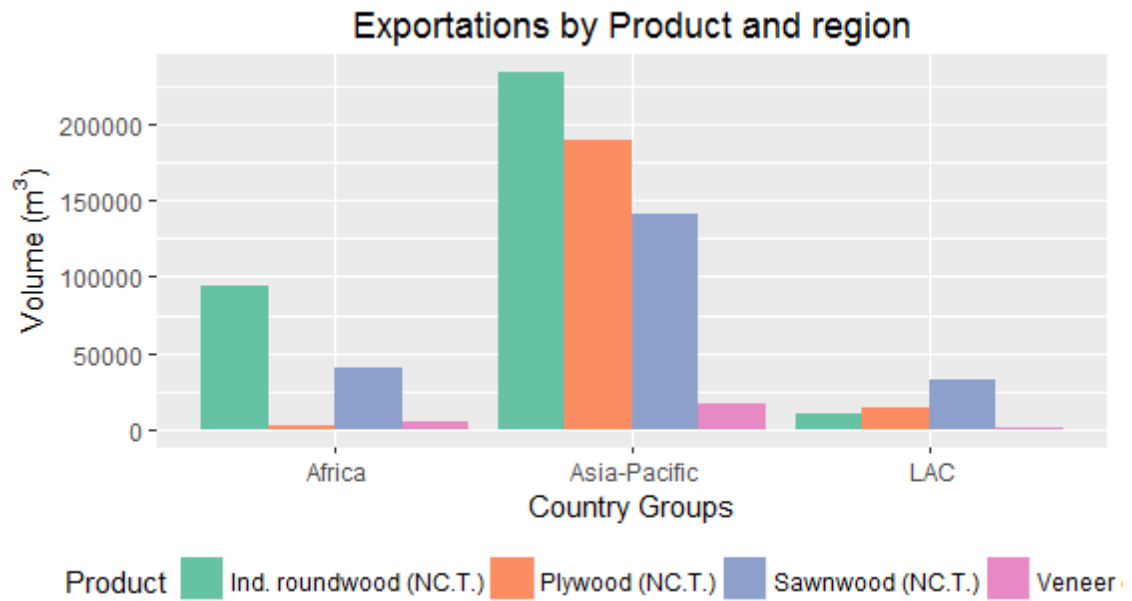
Forest management is an allocation problem of a natural and renewable resource. In an open economy exportation of raw wood is one possible choice of allocation amongst other uses of the forest (i.e. conservation, land conversion for agriculture, timber logging for national markets etc). Under free trade settings, without any restriction nor institutional intervention, forest rich countries - particularly tropical forest rich countries - seem to favor exportation of unprocessed wood over the other possible use of the forest.

A strong result well-known Heckscher Ohlin Samuelson(HOS),based on comparative advantage, is that *countries export the goods produced with the endowed factors that are in relative abundance* (Krugman et al., 2012). Accordingly, forest rich countries should specialize in the production of wooden products production. That is the case for developed countries endowed with temperate forest (like Sweden, Finland, Canada or US). But the scarcity of capital and high-skilled labor in developing countries (like Gabon in the instance) reduces the possibilities of production and prevent them from realizing their comparative advantage . Indeed, initial endowment has led to a specialization in raw wood exportation or at best sawnwood which is first level of wood transformation.

This stylized fact is illustrated by the figure 1.1 shows that the countries of three major tropical forest basins in the world i.e Latin America, Africa and Asia mainly export roundwood and sawnwood, which require less high-skilled labor.

It is important to note that roundwood extraction or commercial logging⁶ *is a capital intensive* activity and could therefore not be undertaken without substantial investments. Given rarity of capital at a national level, foreign direct investment (FDI) largely finances these extractive activities. Hence the major role played by foreign actors in the sector

6. *timber harvested from forests with the intent to sell (as opposed to small-scale logging which is more often for domestic or local use)* Global Forest Watch definition



Source : ITTO data accessed by the author in January 2017

FIGURE 1.1: Wood exportation per regions

of forest exploitation described in the first chapter. The point I stress for the present discussion is that the pattern of trade of tropical wood given the countries endowment in production factors (capital and labor) and resource (wood) leads to tropical forest rich countries exporting export raw wood while richer countries export wood product.

1.1.2 The economics of forest resources : the necessary regulation

The main issue raised by logging is formulated by the basic theory of externalities. Forest harvesting negative externalities and therefore a marginal social cost above the marginal private cost of a single producer. The social cost includes the environmental damages caused by log harvesting. The typical damages caused by commercial logging is direct deforestation coming from the clearing of the forest in order to create the base camp, the logging roads and the log dock (to accommodate temporary storage of logs before they are transported to their next destination). Another common damages linked to logging activity is the incidental uprooting of the trees and vegetation surrounding the logging plot and finally the skidding tracks, on which logs conveyed out forest ⁷ (Megevand et al., 2013). Above all, an excessive extraction rate is the biggest threat to environment as it results in significant deforestation and generate ecosystem perturbation and unbalances (Damette and Delacote, 2011).

The producers marginal cost production does not include these externalities. This underestimated cost is referred to as the private cost and private cost plus the (negative) externalities is called the social cost. In case of negative externalities the private cost is inferior to the social cost and is therefore undervalued and so is the price.

The basic theory of environmental economics prescribes the introduction of a (Pigouvian) tax ⁸ on consumption of the resource in order to restore a pareto efficiency when there are negative externalities. This implies the Government intervention to put the tax on the ones who generate the negative externalities.

Figure 1.5 illustrates the mechanism by which a Pigouvian tax t increases the marginal cost of production from the private marginal cost $MC_{private}$ to the social marginal cost MC_{social} and thus reduces the production of log from Y_P to Y_S . The tax is all the more effective that the demand is price elastic which is the case for tropical wood that is a luxury good.

Theoretically, the Government could also set a standard extraction volume at the level Y_S but that requires the government to know what Y_S ; the aim is to make the

7. the creation of skidding tracks is certainly the least harmful of all in terms of forest degradation, especially in Congo Basin where extraction is highly selective

8. Arthur Pigou is the first author to prescribe the introduction of a such a tax (Pigou, 1928)

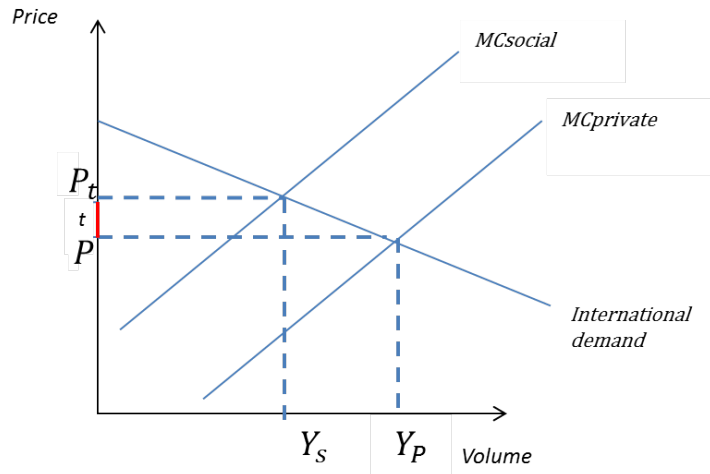


FIGURE 1.2: Tax and Negative externalities

producer internalize the negatives externalities in their cost function, which ultimately result in a price increase from P to P_T . The Pigouvian resolution of externalities demands Government intervention⁹. The fact remains that in the absence of any form of regulation (through the market or through governmental intervention), the resource is necessarily overused *regardless of the actual level of extraction* because negative externalities are not being taken into account.

In the words of Batabyal : *“The statement that resources are overconsumed is practically equivalent to the statement that they are underpriced. Environmental overuse does not occur solely because the locals overconsume their resources, but because they export these resources to a rich international market at prices that are below social costs”*(Batabyal and Beladi, 2001)

This quote underlines role of international market. The demand for tropical wood is essentially fueled by the international demand - more than it is by national or even regional demand. In the case of Central Africa, the share of intra-regional trade between Gabon, Cameroon, Congo and DRC accounts for 8% of the total exportation of the total log production (ITTO, 2009).

The upstream end of timber global value chain is composed of transformation units located in countries that *do not have the primary resource* namely European, and more

9. as opposed to Coasian market-based solutions (Coase, 1960)

recently but very strongly, China. The unprecedented Chinese resource-based growth has rerouted the flow of tropical timber exportations from Europe to China (Shinn, 2005, Canby, 2008, Terheggen, 2010, Sun, 2014) as shown in the figure 1.1

National timber sectors are export oriented i.e driven by an international demand all the more disconnected from the negative externalities engendered by the logging activity that the actors are not (directly) suffering the consequences of forest exploitation. This suggest that the gap between private and social marginal cost could be wider than if the demand was local. (Chichilnisky, 1994)

Because the production is almost entirely exported, a tax on exportation is quasi-equivalent to a tax on production. Ideally a tax should be set in order to adjust the volume of extraction at a level taking into account the environmental and social negative externalities of timber harvesting. Such a tax is difficult to value and difficult to enforce (Krishna et al., 1998, Gomez-Baggethun and Ruiz-Perez, 2011, Gómez-Baggethun et al., 2010) The valuation of the social losses is difficult for practical and methodological reasons. The tax is therefore likely to be the result of a negotiation between logging companies lobbies and the government more than the result an attempt to assess the negative externalities of logging. The second difficulty is the enforcement. One of the crucial issue on the much wider debate of natural extractive activities in Africa and more generally in developing countries is the weakness of the states in enforcing laws (Karsenty and Ongolo, 2012) (Repetto and Gillis, 1988).

An alternative could be to control the quantity. For the same reason that a tax on export is practically equivalent a tax on production, a restriction on exportation is quasi-equivalent to a restriction on production. The authorities can limit the exportation using quotas, a solution tried by Gabon and other countries. Quotas are easier to establish than tax are to levied : it requires less administrative means. However, quotas are equally subject to lobbies pressure and potential strategies aimed at serving private vested interests. It is not declarative as the customs service can directly control the volume of good exported. Of course, corruption may render both instruments (quota and tax) ineffective. However the use of quota is not the best instrument as it prevents the producers to adjust to the price variations and stock evolution. Weitzman had shown that in case of stock uncertainty (which is often the case in fishery and forestry as they both are renewable

resources) taxes are more efficient than quota. When facing a quota, the producers tend to always target the maximum volume allowed by the quota even the equilibrium volume would be inferior to the one authorize given the price variation and resource evolution (Weitzman, 2002)

Ideally a tax on exportation would be the first best, as state by the so called “Ramsey rule” (Ramsey 1927), which states that a government should seek to raise tax revenue by causing as little distortion as possible.

The LEB is a corner solution equivalent to a tax so high exportations that it bring exportations to zero or a quotas equal to zero. It is *clearly not* a first best solution. In the words of Barbier [*... failure to internalize all external effects in extraction (of natural resources) implies that natural resource management typically takes place in a "second-best world". Ever since pioneering work by Lipsey and Lancaster (1956), economists know that trade liberalization in the presence of pre-existing distortions might yield ambiguous welfare results. The second-best nature of resource management makes it a particularly Interesting topic for economic research on the effect of trade liberalization.*

Log export ban must be assessed as a policy within this second-best world. One must bear in mind that free trade in its pure form (i.e. no restriction) cannot be apply to natural resource trade because of those "pre-existing distortions" stemming from negative externalities generated by resource exploitation. Therefore all arguments condemning LEB for its free trade restraining nature are irrelevant and closer scrutiny is necessary before drawing any conclusion.

I am using the existing literature to identify what are the observed negative effect of LEB in the countries that have tried this policy and I test if Gabon fall in those pitfalls in a perspective of learning and building upon precedent experiences.

1.1.3 LEB and the inefficiency trap

Log export ban is in fact a not-so-rare policy amongst the forest rich countries. Since the second half of the 20th century many countries adopted LEB (see Table5). In fact LEB can be considered as the most extreme form of timber export tax (Puzon et al., 2011) as it produces the same effect than a prohibitive tax on crude wood exports. Despite

the heated debates and disregarding the contrary opinions, LEB have been adopted and maintained in a many countries : the table 1 displays a non-exhaustive list of countries that have enacted LEB - most of them are developing countries two noticeable exception namely US and Canada. The literature review on LEB shows that regarding its impact on environment, the effect is negative and LEB in fact increases deforestation. The first subsection exposes mechanism by which LEB translates into increased deforestation. The second subsection illustrate the theory with selected empirical studies.

1.1.3.1 The inefficient argument in theory

Few papers study the LEB from a theoretical point of view, most of the articles on the subject are empirical case studies. However, a noticeable theoretical contribution are Dean's papers *Export Bans, Environment, and Developing Country Welfare* (Dean, 1995) and *Export Bans, Environmental Protection, and Unemployment* (Dean and Gangopadhyay, 1997) concludes that the idea that log restriction prevents deforestation is only operant in a static framework. The dynamic of prices will make roundwood more expensive (because rarer) on international markets, that will in turn increase the price of processed wood at an international level and therefore trigger higher national production of processed wood, which ultimately leads to higher wood extraction (Dean, 1992). Basically banning log is leading to an over-exploitation of the resource which is ultimately welfare reducing compare to free trade. These adverse effects are amplified by the relatively high price elasticity of international tropical log demand.

The diagram represent four markets, namely the international and national market for raw wood (the upper part of the diagram) and the international and national market for processed wood. For simplification, the processed wood market is considered as being a single market where in reality there as many markets as there are types of processed wood (sawnwood, veneer, plywood etc).

The assumption is that the exporter country is a small country and has no influence on international prices. Before the LEB, under free trade settings, the price of logs is fixed on the international market at P_{FT} . At the price P_{FT} the domestic producers of roundwood are willing to offer the quantity R_{FT} of roundwood and the domestic demand can only afford to buy the volume R_D of roundwood. The exportations are represented

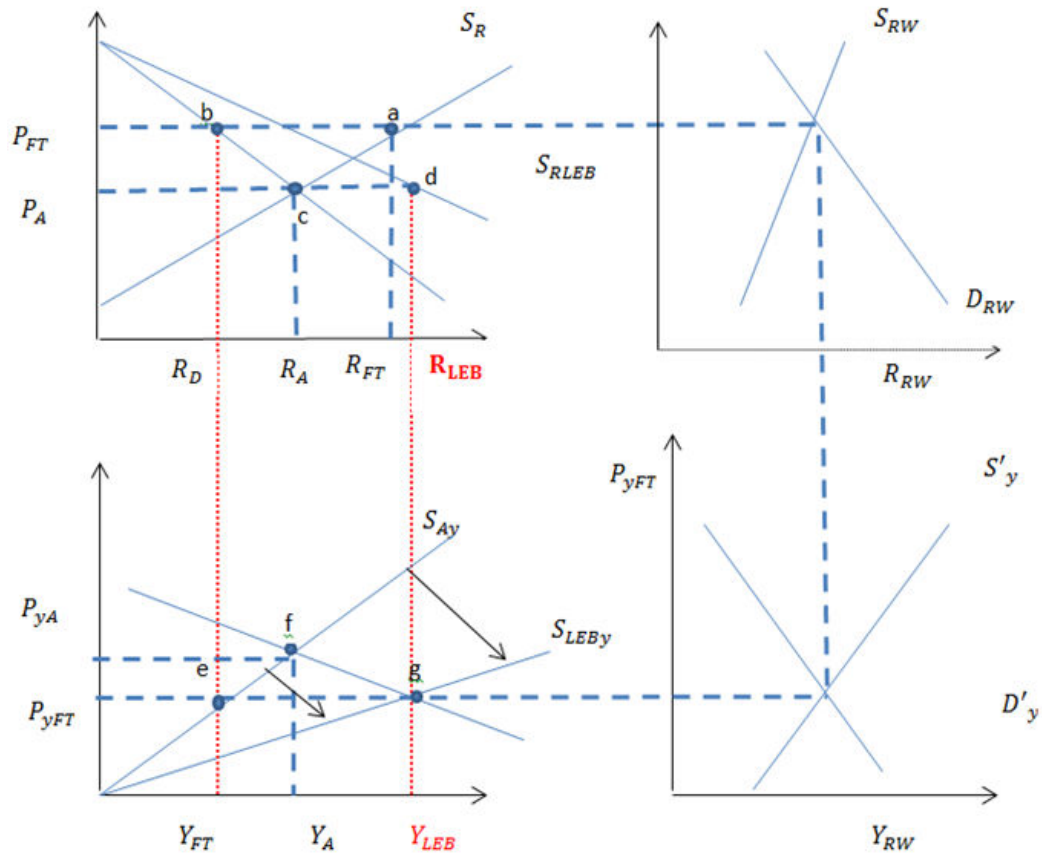


FIGURE 1.3: The inefficiency trap mechanism

by the distance ab : it is the difference between the log production R_{FT} and the domestic roundwood consumption R_D .

Theoretically, the LEB works like a prohibitive tax on export that renders roundwood exportations no longer profitable. Once the LEB is enacted, the level of roundwood exportations drop down to zero and the production is falling down to its autarkic level R_A . But the autarkic level R_A is not the equilibrium in a situation of LEB. It would be if the exportation of *all wood products* (including processed wood) were forbidden, then the production of roundwood would R_A which correspond to the equilibrium f on the processed wood market. Instead, if only the log market is autarkic while the processed wood price is still governed by the international market price, the equilibrium on the

roundwood market might be at a higher quantity than in autarky and even at a higher quantity than in the situation of free trade .

The LEB gives the opportunity to the domestic processors to obtain their input (i.e the rounwood) at a lower price than the foreign processors who purchase their logs on the world market : P_{FT} is superior to P_A . This price difference is a subsidy to the domestic processors. It results in a higher production of processed wood since the main input (i.e roundwood) is now cheaper. The supply curve of processed wood shift to the right from S_{Ay} to S_{LEBy} . After the LEB, the indirectly subsidized log price enables processors whose production cost was too high before the LEB to enter the international market of processed wood products and to sell their production at the international price P_{yFT} . The domestic production of processed wood move from Y_{FT} to Y_{LEB} . The requirement in roundwood to produce Y_{LEB} is R_{LEB} which is actually a larger production than the production of roundwood before the LEB was enacted. The idea here is that inefficient domestic mills can now access the international market but because they are inefficient they waste the resource by using more rounwood to produce less wood products than their foreign competitors.

1.1.3.2 Empirical studies

According to the model, LEB results in a higher production of roundwood than under the previous regime ; it is entirely due to the efficiency gap between national producers and foreign producers. It is likely to end up in overharvesting and higher rates of deforestation. Moreover, the lower price of log induced by LEB might also discourage the use of sustainable log harvesting technics. The national log market might not be as demanding as the international market in terms of labels and certification. Lastly, LEB may result in a surge of illegal logging as the higher risk premium increases the benefits from log trafficking. However, for obvious reasons, data and information are hard to find regarding illegal logging.

Despite these arguments, export bans policies have been maintained in most of the countries that have adopted the policy. As asked by the title of the very relevant paper of Goodland and Daly *If log export ban are so perverse, why is there so many ?*([Goodland](#)

and Daly, 1996). A brief review of the existing studies on LEB consequences might be helpful to answer the question or at least verify if the above mentioned negative effects are actually taking place.

The available case studies on LEB in tropical forest are Indonesia, Philippines, Costa Rica, Cameroon and Ghana¹⁰.

The log export bans in Indonesia is by far the one that received the most attention from NGOs, International agencies¹¹ and scholars. (Lindsay, 1989, Vincent et al., 1991, Barbier et al., 1995, Piketty and Karsenty, 1996, Manurung and Buongiorno, 1997, Brann, 2002, Arya B. Gaduh, 2004, Dudley, 2004, Resosudarmo and Yusuf, 2006). The Indonesian forest covers an area 161 million ha, it is the third largest tropical forest in the world after Brazil and DRC (Global Forest Watch (GFW) 2013 (FAO, 2010)). Indeed, alarming deforestation rate were reported in Indonesian rainforest threatening its rich ecosystem. Besides, the country plays an important economic role on the Asian timber sector (as a roundwood exporter before the ban and as a wood product exporter after the ban) and its decision strongly affected its partners namely Malaysia, Thailand, Japan, China (Tachibana and Nagata, 1999). Most studies conclude that LEB in Indonesia has *accelerated* deforestation (Achard et al., 2002) because it has subsidized less efficient local producers who have wasted the resources. From a political economy perspective, the Indonesian government has been under the pressure of the Indonesian wood processor to keep (or come back to) the LEB. An ITTO report in 2001 also confirm that the log export ban is at the origin of large out-flow of illegal roundwood from Indonesia to Malaysia or Japan. Indonesian sawmill did not improve their productivity so they did not added more value or created more wealth, but instead increased their production capacity in volume so much so it created an overcapacity causing massive deforestation. (Repetto and Gillis, 1988, Dudley, 2004), (Piketty and Karsenty, 2001). Indonesian LEB is the textbook case of the failure of LEB, in line following the model of inefficiency described below.

The studies of log export ban in Costa Rica (Kishor et al., 2001) and in Philippines

10. There are also a very interesting case study of the log export ban in British Columbia (Canada) by Fooks, Dundas and Awokuse (Fooks et al., 2013), which prescribe the removal of the LEB and another one by Cornelis with much more mitigate on the question (van Kooten, 2014) but I will not discuss these articles as the focus is here on tropical forest

11. The World Bank, Global Forest Watch, Forest Watch, WWF issued notes and reports related to the log export ban in Indonesia.

(Tumaneng-Diete et al., 2005) estimates the forgone export revenue and conclude that a removal of the LEB is desirable for the welfare (i.e the export revenue) being higher under free trade regime.

In Ghana, LEB has been proven to have increased the volume of processed wood and has "increased the value-added products" (Amoah et al., 2009), (Von Amsberg, 1994) but it also has reduced the revenue from export compare to the level of export revenue before the LEB.

The fact that export revenue subside in the short run after the LEB is neither surprising nor alarming : the danger is if the trend persists and ultimately decreases the terms of trade. The inefficiency trap is much deeper and harmful for a country because it has negative durable even irreversible effects (such as deforestation) and jeopardize the economic development of the country.

That is why the empirical analysis in Gabon primarily focuses on that very aspect.

1.1.4 Has Gabon fallen into the trap ?

The discussion above underlines necessity of a regulation in forest management. The lessons learnt from other countries tell us LEB has had, in some countries, negative effects and had in fact *accelerated* forest destruction because of what I have called the inefficiency trap.

In the light of the existing research and using the available data on Gabon forest, I will show that this observed perverse effect of the LEB is not occurring in Gabon.

1.1.4.1 Graphical Evidences

Evolution of volume exported

The exported volumes evolution between 2004 and 2016 (graphic 1.4) shows that the exported volume of wood products decrease by nearly 100% after the LEB adoption. The total exportation composition consisted of an average of 77% of log exportation before the ban on log export. Now, main exported category is sawnwood which account to an average of 75% of the total exportations. Plywood exportation (in yellow) share in total exportation has increased 4 points growing from 2% in 2010 to nearly 6% in 2016. The

share of veneer exportation also increased from an average of 8% before the LEB to an average of 15% after the LEB.

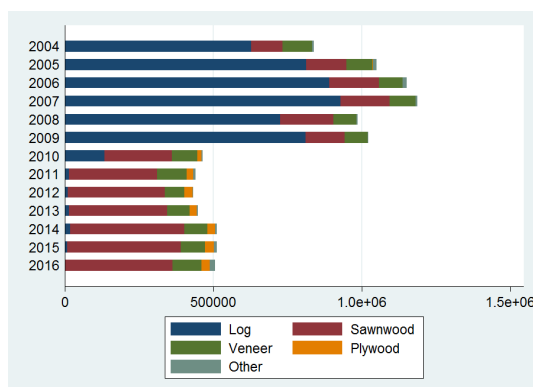


FIGURE 1.4: Wood products exportations volumes composition

Source : Gabon Custom Service. Direction générale de la Statistiques_Services des Douanes_Section bois. The graphic displays the main categories of exportation namely Log (4403), Sawnwood (4407), Veneer(4408) and Plywood (4412). The category "other" is for other wood products such as wooden furniture, paper, wood shaving etc. they are very marginal in the exportations.

The figure 1.5 shows the annual evolution of the Equivalent Roundwood ($EQRWE$). I compiled this index in order to obtain the exportation in their roundwood equivalent volume and assess the impact of the LEB on the resource use. The index (RWE) is obtained by converting the volume exported by category of products into their roundwood equivalent, given the Average Rate of Conversion (ARC) in Gabon's industry (table 2). The average rate are the ratio of the volume of wood processed over the corresponding volume of roundwood used, they are the standard indicators of productivity used in timber processing.¹² There is a decrease of -21,6% of the RWE between the two periods before and after LEB. The RWE only take into account for the exportations and do not reflect the domestic consumption of roundwood. In order to have a full view of the evolution of the resources use, one must look at the production figure. The reported production, compiled by ITTO on the bases of national statistics, displayed in graphic 1.9. Timber production closely follows the trend of the RWE and the volumes are of the same order of magnitude. The production is slightly above the exportations, confirming that the share of the production used by domestic market remains marginal compare to the share exported.

12. In this analysis I use the ARC given by the following calculation : $ARC = \text{Volume of produced wood product} / \text{Volume of Roundwood}$ but some survey use the so called Forest Products Conversion Factor ($FPCF$) which the inverse of ARC i.e $\text{Volume of roundwood} / \text{Volume of produced wood product}$

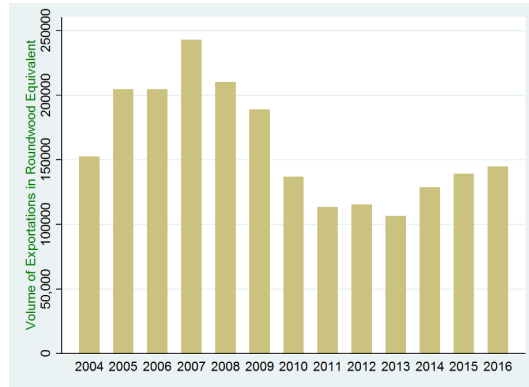


FIGURE 1.5: Total wood products exportations in Roundwood Equivalent

Source :Gabon Custom Service. Direction générale de la Statistiques_Services des Douanes_Section bois. The graphic shows the annual aggregate volume of all wood products exported from Gabon, converted in the correspond volume of roundwood. As an example, if the total volume of swanwood exported in January 2013 is 1000, the equivalent in roundwood $RWE_t = 1000/0,485$ when $t = 01/13$. The volume displayed in this graphic are the annual aggregates of the monthly converted volumes.

Evolution of Exportation Revenue

The adoption of LEB reduced the exportations revenue from wood products exportations especially during the three first years following the enacting of the policy. However, in 2016 the revenue returned to its level of pre-export ban after constantly increasing from 2014 onward.

The composition of exportation revenue clearly highlights the predominance of log exportations share in the total revenue until the LEB, echoing the trend in volumes. Indeed before LEB log exportation revenue accounted for 60% of the total exportation revenue. Currently, sawnwood exportation are the main source of export revenue (growing from 20% of the total exportation to 70% since the LEB). The share of veneer exportation revenue remained stable at 20%, echoing the trend in volume and finally plywood exportation revenue increased from almost nothing to 10%.

This graphical analysis reveals important facts : first, of all LEB did not result feared resource overuse, second despite the ban, he exportations revenue did not experience a severe fall and had quickly return to a level similar to the ones prevailing before LEB and finally sawnwood has arguably supplanted log exportation in volume and in revenue.

In the next part, I am using different forms of regression specifications in order to measure the impact of LEB. I use the RWE as the dependent variable when controlling for other explanative variables described in the following section.

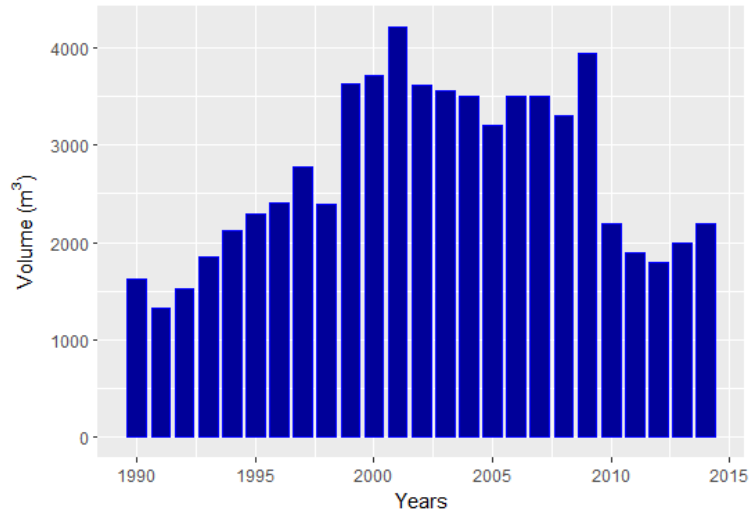


FIGURE 1.6: Exportations of roundwood between 2004 and 2016

Source :Gabon Custom Service. Direction générale de la Statistiques_ Services des Douanes_ Section bois. Despite minor discrepancies in reported volume, the trend is the same than reported by *ITTO*

1.1.4.2 Data description

International tropical timber prices vary depending on wood species. In the case of Gabon, the main species produced and exported is Okoume (*Aucoumea klaineana*) which accounted for nearly 50% of log exports and is estimated to cover 60% of the total timber production. Renowned for the quality of its peeler logs, Okoume is native of Equatorial West African region and is by far the best of African species for plywood manufacturing for use both as central ply and face veneers. Even if Okoume can be found in southern Cameroon, Northern Congo and also in Equatorial Guinea, Gabon remains the main producer of the region and provide two third of the world okoume production. Gabon's Okoume had placed the country in a lucrative niche market and had arguably help to build its commercial notoriety on the international timber market. However, during the 80's and the 90's, the increasing of use of other species for plywood production and substitution of plywood with other wood panels¹³ had strongly compete okoume plywood. Therefore, Gabon remains price taker despite its quasi-monopoly in Okoume production. The effects of international price on timber production are mixed. It depends on the aggregate demand price elasticity and availability of substitute. This is reflected more generally,

13. Medium Density Fiberboard (MDF) or Oriented Strand Board (OSB) panels are the two main substitutes for plywood; they are less expansive

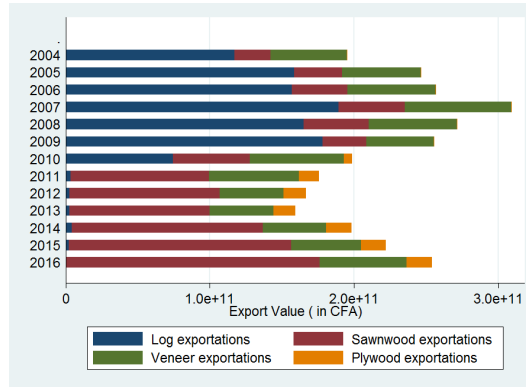


FIGURE 1.7: Wood products exportations revenue composition

Source :Gabon Custom Service. Direction générale de la Statistiques_Services des Douanes_Section bois. Compiled by author. The values is the FOB registered and reported at Gabon custom services

by the ambiguous effect of international log prices on deforestation. (Combes Motel et al., 2009, Chomitz, 2006), (Pfaff, 1999).

I control for the oil prices because Gabon’s national revenue heavily depends on oil. In 2015 oil (and oil derivate) accounted for 87% of the total Gabon export and 79,5% in 2016 (FocustatGabon). This decrease of 7,5 points of oil export revenue is due to the current falling of oil price. Moreover the oil sector account for almost 50% of the Gabon’s GDP since 2004. The particular dynamic between oil production and timber production in oil producing tropical countries has been investigated by Wunder and Sunderlin (Wunder, 2005) in a comparative study of height countries, including Gabon. They show that oil boom in tropical oil-exporting countries results into a reduction of forest degradation and deforestation. The increase of oil revenue appreciates the real exchange rate and the relative price of non-tradable goods, which increase the total cost of production(of both labor and capital) and thus, reduces agricultural expansion, forest clearing for extraction activities and also timber production. Inversely, an oil price decrease is expected to boost timber production (and exportation) by inducing a cost reduction.

I use Gabon’s GDP per capita to control for national economic circumstances in general. The relation is expected to be positive : assuming the that growth stimulates timber production. However, the use of GDP per capita as an explanatory variable for logging echoes the "Environmental Kuznets Curve" assumption predicting a positive relationship between per capita income and environmental losses until a certain level of development. At this turning point, negative relationship between growth per capita and

environmental losses becomes negative. The underlying rationale is that richer people demand for environmental quality is higher. The literature on the matter do not always conclude on the existence of an Environmental Kuznets Curve and results vary from a region to another (Stern et al., 1996, Munasinghe, 1999, Barbier, 2001, Copeland and Taylor, 2004, Raunikar and Buongiorno, 2008, Yang et al., 2015).

I also use the GDP of the two main trade partners namely China and France in order to capture an international demand effect.

Monthly wood products price for log, sawnwood, veneer and plywood have been compiled with the data on international FOB prices of Global Wood market. The monthly price is an average of the different type of each product. Oil price and GDP per capita have been downloaded from the sources in table 3.

The data set gives the monthly volume of exportation by company and by product. While most of the international data source (ITTO or UNCOMTRADE) on exportations provide annual volumes, the national data set used in this analysis provides disaggregated exportation volume per month and per companies. It thus offers a higher number of observations which strengthen statistical results. A second advantage is that this data set has the information on destinations and the identity (thus the nationality) of the exporting company ; it make it possible to map the flow of the exportations.

1.1.4.3 Regression model

The main difficulty of an empirical assessment of the policy is the absence a counterfactual. When trying to assess LEB's effect, one faces the usual difficulty inherent to macroeconomic policies evaluation : we do not know how it would have been without the policy.

There are two possible strategies to identify the effects given that obstacle ; either a natural experiment (if a very similar neighboring country had adopted LEB before Gabon for instance) or a "before/after" evaluation using time series data. The latest is the only one available in the case of Gabon. In order to answer the question poses by the inefficiency trap, I use a simple identification strategy consisting in the estimation of the LEB policy on the volume of raw wood exported. I compare the exported volume of roundwood (which is, as said earlier a good proxy for the volume of roundwood produced

for the industry being strongly market oriented) before and after the LEB. I use the following specification for the regression analysis :

$$Y_t = F(L_t, \mathbf{Z}_t) = \alpha + \delta L_t + \beta \mathbf{Z}_t + \varepsilon_t$$

where Y_t is the total exportations in roundwood equivalent EQRW. The dummy variable L_t is equal to 1 when the period t is during LEB and 0 if the time period t is pre-LEB, this dummy is meant to capture the effect of LEB. The time unit t is a month.

The vector Z_t contains control variables ; controlling for other observables likely to have an impact on wood extraction. These variables are detailed below.

I am using is an extraction from the registration system coming from the Gabonese Custom Services from January 2003 to December 2016.

The descriptive statistics of the variables used in the following econometric model are given in table 4

The first specification is the following log log model :

$$(1) \log EQRW_t = \alpha L_t + \log \beta \mathbf{W} p_t + \log \beta_1 \mathbf{O} p_t + \log \beta_2 \mathbf{O} \mathbf{i} l p_t + \beta_3 Y_f^2 + \beta_3 Y_c^2 + \epsilon_t$$

The dependent variable is the log of the exported volume in roundwood equivalent and the controls are the dummy accounting for LEB, log of woodprice, which include sawnwood, veneer and plywood prices, okoume log price only and the GDP of France and China, accounting for a the demand effect.

The second specification use lagged variables

$$(2) \log EQRW_t = \alpha L_t + \log \beta \mathbf{W} p_t + \log \beta_1 \mathbf{O} p_t + \log \beta_2 \mathbf{O} \mathbf{i} l p_t + \beta_3 Y_f^2 + \beta_3 Y_c^2 + \epsilon_t$$

The data set is detailed in the following section.

The third specification only explains the trends :

$$(3) \text{TrendEQRW}_t = \alpha L_t + \log\beta \mathbf{W}p_t + \log\beta_1 \mathbf{O}p_t + \log\beta_2 \mathbf{O}ilp_t + \beta_3 Y_f^2 + \beta_3 Y_c^2 + \epsilon_t$$

The figure in wood export, as shown by the following graphic (graphic 1.8)

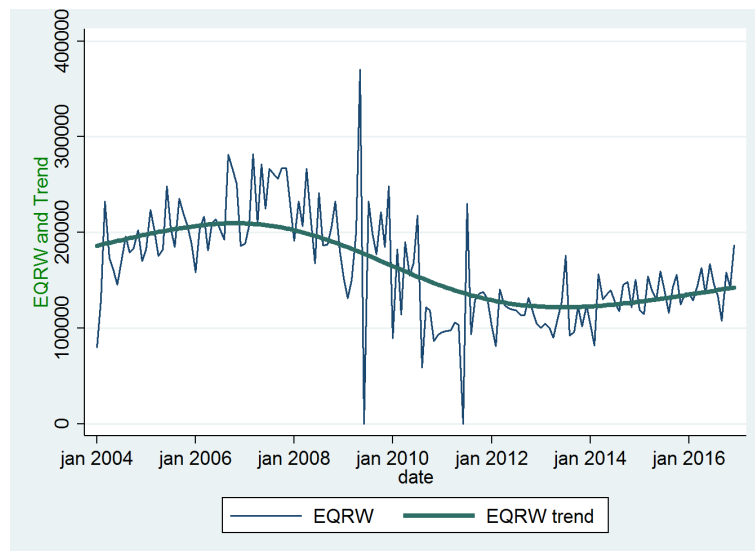


FIGURE 1.8: Total wood products exportations in roundwood equivalent per months

Source :Gabon Custom Service. Direction générale de la Statistiques _ Services des Douanes _ Section bois. The data base gives monthly volume of exportation by company. The volumes have been aggregated by company and by product in order to be the total exportation in equivalent roundwood per month. The trend is given by a Hodrick–Prescott decomposition representing the long term evolution the wood exportations

1.1.5 Results

LEB, Oil Prices and Chinese demand

The results of the above regressions are displayed in table 5.

The three specifications yield very similar results : the negative effects of LEB and oil prices is highly significant. Chinese growth rate is positively and significantly correlated with roundwood exportations.

As expected, LEB contributes to decrease the overall level of timber exportation. This decrease has been amplified by high oil price.

Graphic 1.9 illustrates this inverse relation between oil price evolution and log production. Three periods are distinctly appear : the first between 1990 and 2000 where oil prices are very low and rather stagnant while the log production increased constantly throughout the period. The second period goes from 2000 to 2010, oil price increase sharply during the decade while log production stabilized around 3500 and start to decrease. Finally the last period is the post-export ban, but yet the inverse evolution of oil price and log production remains unequivocal and the fall of oil price since 2014 is likely to have contribute to the increase of the EQRW over the last two years.

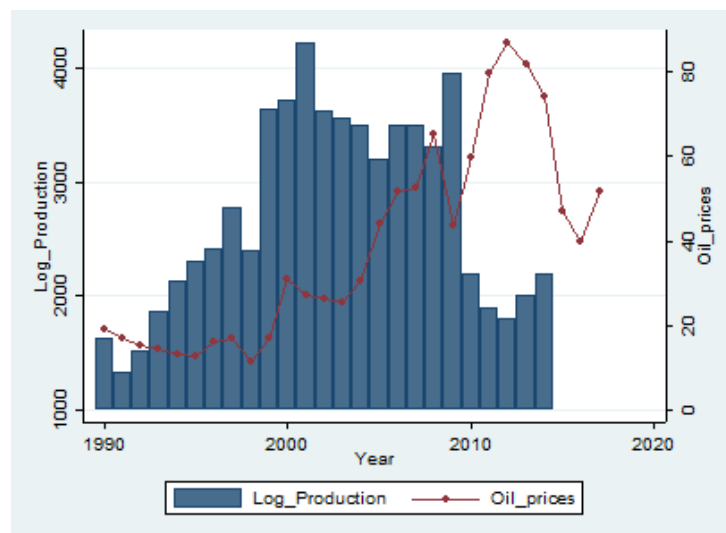


FIGURE 1.9: Log production and oil prices

Source :ITTO *ITTO* accessed by author in june 2017. Oil prices Monthly price of a barrel of crude oil in USD *UNCOMETRADE*

Wood exportation volume are driven by China's demand, hence the positive and significant coefficient of the Chinese GDP. National growth of Gabon does not have

significant impact on wood production ; the industry is very much export oriented even though the domestic demand for wood is growing since the implementation of the LEB. Neither international wood prices nor French growth have significant impact on wood exportation. The third specification, is explaining the trend of EQRW volume displayed by the graphic 1.8. When removing the seasonal variations, the trend of EQRW volume decline from 2009 onward and shows that 97% of the wood export trend is explained by the oil prices, China's growth rate and LEB.

The adoption of the LEB had clearly slowed down timber production was not harmful for forest. The oil price upsurge after the financial crises between 2009 and 2014 has contributed to reinforce timber extraction decrease. The estimations of futures oil production range between 250 000 bpd for the more optimistic to 100 000 bdp by 2025 see reserves will result in the sector's decreasing contribution to the national income. This is likely to have the same effect as of an oil price falling and might trigger, through a compensation mechanism, an significant increase of other extractive activity and timber harvesting.

1.2 Has Gabon gone further in Industrialization ?

The second aim of LEB is to further industrialization. LEB is part of a larger macroeconomic plan aiming at diversifying the economy, knowns as " Emerging Gabon Strategic Plan "(Plan Strategique Gabon Emergent, PSGE). The Code Forestier (Loi N 016/01 ; Forestry Code), introduced in 2001, was the first legal document to reflect the government's aspiration to intensify the commercial usage of the forest through the promotion of domestic processing. Article 228 of the Forestry Code dictates a gradual increase of the national level of wood processing as, "the transformation rate of local production should reach 75% within the decade following the promulgation of the present law" (République du Gabon, 2001) . Despite the unequivocal will of the authorities to further industrialization, the average share of domestic log processing was a mere 27% in 2009 (ITTO, 2009)of the total exportation. The attainment of the processing target rates of first 75% and then 100% was -and still is very unlikely.

1.2.1 From log to sawnwood

A shift from log to sawnwood production occurred since log exportations are forbidden. Previous studies show that primary processing, especially sawnwood, is less profitable than log exportation and that only plywood production is as economically lucrative as log exportation (Terheggen 2010b; Karsenty 2013). But high entry barriers to plywood production (for the EU), set by the competitive advantage of Chinese processors and set by increasingly more stringent European standards for wood products, limits the options of many actors in Gabon to fully specialized in plywood production.

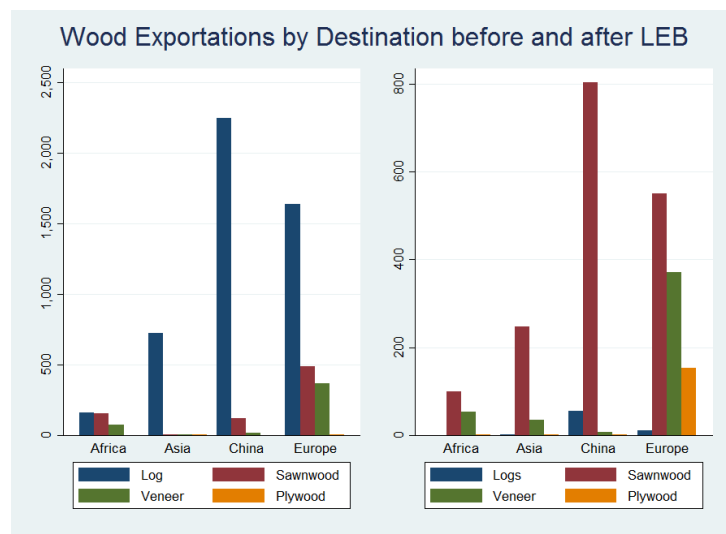


FIGURE 1.10: distribution of wood product exportations by region

Source :Source :Gabon Custom Service. Direction générale de la Statistiques_Services des Douanes_Section bois. Data compiled by author

1.2.2 Actor strategy

One of the immediate consequences of the LEB has been a very sharp decline of the volume of wood product (all type of products) exported to China, which plummeted to one fourth of the volume exported before the LEB (see graphic 1.10). Contrastingly, the decrease of the volumes exported to Europe is not dramatic, since European markets buy processed wood, especially veneer and plywood, instead of logs. The LEB has allowed Europe to regain its position as the top importer (of wood products) that had been occupied by China (in logs) for the last decade.

In the aftermath of the abrupt decline of log exports, the sector began to face significant financial difficulties. The LEB amplified the adverse effect of the global financial crisis that had already contracted the demand for tropical wood and had hence worsened the financial situation of all forest companies in Gabon. Between 2009 and 2010 the turnover of the five biggest Chinese companies fell by 40% and the one of FSC-certified European companies declined by 20%. Total profits decreased by 60% and 13% respectively ([eaux et Forêts, 2014](#)). These numbers reflect the relative importance of logs to different groups of investors' portfolio (which is a result of their respective markets). Subsidies to companies promised by the government along with the declaration of the LEB have not been released.

European companies largely try to absorb the financial losses following the LEB, instead of increasing the prices of their products, to stay competitive in the international market. Furthermore, all European companies have increased their processing capacities (e.g. by purchasing processing equipment, by opening a new line in their existing units or by outsourcing the production to a third part). They are also prospecting domestic and regional markets more often than before the LEB for additional opportunities in Africa, hence the increase of volume exported in Africa.

Asian companies continued to export the largest part of their production as logs to China, as was the case under the Forestry Code. A study of the Bureau industrialization du Bois (Bureau of Forestry Industrialization) ([PAPPFG, 2013](#)) reports that Asian (inclusive of Chinese) actors are essentially only present in primary processing (i.e. sawnwood). The same study reports that, except for five Asian companies specialized in veneer and plywood production, Asian investors dominantly produce sawnwood with a rate of conversion of 60% (up to 70%), which is above the national average of 55% ([PAPPFG, 2013](#)). These numbers suggest only a minor transformation of logs in Gabon (*ibid*; [Terheggen, 2010](#)). The LEB coping strategy of Asian actors, whose main export destination remains China, seems to be to process the logs at the smallest possible level in Gabon and to export "quasi-roundwood" in order to leave as much processing work as possible for the Chinese industry, which explains the striking volume of sawnwood and the very low volume of processed wood exported to China.

In general, Asian companies tend to cut more hardwood species per hectare than

European companies Since Asian operator arrival, about ten additional species are being extensively exploited due to Chinese market demands (Billard, 2012 ; Terheggen, 2010). The LEB has reinforced the selective logging system applied by European companies exporting to Europe : which are essentially focused on Okoume (*Aucoumea klaineana*) for their specialized veneer and plywood production.

Gabonese companies are secondary players in their own forestry sector, dominated by foreign investors. Prior to the LEB, inferior quality logs that could not be exported by larger (foreign) companies constituted a stock of supply for smaller Gabonese units serving mostly the local market. Post LEB, large-scale concessionaires are much more selective and harvest no more logs than their own minimum requirement. As a result, smaller Gabonese companies without a concession struggle to satisfy their demand. The exploitation of logs (without the option of exporting them) or the purchase of low-priced logs on the domestic market leaves no profit margin for most smaller local logging units. They subsequently exited the sector.

1.2.3 National log price evolution

During the first year that followed the LEB, the log scarcity as led to a relatively high price of logs on the domestic market, which is exactly the *opposite effect* of what the theoretical models predicts : The main expected effect of the LEB is theoretically to increase the price differential between the international log market price and local market.¹⁴ The LEB fails to trigger the expected log price decrease - which means it fails to provide the local producers with subsidy supposed to push the infant industry. Instead, the prices went up and this self-restricted felling system has resulted in Gabon producing only 63% of its annual theoretical capacity (PAPFFG, 2013)pp29.

Since 2014 however, the production increased significantly, pulled by the oil price decrease and the associated production cost reduction ; it thus difficult to identify the extent to which the recovery is due productivity gain in wood processing or just total cost decrease via oil price downward evolution.

The increasing trend of exported volume of all processed wood (namely sawnwood,

14. There is no available official secondary data on domestic prices evolution but I use the interviews with members of the Gabon's Forestry Union UFIGA (Union de Forestier du Gabon) in 2013 and 2014

veneer and plywood) illustrated by the graphic 1.11, 1.12 and 1.13 while the production of log decrease is not due to a major change in productivity. In fact, only sawnwood ARC increased better quality log which are no longer being exported are transformed. (PAPFFG, 2013)

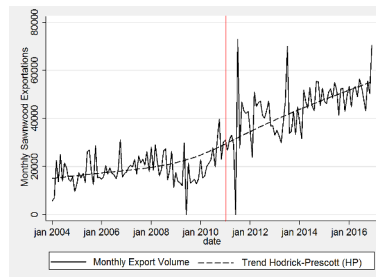


FIGURE 1.11: Evolution of sawnwood exportation between 2004 and 2016

Source :Gabon Custom Service. Direction générale de la Statistiques_Services des Douanes_Section bois.

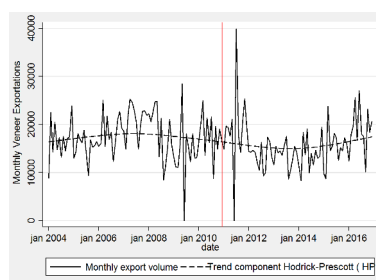


FIGURE 1.12: Evolution of Veneer exportations between 2004 and 2016

Source :Gabon Custom Service. Direction générale de la Statistiques_Services des Douanes_Section bois.

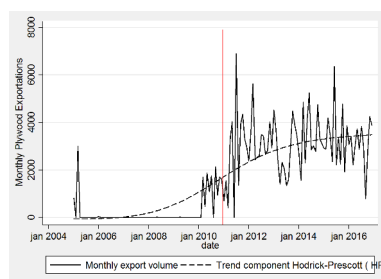


FIGURE 1.13: Evolution of Plywood exportations between 2004 and 2016

Source :Gabon Custom Service. Direction générale de la Statistiques_Services des Douanes_Section bois.

1.3 Conclusion

The theory predicts that LEB inevitably ends in resource overuse; Indonesian experience has proven that a LEB can generate indeed results in irreversible environmental damages as it might cause in the long run over-exploitation and illegal harvesting (Dudley 2004; Karsenty 2013; Piketty and Karsenty 1996). In Gabon it is a different story and LEB has contribute to decrease log production. Given the expect exhaustion of oil within the next decade, the LEB come across as a sound decision to protect the forestry resource by attempting to build an efficient wood processing industry.

That second objective has not been achieved. It would be premature to talk about failure of the LEB in Gabon, however, the challenges ahead for the policy to lead to the emerging of a competitive domestic wood industry are such that they pose the question of their achievability.

Annexes

TABLE 1: Export bans and Restrictions by regions

Country	Product and applicability	Year
AFRICA		
Cameroon	log export restriction. Export Ban to some hardwood species (iroko, moabi, bibolo, wenge and bubinga)	1999 to date
Cote d'Ivoire	Log Export Ban on unprocessed logs.	1976 to date
Djibouti	Sawnwood export ban.	trouver la date
Gabon	Logs export ban.	2010 to date
Ghana	Log export ban	1994 to date
Madagascar	export ban on unfinished wood products.	1975
Mozambique	first class logs cannot be exported, must be processed domestically	2012
Nigeria	logs export ban	trouver la date
Sierra Leone	Temporary log export bans in 2008 and 2010	2008 ans 2010
AMERICA		
Belize	Rosewood (<i>Dalbergia Stevensonii</i>) logging and export ban.	2012
Brazil	log export ban. Moratorium of bigleaf mahogany (<i>Swietenia marcophylla</i>) exports. Certain wood exports (eg imbuia, virola) are subject to specific rules and require prior authorization from IBAMA.	1996
Canada	Restrictions on log exports from British Columbia. A variety of federal and provincial regulations regarding log exports.	1906
Continued on next page		

TABLE 1: (continued)

Country	Product and applicability	Year
Chile	Logging and export ban on <i>Araucaria araucana</i> and <i>Fitzroya cupressoides</i> (both CITES Appendix I).	1976
Colombia	Regulations on log exports from natural forests. Roundwood can be exported only if it comes from planted forests.	1986 to date
Costa Rica	Log export ban. Export ban on roughly squared wood from certain species.	1986 to date
Dominican Republic	Export ban on certain wood types.	trouver la date
Ecuador	Roundwood export ban, except in limited quantities for scientific and experimental purposes. Semi-finished forest products exports are allowed only when "domestic needs and the minimum levels of industrialization have been met." Export ban on mahogany and cedar logs.	trouver la date
Guatemala	Log exports from natural forests are banned. Ban does not apply to furniture and processed products made from wood.	1996
Guyana	Only companies holding forest concessions may export logs.	2009
Honduras	Export ban of wood from certain forests unless it is in finished products.	1998
Continued on next page		

TABLE 1: (continued)

Country	Product and applicability	Year
Nicaragua	Export ban on certain precious hardwoods (mahogany, royal cedar, pochote). Mahogany exports permitted only in sawn wood, plywood or veneer. Sawnwood exports require a license.	1997 to date
Panama	Export ban on logs, stumps, roundwood and sawn wood from natural forests, as well as from wood submerged in water.	2002
Paraguay	Log export ban.	1970 to date
Peru	Log export ban. Export of forest products "in their natural state" is prohibited unless the originate from nurseries or forest plantations and do not require further processing for final use/consumption.	1972 to date
ASIA AND PACIFIC		
Cambodia	Log export ban.	1992 to date
Fiji	Log export ban.	1994
Indonesia	Log export ban. Since 2009, plantation-grown logs may be exported.	1981 to 1992 and 2001 to date
Malaysia	Quota on export of logs from Sabah (40 percent of total harvest volume may be exported) and Sarawak. Total ban on export of round logs from Peninsular Malaysia.	1992 to date
Continued on next page		

TABLE 1: (continued)

Country	Product and applicability	Year
New Zealand	Export ban on most logs, chips, and sawn timber from natural forests. 1993 to date Philippines Export ban on all native wood products except value-added products. Log export ban on logs from natural forests. Logs from plantation forests may be exported.	1989 to date
Philippines	Export bans on all wood products with the exception of value added products.	1989 to Present January 1999 to Present

Table 2 : Average Rate of Conversion (ARC)

TABLE 2: Average Rate of Conversion (ARC)

Production Units	products	HS code	ARC
Classical sawnmill	sawnwood (product>6mm)	4407	42%
Basic Sawnmill	sawnwood (squared timber)	4407	55%
Veneer Factory	Sheets for veneering(product<6mm)	4408	60%
Plywood Factory	Plywood, veneered panels	4412	55%

^a The HS code comes from the <http://www.tresor.economie.gouv.fr/Pays/gabon> nomenclature and classification of goods. The definitions of the 4407 and 4408 are respectively "Wood sawn or chipped lengthwise, sliced or peeled, whether or not planed, sanded or end-jointed, of a thickness exceeding 6 mm." and "Sheets for veneering (including those obtained by slicing laminated wood), for plywood or for similar laminated wood and other wood, sawn lengthwise, sliced or peeled, whether or not planed, sanded, spliced or end-jointed, of a thickness not exceeding 6 mm."

^b The Average Rate of Conversion comes from the survey *Rapport d'Etude : Diagnostic de la filière industrielle du bois au Gabon* done by the Office for Wood Industry (Bureau Industrie du Bois) in July 2013. This survey has been commissioned by the Ministry of Waters and Forest of Gabon.

^c Average rate of conversion are calculated as follows $ARC = \text{Volume of produced woodproduct} / \text{Volume of Roundwood}$

Table 3 : Variable definition and sources

TABLE 3: Variable definition and sources

Variable	description	source
Wood products prices	Monthly price time series from 2004 to 2016	Global Wood Market
Oil prices	Monthly price of a barrel of crude oil in USD	UNCOMETRADE
Gabon_Per capita	Gabon GDP per capitat in PPP in USD	World and Income database
World_Per capita	World GDP per capitat in PPP in USD	World and Income database

Variable	Mean	Std. Dev.	N
gdpfrance2	1450248647.822	45021279.594	180
gdpchina2	99165303.956	55259161.491	180
gdpchina_lag	9.115	0.304	175
gdpfrance_lag	10.548	0.015	175
log_prix_okoume	5.502	0.338	184
LEB	0.570	0.496	193
oil_lag	4.052	0.344	175
logwoodprice	5.845	0.53	106

TABLE 4: descriptives statistics

Source : *Forest Legality* :<http://www.forestlegality.org>, *Guyana Forestry Commission (GFC)*, *ITTO*, *Timber network*, *Wood Business Forum*. This non exhaustive list of national log export ban shows

VARIABLES	(1) OLS	(2) Model 2 Lagged regressors	(3) Model 3 Trend
gdpgabon2	-2.79e-10 (8.72e-10)		-1.24e-10 (2.15e-10)
gdpfrance2	1.12e-09 (1.17e-09)		0 (2.27e-10)
gdpchina2	5.91e-09*** (2.08e-09)		-4.21e-10 (5.47e-10)
log_prix_okoume	0.208 (0.128)	0.0282 (0.113)	-0.0297 (0.0301)
LEB	-0.808*** (0.174)	-0.858*** (0.175)	-0.314*** (0.0358)
oil_lag	-0.614*** (0.137)	-0.353*** (0.102)	-0.228*** (0.0236)
logwoodprice	-0.0174 (0.0553)	-0.0308 (0.0461)	-0.00586 (0.00814)
gdpgabon_lag		-0.692 (0.929)	
gdpchina_lag		0.758** (0.352)	
gdpfrance_lag		-1.517 (2.803)	
Constant	11.79*** (1.974)	30.04 (35.25)	13.41*** (0.366)
Observations	89	95	89
R-squared	0.701	0.669	0.980

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

TABLE 5: Regressions results

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Chapitre 2

Timber logging and Foreign

Investments in the forest of Congo

Basin : Assessing the interactions with local people

Abstract

This study investigates the nature of the interactions between foreign logging companies and the surrounding forest-dependent communities at village level. The quality of these interactions is assessed through villagers' perceptions, using the dataset of a household survey implemented in Gabon between August and November 2012. The core assumption is that the interactions between logging companies and local people depend on two main criteria : the nationality of the company (i.e. the origin of its capital) and its level of commitment in adopting sustainable logging practices. Using a DID (Difference in Differences) as a comparative method, the nationality effect is measured by the comparison of Chinese logging companies to non-Chinese ones while the difference in logging practices is captured through the level of completion of the Sustainable Management Plan. The results show that the presence of a logging company is generally worrisome, regardless of its nationality or the rate achievement of its Sustainable Management Plan.

Introduction

Industrial logging companies are important players in tropical forest management. Commercial logging is associated with ecological disturbances and social issues. The two aspects are linked, as ecological interactions generate negative externalities that ultimately translate into social welfare loss for local populations. However, for the most part, preceding analysis focus essentially on the ecological effects of logging (Lentini et al., 2010, Börjesson, 2000, Barbier et al., 1995) even in central Africa and Gabon (Laurance et al., 2006, Timothy and Rawling, Timothy and Rawling, Karsenty and Gourlet-Fleury, 2006, Ruiz Pérez et al., 2005) where the social issues are all the more crucial that populations there are often in a very dire situation.

The fragility of local populations situation is due to an adverse general economic environment, sometime emphasized by difficult political contexts (UNDP, 2017)¹. In Gabon, despite a relatively high GDP per capita compared to the average of Sub-saharan African countries (UNDP, 2014), forest dependent people are vulnerable mainly because of the weakness of their property rights. (Wily and Faure, 2012, Billard, 2012). In such a context, social interactions of logging companies deserve special attention.

Social interactions between logging companies and local communities essentially revolve around two questions. The first one is the distribution of the forest economic rent and how the benefits from timber harvesting trickle-down to local populations. The second question is the access to and use of forestland resources. These questions become increasingly urgent as the disturbances caused by logging activities interfere with local population daily lives.

Local communities' livelihood depends on their access to the forest for agriculture, hunting, fishing and gathering. Sustainable forest management efficiency, in turn, depends on their ability to improve standards of living of those who are dependent on forest (Babigumira et al., 2014) (Wunder et al., 2014)(Sunderlin et al., 2005)(Mertens et al., 2000)(Kant, 2000)(Angelsen, 1999)(Vincent, 1990) (Gelo and Koch, 2014, Angelsen et al., 1998, Sunderlin et al., 2005). Hence the importance of understanding the effects

1. The latest **United Nation Development Program (UNDP)** report on the central African sub-region describes the fragile economic situation of the countries of the sub-region. Political unrest in Democratic Republic of Congo, Central Africa or Equatorial Guinea causes acute poverty and land insecurity

of commercial logging on forest dependent people in order to enforce and further promote sustainable forest management.

The present study characterizes these effects from the local population perspective by capturing the perceived effects of industrial logging in rural villages in Gabon, taking into account the two main features of timber sector. The first feature is the predominance of foreign investors in Gabon's timber industry. The second is that forest concession under sustainable forest management policy is the predominant form of industrial logging. A **Sustainable Management Plan (SMP)** is a document required by national forestry law ; it has to be approved by the National Authority (in the instance the Ministry of Forest and Water in Gabon). It plans the exploitation process, outlines the logging activity of concession during the first rotation. It includes an inventory of trees species, disposition for ecosystem protection and, more importantly for the present discussion, it includes a social component stating the actions the company will take in order to enhance local development

In Gabon and in Congo Basin in general, timber sector is dominated by foreign investors. During the second half of the 20th century, in the aftermath of European colonization era, Europeans companies remained the main actors of the sector along with national state companies like for instance *Société Nationale du Bois du Gabon* (SNBG). Since 2000, Chinese investors became increasingly active in forestry sector and are currently amongst the largest concession holders in Central Africa, particularly in Gabon where 26% of the productive forest of the country is held by Chinese companies ([eaux et Forêts, 2014](#)). Gabon is a well suited case study for a comparative study between different nationalities of investors.

The rationale behind a comparison of investors based on their nationality has been highlighted by Ruiz Pérez and al. in their paper "Logging in the Congo Basin : A multi-country characterization of timber companies" ([Ruiz Pérez et al., 2005](#)). The authors find that *"Based on a detailed questionnaire complemented by published statistics ; the concessions are characterized by the country in which they operate, their legal status, age, size, origin of capital, and market focus. Concessions show patterns shaped by interactions between these factors, with different logging strategies associated with the resulting*

groupings". This result suggests that the ecological and social interactions of logging companies are *not* homogeneous and differ according to objective criteria, one of them is the nationality (i.e. the origin of capital) . Nationality underlies different market focus, different market strategies which ultimately translates into different logging practices. The magnitude of Chinese investments over the last decade in Gabon's forest industry offers the opportunity to compare between logging practices of the new comers and the ones of long established Europeans companies. Several studies address that question ([Kaplinsky and Morris, 2009](#), [Terheggen, 2010](#), [Putzel et al., 2011](#), [Wenbin and Wikes, 2011](#)) A very similar work has been done in Cameroon by Cerutti *at al* ([Cerutti et al., 2011](#)) where the authors compare European and Chinese logging firms behavior looking at business strategy , but no research has been done at a local level amongst rural population.

The second characteristic of forestry sector in Congo Basin and more specifically in Gabon is the generalization of concessionary system as the dominant form of forest exploitation. Most countries of the region issue small forest exploitation permits for local smallholders but only a marginal share of the forest is covered by these permits (3 million hectares out of 13 hectares commercially harvested in Gabon) and Community Based forest management remains in a minority in the region. In Gabon, the concessions are granted to the operators for a renewable period of twenty five years under the condition that the operator provides a SMP. As long as the SMP is not approved by the administration, the operator is only entitled with a temporary permit and only can access a small portion of the whole concession. In practice, the operator is given three years to produce the SMP. The efficiency of sustainable forest management policy in Congo basin is a controversial subject. In a recent article Brandt *at al* show that SMP works a "permit" allowing the use of the forest for twenty five years, ([Brandt et al., 2016](#)) which induces more deforestation and environmental damage than other form of forest management such as Joint forest Management for instance. On the other hand, sustainable forest management policy is supported by some scholars like Karsenty *at al*([Karsenty et al., 2016](#)) stating that SMP improve forest management by establishing good practices.

This study may contribute to bring evidence on that question as it also controls for the differences perceived by local people between concessions with an approved SMP and concessions without, regardless of their nationality.

The chapter is organized as follows : the next section gives the general context of the survey. Section 3 details the empirical strategy. Section 4 presents the econometric framework that informed the empirical strategy. Section 5 discusses the results and finally, section 6 concludes.

2.1 Background and context of the study

2.1.1 Background

Gabon has a very low population density and the distribution of the population over the country is skewed in favor of urban areas. The total population of Gabon is about 1.8 million inhabitants of which only 13% live in rural area according to the latest census (2013). The population density is between 250 and 300 inhabitants per km^2 in urban areas against an average of 6 inhabitants per km^2 in rural zones². Despite a very small population, the ratio of arable land in hectare per inhabitant is 0.17 which is slightly under the subsaharan average of 0,20 and far behind the 0.31 of the OECD countries³. The forest cover is such that it reduces the availability of arable land. In such a context, expanding agriculture induces forest clearing. There is a land use competition over forest and woodland ([Barbier and Burgess, 2001](#)) : this competition opposes logging on one hand and other activities that require a large-scale forest cleaning such as mining, plantations, cattle farming and agriculture. Until recently in Gabon⁴, forestland allocation was in favor of logging.

Agriculture is a very narrow sector consisting only in cash crops (i.e coffee beans and cacao). Food product importation represents 15% to 20% of total importations of the commercial balance. These importations are crucial for the country to satisfy the national food demand. They are also expensive : the relative price of food is high and food expenditure is the highest expenditure item of household consumption. Indeed food expenditure accounting for 33% of total the household budget (before housing and transportation expenses). The weight of food in Gabonese household expenditure is dispro-

2. All figures and statistics present in this section come from Gabon official website ([FocustatGabon](#)) accessed by the author in June 2017 unless specified otherwise

3. World Bank Data accessed by the author in June 2017 [World Bank](#)

4. I will come back to this subject and develop in the last chapter

portionate given the relatively high GDP per capita⁵ (Blaney, 2008). Many lower and middle classes households living in urban areas receive staple food (i.e cassava, bananas, taro, yams) from their relatives living in the country side (Temple and Dury, 2003). In rural areas, where imported food is not easily accessible, population heavily relies on their small plots production to meet its food requirement.

Large-scale agriculture in Gabon is virtually inexistant ; there is no private or state owned company involved in agri-food industry⁶. In this context, subsistence farming is essential to population livelihood. There is no available figure on the global production or consumption of the staples food stuffs or vegetables produced by small land owners, even less is known about the proportion of this production dedicated to self-consumption or (informally) sold .⁷ Only few research monographs have been produced on the subject (?Blaney, 2008, Temple and Dury, 2003). The production, commercialization and distribution of food are provided by rural people through informal channels, notably on markets in peri-urban areas at the outskirts of cities centers. Access to forest is critical to standards of living as food security of rural and, to a certain (unknown) extent, of poorest urban population depends on forest resources (NTFP (non-timber forest products))and forestland for agriculture (Blaney, 2008, Temple and Dury, 2003). Despite that land access is central to population livelihood, the allocative choice of Gabon has been in favor an industrial use of the forest, promoting the development of logging industry and more recently cash crops plantation.

So far, Gabon's forest has been spared from massive deforestation by the overwhelming contribution of oil exploitation to national growth : the deforestation rate is amongst the lowest in Africa with less than 1%⁸ per year. Gabon's forest houses more than 1000 animal species (of which 17 are totally protected species) and over 8000 tree species of

5. Gabon fall into the " Medium Human Development" group according to the [UNDP classification](#)

6. There is only one private company agri-business calla *Agritop* and based in Port-Gentil and only active within the area of Port-Gentil

7. This question raises a well-known issue in agricultural development economics, namely the notion of separability when modeling agricultural household's decision. Rural household's are both producers and consumers. This issue has been extensively studied since the early 80's (Sing *at all*, Taylord, Stiglitz, Sadoulet, Lambert, Bardhan etc) and is not at all addressed in this analysis even if this dual aspect of rural household has been fully taken into account especially in designing the questionnaire.

8. Gabon tree cover loss superior to 10% of the canopy density between 2001 and 2016 is of 350 442 ha of the total 26 million ha tree cover of the country. [Global Forest Watch](#)

wich 60 are commercialized (WRI, 2009). Industries generating net deforestation such as palm oil or rubber plantations have only started to settle in Gabon in 2013 in line with the economic strategy of A. Bongo to diversify the economy⁹. The main activity in the forest is logging. Gabon has one of the highest density of logging concessions area in Africa with 62.4% of forestland dedicated to logging¹⁰. Timber logging is a key sector of Gabon's economy. In this country almost entirely covered by rainforest and with a very low population density, there is no problem of land availability *per se*. Yet, local population's land access and land use is, in some case threatened, by the allocative choice. As the industrial use of forestland expands, the pressure on forest resources increases and the interferences with local population's activities inevitably arise. The sustainability of the forest exploitation thus depends on the capacity of the actors to interact and find an agreement on land use and access.

2.1.2 Context

This study comes as part of a CIFOR project entitled "Chinese trade and investment in Africa : assessing and governing trade-offs to national economies, local livelihoods and forest ecosystem", which was started in 2010 and carried out thanks to funding from the German Ministry for Economic Cooperation and Development. The local partners are the Ministry of Water and Forests of Gabon, the Project for Managing Small Gabonese Forest Licences (Projet d'Aménagement des Petits Permis Forestiers Gabonais, PAPPFG) and the Timber Industry Bureau (BIB).

The survey instrument has been conceived by me, as a project manager for the above mentioned CIFOR project in Gabon, I was in charge of the budget allocated for the study. It has financed a team of 6 enumerators and 3 drivers for the field work *per se*. The data entry work required the assistance of 3 research assistants.

The total length of the mission was of thirteen weeks and happened in two waves between July 2012 and June 2013 : this interruption was due to rainy season that renders

9. The multinational Olam contracted with the government and got long-term lease on land Woleu Ntem province for rubber cultivation and Estuaire region for palm oil plantation. It is part of Emerging Gabon strategy aiming at developing other sectors and notably forestry to reduce the country's dependence on decreasing oil revenue

10. Data [FocustatGabon](#)

access to some villages costly, time consuming and difficult.

2.2 Evaluation strategy

2.2.1 Survey design

The field work for data collection happened in two waves : the first one between July 2012 to October 2012 and the second one between April 2013 to June 2013. The survey mainly consists in implementing the survey instrument (questionnaire) to a member of the household (preferably the head of the household). It is also supplemented by participatory mapping and focus groups undertaken in each of the 16 villages within the sample.

The evaluation technics used for the survey is a double difference also known as DID (Differences in Differences). DID is increasingly used in the social sciences to evaluate public interventions, often taking the form of a public program implementation. The principle is straightforward ; I first evaluate the impact of being close to an industrial timber concession - any concession. Secondly, I evaluate the effect of being near a Chinese concession compare to being near a non-Chinese concession, the same principle applies for concession with finalized SMP and the concession without a finalized SMP - regardless of their nationality.

2.2.2 The DID assumptions

In order for this estimator to give a reliable, that is, unbiased, estimate of the effects of the presence of a concession, it is necessary that certain assumptions are respected :

the selection

In order for the effects estimated to be unbiased, the group and period to which each household belong must ensure the outcomes observed are random variables and eliminates any selection bias.

In our this case, a random selection was not possible, I correct for the potential biased by use a propensity score matching.

Independence

The other factors likely to influence the evolution of the outcome variables must be

the same for all the households in the sample. In other words, being in a given group or a given period must not change the conditions in which the household are evolving.

We choose the control and treatment group according to their proximity to a concession but within the same geographic areas. The village are quite similar in terms of sources of revenue, way of living and social structure.

Homogeneity of the population

Subgroups should be homogeneous, that is, they should have the same characteristics to ensure that expected effects over time would occur in the same manner within both subgroups.

As shown by the socio-demographic variables, the groups are very similar in their characteristics.

These assumptions should guarantee an unbiased estimate of effects under a standard DID. It should be noted that the first two conditions of non-selection and independence are more than necessary for the estimate to be reliable. The respect of these assumptions made it possible to define the eligibility criteria of the villages chosen for the study and the constitution of the sample.

As for all the evaluation methods, the principle is to divide a sample into two groups : a treated group that benefits from the program (the treatment) and a control group that will not. Ultimately, the effect of the program is given by the comparison of the outcomes of interest between the treated and the control group. The validity of the results rests on the core assumption that the two groups only differ by the fact that received the treatment or not, they are similar otherwise. Therefore, the observed differences in outcomes are only due to the treatment and nothing else.

2.2.2.0.0.1 Baseline & counterfactual The first obstacle I encounter is to find a counterfactual. Theoretically, the first difference is computed by comparing the *same sample* before and after the treatment occurred. In this case, such baseline collection was impossible because the concessions were established already at the time of the study. Thus no baseline collection could be done in the villages *before* the timber company arrives. That is why, I use as a counterfactual the cluster of villages located far enough from the logging area so they are not (yet) influenced by the activity.

The figure 2.1 illustrates the design of the survey.

The villages of groups C and B are the villages of the treatment group G_1 because they are close to a Chinese concession. Within this control group, the grouping of village B is considered as that of the period T_0 , that is to say, they are not yet influenced by the activity of the forest concession because they are too far from the actual logging stand (ALS). This group is the counterfactual. The group C is that of the period T_1 where the operations are in progress, this cluster of villages is subject to the effects of the company's activities.

Similarly, the villages of group A and D are the villages of the control group G_1 because they are close to a non-Chinese concession. Villages of group A, which are far from the (ALS), are the the pre-exploitation counterfactual period T_0 and those of the group D which will be the villages of the period T_1 .

Formally, the first differences can be written as follows :

— For the treatment group :

$$(B - C)$$

— For the control group :

$$(A - D)$$

And the second difference (i.e. the DID estimator) is thus obtained as follows :

$$(A - D) - (B - C) \tag{2.1}$$

A similar comparison is applied to the same with the Sustainable Management Plan finalization as a treatment variable. The second DID allows to verify if there is a difference between concession with an officially approved **SMP**), and those with temporary logging permit in terms of interactions with local population *regardless of their nationality*. The very same design is applied first to a pair of Chinese and non-Chinese companies with a finalized plan and secondly to a pair of Chinese and non-Chinese companies without a finalized plan. The sample is distributed as follows :

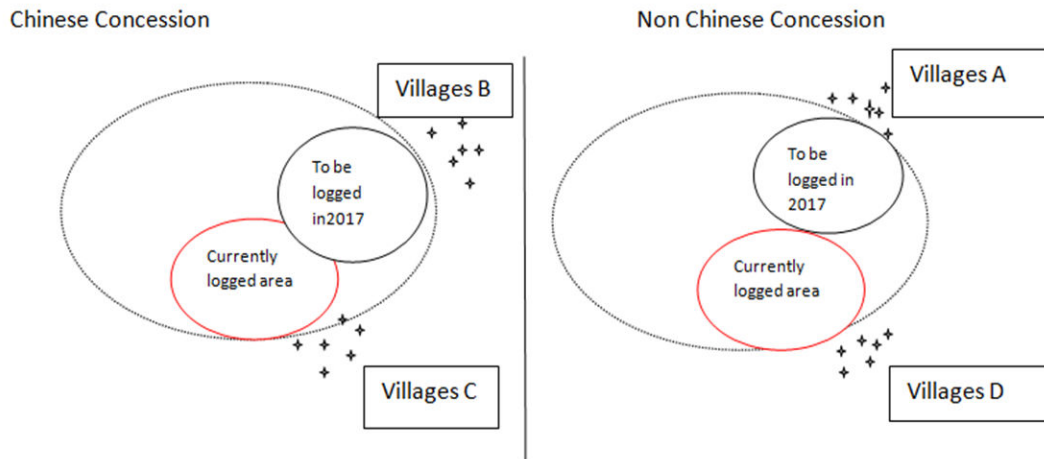


FIGURE 2.1: Study design

	Forest management Plan finalized	Forest Management plan in Progress
Chinese companies	4 villages n = 71	5 villages n= 90
Non Chinese companies	3 villages n= 87	4 villages n= 59

The next subsection outlines the mechanism by which there might be observable and significant differences in the effect on the population of two logging companies; from those mechanisms stem the outcome variables I choose to compute the DID estimator.

2.2.3 Mechanism and outcome variables

Chinese operators are less selective than the European ones in terms of tree species. The Europeans operators harvest mainly a dozen of species as they supply the European niche market, demanding a certain quality and fewer species. Chinese operators on the other hand harvest a much wider range of species as their final market (mainly in Asia) is larger and less demanding in quality. In 2015, fifty different species from Gabon have been exported to China¹¹. I assume that this induces more intense forest clearing and therefore for more disturbances for the local populations. Besides, China growth, before

11. see first chapter

its recent slowdown, was very much primary resources based. Chinese operators are more interested in roundwood and do not process roundwood in Gabon and even when they do transform locally, they tend to employ Chinese workers. That is why the first intuition is to find more disturbance in village close to Chinese concessions.

It is difficult to disentangle the ecological effects from the social ones as they feed off each other : the disturbances generated by logging at an industrial scale have consequences on ecosystems that in turn affect local populations' daily lives and lead them to misuse (or overuse) the resource, creating ecological damages. An illustrative example of this interaction is the highly problematic human-elephant conflicts in Central Africa in general and in Gabon particularly. Elephants pushed out away from their natural habitat because logging (or other extractive activities) are entering farming areas at the edge of the forest and destroy plantations. This causes significant financial loss for populations that in some case leads to over-fishing or over-hunting (Boukoulou et al., 2012, Ngouhouo Poufoun et al., 2016). Because ecological and economic consequences of logging are intertwined, the study focuses on the global perceptions of the villagers about the changes induced by the presence of a concessionaire. Therefore the effects of logging identified in the present study are the one perceived by local populations, regardless of their nature.

A relevant depend variables would have been the revenue of the households, income being the main economic indicator of wealth. However in the context of a developing country such as Gabon, there are no records or official data regarding people earnings. So the only way to obtain the household income estimates would be to ask the respondent. However, people main activity is agriculture, a part of the production is directly consumed, the earning depends on the season of the agricultural calendar, people do not take records of their sales. Additionally, there are income transfers between and amongst households. For all these reasons it is very difficult to come up with a reliable estimate of a rural household income.

Based on a literature review on the most common effects of logging on local populations (Sunderlin et al., 2005, Wunder et al., 2014, ACTED, 2012, Bacha and Rodriguez, 2007) and taking into account logistical consideration, especially the limited time available for data collection, I choose three outcome variables. The first one is the existence of conflict of land which is a *factual* variable as opposed to the others which are subjective

perceptions. The second outcome variable is the perception of the future. The respondent is asked what is, according to him, the biggest threat for his household and what would be the most promising opportunity. The answers are screened in a way that each time the presence of the concession is either mentioned as an opportunity or associated with future opportunities the variable "opportunity" take the value 1 and 0 otherwise. The dummy variable "threat" is built in the same manner.

The next section outlines the econometric methods used to identify and measure the aforementioned outcome variables.

2.3 The data

2.3.1 Presentation of the studied area

The area we studied is located along National 1, which connects the capital Libreville to Tchibanga and is one of the main roads of the country. The road is often the first place of sale for the villagers who expose their traffic along the road that borders their village. The rate of road use is a determining factor for the economies of the surrounding villages and being located in a landlocked area greatly reduces the opportunities for economic development of a village. This is why I choose concessions located along the same road. Moreover, it is important to eliminate the bias that coming from the variation of the distance to a large city; all the concessions are located between 80km and 100km of the capital of the province where they are located in. Those are namely Libreville for the province of the Estuary, Lambaréné for the province of Moyen Ogoué and Mouila for the province of Ngounié.

This area is part of the so-called rear shore area which is particularly popular amongst logging companies as it is relatively easier to access and less cumbersome to transport logs from this part of the forest. Indeed the presence of the two big rivers Ogoue and Ngounié allows waterway transport. In addition, National 1 allows a road access to the port of Mayoumba and the one of Owendo.

2.3.2 Presentation of the studied population

The local populations of the area studied mainly live on a mixed production system which includes : production of agricultural production (a part of which is for sale, the other part for self-sufficiency), hunting, fishing, gathering and palm wine production. Agriculture is by far the main source of revenue (see figure 2.2)

In all villages, financial capital is non-existent. There is no lending system except for loans in the form of rotating savings and credit (the so called "tontine") and lending capacities are limited. This means that there is almost no agricultural investment and the only factor of production is labor. During the clearing season, only households able to pay for the extra labor needed or have enough savings to invest in the leasing of a chainsaw can extend their cultivation area. In other words, agriculture is not mechanized at all and yields in agriculture tend to stagnate at subsistence levels.

The surveyed villages with the exception of two villages located in Ikobé are directly located along the roads in a strip that rarely exceeds 2 km. This strip constitutes the village extend on either side of the road. It includes the habitat and the agricultural soil.

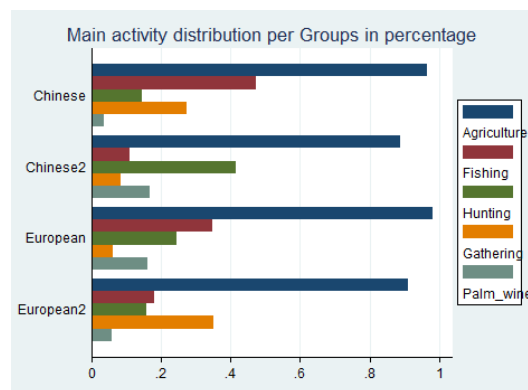


FIGURE 2.2: Distribution of Household activity per group

Source :Author. Primary data. Based on a survey of 305 household in 2013

The profile of the population shows that the level of education is relatively low, 60% of the population has not exceeded the level of primary schooling. It should be noted, however, that the literacy rate is quite high (97% for our sample). The population is evenly distributed between men and women , the distribution of men and women is 52% and 48% respectively. However, this distribution applies only to the household representatives we interviewed (see figure 2.3).

As mentioned before, the methodological difficulties associated with the assessment of household income did not allow us to make a quantified study on the basis of the average household income. However qualitative data collected through interviews and focus groups confirms that men control income from hunting and selling bush meat while women, on the other hand, manage incomes from agricultural production and their marketing, this result is in line with Wily and Alden rural Gabon study (Wily and Faure, 2012, ACTED, 2012). Women also determine the ratio between self-subsistence and production for sale, which changes according to the season (dry season or rainy season) and the fluctuations of income on other household activities (hunting, Picking etc.).

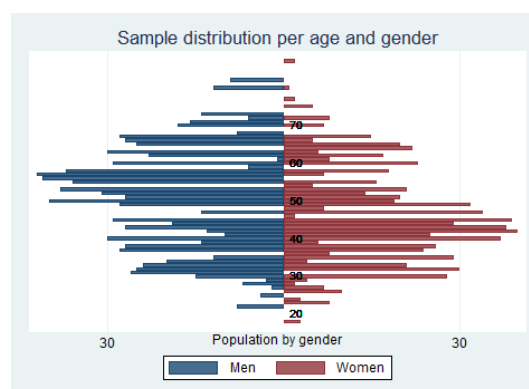


FIGURE 2.3: Sample distribution per age and gender

Source :Author. Primary data. Based on a survey of 305 household in 2013

The social organization of the villages is clan or lineage. Thus the distribution of the forests around the village for agriculture depends on the time spent by the family in the village ; the better plots go to families installed for more than a generation. In our sample, 72% of the households surveyed said that they got the land they cultivated because they belonged to their fathers (or eldest).

The method of distribution described above means that newcomers to a village must solicit the oldest inhabitants to obtain a plot. They are often granted plots which are the most remote from the village or the least fertile.

The migratory flow in the villages of the Estuary and the Moyen-Ogoué have been accelerated by the presence of the palm oil plantation of Olam (a multinational company involved in agro-business in Central Africa). Consequently, there has been noticeable waves of arrival of young people (25-35 years) in the villages located in the Estuary.

They were attracted by the potential job opportunities brought by the installation of the palm oil plantation (see chapter 4). They are fleeing the unemployment that prevails in the more southern regions (especially in the department of Nyanga). However, the employment opportunities did not always materialized but these young people remained in the northern villages and started to farm, which exacerbates competition in land access.

This situation creates tensions and neighborhood conflicts in some villages where new arrivals, mainly the Punu, struggle to integrate into the predominantly Fang villages of the Estuary and Moyen Ogoué ¹².

The average size of the household is five persons per household and the average number of plots is two plots per households (see figure 2.4 and figure 2.5)

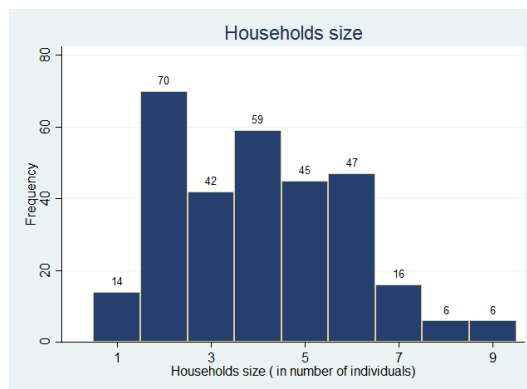


FIGURE 2.4: Sample per Households size

Source :Author. Primary data. Based on a survey of 305 household in 2013

The plots size vary between according to the household size : the more labor force is available the larger is the field. Besides, land access is free and depends only on the ability of the family to clear up the spot and of course, the acceptance of the other villagers to give them access to land. There is no land titling system however customary rights prevail and ownership is acknowledged and granted within the village community.

2.4 Econometric framework

In a probabilistic form, the double difference illustrated above (see equation 2.1 could be written as follows :

12. Punu are native of the area of Ogooué River basin, they are mainly present in Ngounié Province in the south of the country. The Fang are native of the North of the country

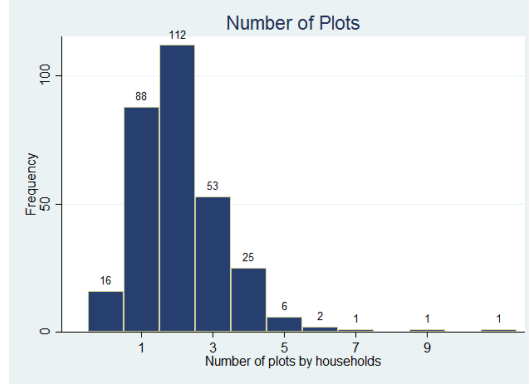


FIGURE 2.5: Number of plots per household

Source :Author. Primary data. Based on a survey of 305 household in 2013

$$\delta = [(\mathbb{E}(y_i|\gamma_i = 1, \tau_i = 1)) - (\mathbb{E}(y_i|\gamma_i = 0, \tau_i = 1))] - [(\mathbb{E}(y_i|\gamma_i = 1, \tau_i = 0)) - (\mathbb{E}(y_i|\gamma_i = 0, \tau_i = 0))] \quad (2.2)$$

Where Y_i is the outcome of interest for each household $i = \{1, 2, 3...N\}$, γ is a dummy equal to 1 after the logging activity started (or when the village is near the active zone of the concession) and 0 otherwise and τ is a dummy equal to 1 when the village is near a Chinese concession (or a near a concession that have finalized its SMP) and 0 otherwise.

The estimator δ is the *differences in differences estimator*. In order to estimate the correlation with the independent variables and its significance when controlling for other socio-demographic covariates, I use the following logistic regression model.

The outcome of interest is y_{ipt} for village p and year t . I_{pt} is a dummy of whether the nearby concession is Chinese (in the first specification) and where the nearby concession has finalized its SMP(in a second specification).

The outcome variable of interest is :

$$Y_i = \alpha_0 + \delta_0 y_i | \gamma = 1 + \alpha_1 y_i | \tau = 1 + \delta_1 y_i | \tau = 1 \gamma = 1 + \varepsilon_{ipt} \quad (2.3)$$

The intercept α_0 gives the value of the variables of interest when the village is not around a Chinese concession nor a concession with SMP finalized and far from the concession activity. δ_0 estimates the change in all villages experiencing the presence of a logging concession. α_1 gives the change for all the villages near a Chinese concession (or a near

a concession that have finalized its SMP) regardless of whether or not the activity has started or not. In other words, it captures the effect that is *not* due to the nationality nor the SMP. The difference in differences is $\delta 1$. It is an interaction variable combining the fact to be near the exploitation zone and close to a Chinese concession or a concession with finalized management plan.

2.4.1 Matching and resampling

The two econometric obstacles faced during the fieldwork were first that the sample could not be randomly constituted as it was not possible to randomly select the respondents, therefore we obtained a set of observational data. The second obstacle is the smallness of the sample. In order to produce valid results given these two restrictions I used a matching method and a resampling method.

2.4.1.1 Propensity Score Matching

This is an observational study in which the assignment to the treated or to the control group is not random, neither is the selection of the respondents in the village. Indeed, the respondents are often the one that are not busy and out the village for field labor or other activity at the moment of the survey. The impossibility of a random assignment of the individuals in the sampling demands a correction in order to minimize the possible selection bias.

Using propensity Score Matching is a way to match the control and treated group on the sociological and demographic variables in order to enhance internal validity. Propensity score matching calculates the probability P to be part of the treatment group given certain characteristics and then, matches the individuals of treated group with the individual of the control group having the closet Propensity Score P . In other words, the matching ensures that each individual of the treatment group is compared to the individual of the control group that resembles him the most.

Formally, Propensity Score Matching produces a Probit using the vector X of observables. In the instance X is made of socio demographic variables namely the gender, the age, the education level and the marital status (see table 5, table 6 & table 7)

P is the resulting the probability of being in a " Chinese influenced " village or being close to a concession with a finalized management plan given the household's characteristics. The probit model is the following :

$$P(\gamma_i = 1|X_{ipt})$$

$$X_{ipt} = age_{ipt}, genre_{ipt}, educ_{ipt}, hh_size_{ipt}, status_{ipt}$$

$$P(\gamma_i = 1|age_{ipt}, genre_{ipt}, educ_{ipt}, hh_size_{ipt}, status_{ipt})$$

The result of the Propensity score matching for both estimated effects i.e nationality and sustainable management plan are displayed in the results section.

2.4.1.2 Resampling method : bootstrap

The smallness of the sample reduces the statistical power and the external validity of the results. Therefore, the using resampling method is necessary in this case. I choose to use a non-parametric bootsratp method. The principle of bootstrap resampling is to use repeated sampling of the original dataset, in the instance all the results use a thousand repetitions¹³. The underlying idea is that it is possible to approximate the distribution of the entire population by using repeated sampling of the original set of data. All the results displayed in the rest of the analysis are using bootstrapped data.

13. for further explanation on technical details see Woolridge and Davison([Wooldridge, 2012](#), [Davison and Hinkley, 1997](#))

2.5 Results

The following section presents the results of the two comparisons, namely nationality effects and sustainable management plan effects on the outcomes variables chosen for the analysis.

2.5.1 Nationality Effect

The population of villages near the Chinese concessions and the ones near the European concessions have very similar social and demographical characteristics as shown by the summaries of descriptive statistics in table 1 to table 4.

The estimation of the equation 2.2 is displayed in the table 8. The raw double difference calculated without controlling for any other variables are only significant at 10% level. They suggest that being close to a Chinese concession is equally perceived as a threat and as an opportunity, which is not impossible : it reflects the mitigated perception within the population. The effect of divergent opinions should be smoothed when controlling for socio-demographical variables after matching.

Indeed, when adding socio-demographical control variables and thus estimating the linear regression 2.3, the results (table 9) suggest that if anything, being near a Chinese company when the logging activity has already begun is associated with a higher perception of threat. This result is only significant at 10% per cent level.

The coefficient *period* captures the effect of logging on the outcome variables for *all* villages. This coefficient is significantly positive at 1% level for the outcome variable "opportunity". It reflects the hopes for employment opportunities that the arrival of a company usually provokes. At the same time, it is also associated with higher insecurity but the coefficient is less significant.

The coefficient "nationality" captures the nationality effect that has nothing to do with logging activities. It shows that there were significantly less conflicts related to land in villages near Chinese concession *even before the logging exploitation started*. The DID coefficient in bold, shows that the only double difference is significantly positive for the outcome variable "threat".

The focus groups and the participatory mapping done during data collection give

some additional evidence very helpful to better understand these results. The villagers near Chinese concessions tend to be more concerned about the scarcity of bush meat resulting from deforestation and also complain more elephant aggressive behavior. This confirms, to some extent, the assumption that Chinese concessions, because they are exploiting a larger range of species, are likely to have relatively higher rate of forest clearing compared to Europeans concessions.

When confronting the results from data analysis to the ones of the focus groups, it appears that the higher expectations in terms of job opportunities are in fact totally gone when a Chinese concession is coming.

2.5.2 Sustainable Management Plan Effect

The measure of the sustainable management plan effect (regardless of nationality) holds interesting results. The estimation of the first and second differences without controlling for any other which correspond to the estimation of the equation 2.2 does not show any significant difference (see table10).

But when measuring the DID coefficient(estimation of the specification 2.3) and controlling for socio-demographic variables, it appears that Sustainable Management Plan is very significantly associated with higher level of threat perception and less significantly to a higher level of conflicts over land.

Once again, qualitative data help to shed some light on this seemingly counter-intuitive result. The social part of the SMP implies that representatives from the nearby concession come to see and discuss with the local population representatives, namely the chief of the village and a group of eldest villagers. This very confrontation triggers more suspicion and fear of being dispossessed amongst the villagers. Paradoxically, in the village where a delegation from the logging company has come to talk with the population, the villagers are much more anxious as to their access to the forest, their ability to keep on hunting and fishing etc. Somewhat, as long as the company has not yet approached the villagers, its presence is less tangible, less concrete so less threatening.

When doing participatory mapping though, it appears that the logging companies who have a finalized sustainable management plan are actually not encroaching on the

villages activity zones (see maps 6,7 and 8)

This reveals two important facts. The first, the process of elaborating a management plan allows the concessionaire to be aware of where the limits of the villagers activity zones. In fact, concession with approved SMP are more respectful of the villagers land access because they have interacted with the local population at least once. Secondly, this result confirms the logging companies' notorious failure to ensure some benefits to the population and to convince the villagers that the access to land and resources they are secured.

2.6 Conclusion and Discussion

This survey contributes to bring evidence on the difference on how different logging practices might be experienced at a microeconomic level by local population.

DID estimations suggest that Chinese concessions are perceived more like a threat than the others. The relation between the higher level of perception of threat and the nationality can only be trusted at 90% from a statistical point of view. But the qualitative data complementing the statistical analysis allow concluding that the main difference between Chinese operators and the others is the substantially higher rate of forest cleaning .

Chinese investors' business model might change over the years as China's growth rate started to slow down - given that the main Chinese operators market is China. Besides, Chinese logging companies have created an Union¹⁴ in order to show their willingness to improve their practices. The demonstrated intention of both Gabonese and Chinese governments to tighten their commercial links makes it obvious that Chinese operators will be in Gabonese forest for several more years.

Several months long field work for data collection shows that relation between concessions and local population are minimum and unproductive. The presence of a concession is worrisome, even when the company is established far enough from the village and is not interfering with the villagers' activity. Even more alarming is the total absence of any form of economic distribution between the concessionaire and local populations. In-

14. Union des Forestiers et industriels asiatiques du Gabon (Ufiag)

ternational certification system such as Forestry Stewardship Council (FSC) with the contribution of influent NGO such as WWF have been promoted so called Free, prior and informed consent (FPIC) principle (Mahanty and McDermott, 2013, Goodland, 2004). In theory FPIC commands a consultation with local population *before* starting the activity (may it be forestry, mining or anything else). The way the social aspects of the sustainable management is conducted in Gabonese forest are far from a FPIC.

Annexes

.1 Descriptives statistics

.1.1 Nationality Effect

variable	N	mean	p50	sd
age	86.0	48.3	48.5	14.3
educ	91.0	0.9	1.0	0.7
hh_size	91.0	4.5	5.0	1.8
genre	91.0	0.5	1.0	0.5

Source : Analysis.dta _Author data

TABLE 1: Villages close to a Chines concession

variable	N	mean	p50	sd
age	138.0	51.3	53.0	13.9
educ	148.0	1.0	1.0	0.7
hh_size	149.0	3.9	4.0	1.9
genre	149.0	0.6	1.0	0.5

Source : Analysis.dta _Author data

TABLE 2: Villages close to a European concession

.1.2 Sustainable Management Plan Effect

variable	N	mean	p50	sd
age	121.0	48.2	49.0	13.1
educ	135.0	1.0	1.0	0.7
hh_size	136.0	4.1	4.0	1.9
genre	136.0	0.6	1.0	0.5

Source : Analysis.dta _Author data

TABLE 3: Villages close to a concession with finalized management plan

.2 Propensity Score Matching

.2.1 Nationality Effect

variable	N	mean	p50	sd
age	103.0	52.5	51.0	15.0
educ	104.0	0.9	1.0	0.7
hh_size	104.0	4.1	4.0	1.9
genre	104.0	0.5	1.0	0.5

Source : Analysis.dta _Author data

TABLE 4: Villages close to a concession without finalized management plan

prob_range	nationality		
	<i>Non_chinese</i>	<i>Chinese</i>	<i>Total</i>
	%	%	%
.1 (n=8)	6.6	0.0	4.3
.2 (n=53)	31.1	23.4	28.5
.3 (n=67)	32.8	42.2	36.0
.4 (n=58)	29.5	34.4	31.2
Total (n=186)	100.0	100.0	100.0

Source : author data

TABLE 5: Matching_Nationality Effects

.2.2 Sustainable Management Plan Effect

prob_range	P_finalized		Total
	Non_finalized	Finalized	
	%	%	%
.3 (n=18)	28.9	16.1	23.7
.4 (n=58)	71.1	83.9	76.3
Total (n=76)	100.0	100.0	100.0

Source : author data

TABLE 6: Matching_Management Effects

.3 Diff in Diff Results

.3.1 Nationality Effect

VARIABLES	(1) SMP	(2) Nationality
age	-0.0155** (0.00688)	-0.00478 (0.00690)
genre	0.151 (0.176)	-0.283 (0.178)
educ	0.0973 (0.126)	-0.105 (0.131)
hh_size	-0.0467 (0.0498)	0.0856* (0.0510)
status	0.0597 (0.105)	-0.202* (0.107)
Constant	0.701 (0.587)	0.475 (0.591)

Observations 224
 Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

TABLE 7: **P** score calculation according to observable variables

.3.2 Sustainable Management Plan Effect

VARIABLES	(1) Conflict	(2) Opportunity	(3) Threat
Diff-in-diff	-0.00830 (0.0449)	0.225* (0.120)	0.253* (0.135)
Observations	240	240	240
R-squared	0.017	0.022	0.032
Mean control t(0)	0.0294	0.750	
Mean treated t(0)	0	0.694	0.444
Diff t(0)	-0.0294	-0.0556	-0.0114
SE diff t(0)	0.0207	0.0953	0.102
Mean control t(1)	0.0741	0.667	0.358
Mean treated t(1)	0.0364	0.836	0.600
Diff t(1)	-0.0377	0.170	0.242
SE diff t(1)	0.0401	0.0702	0.0869

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 8: **First and Second Differences Calculation without covariates _Nationality Effect**

VARIABLES	(1) conflict	(2) opportunity	(3) Threat
Nationality	-0.0423* (0.0256)	0.0684 (0.193)	0.482 (0.456)
Periode	0.0243 (0.0374)	0.471*** (0.135)	0.707* (0.378)
DID(Aftert#Chinese)	-0.00707 (0.0315)	0.101 (0.176)	0.857* (0.464)
Age	-0.000797 (0.00110)	-0.00322 (0.00682)	-0.00991 (0.0130)
genre	0.0270 (0.0241)	-0.00356 (0.128)	-0.568 (0.357)
educ	-0.0215 (0.0145)	0.0415 (0.0989)	0.176 (0.217)
hh_size	0.0146 (0.00960)	0.00646 (0.0395)	0.0799 (0.114)
status	0.0112 (0.0106)	0.0223 (0.0951)	-0.0546 (0.260)
Constant	-0.00817 (0.0900)	1.596*** (0.609)	2.614** (1.180)
Observations	224	224	224
R-squared	0.040	0.045	0.056

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 9: DID estimation with control variables _Nationality Effect

VARIABLES	(1) conflict	(2) Opportunity	(3) Threat
Diff-in-diff	0.0230 (0.0456)	-0.0792 (0.117)	0.170 (0.136)
Observations	240	240	240
R-squared	0.022	0.006	0.022
Mean control t(0)	0	0.667	0.436
Mean treated t(0)	0.0308	0.769	0.462
Diff t(0)	0.0308	0.103	0.0256
SE diff t(0)	0.0219	0.0896	0.0983
Mean control t(1)	0.0308	0.723	0.354
Mean treated t(1)	0.0845	0.746	0.549
Diff t(1)	0.0537	0.0234	0.195
SE diff t(1)	0.0400	0.0746	0.0845

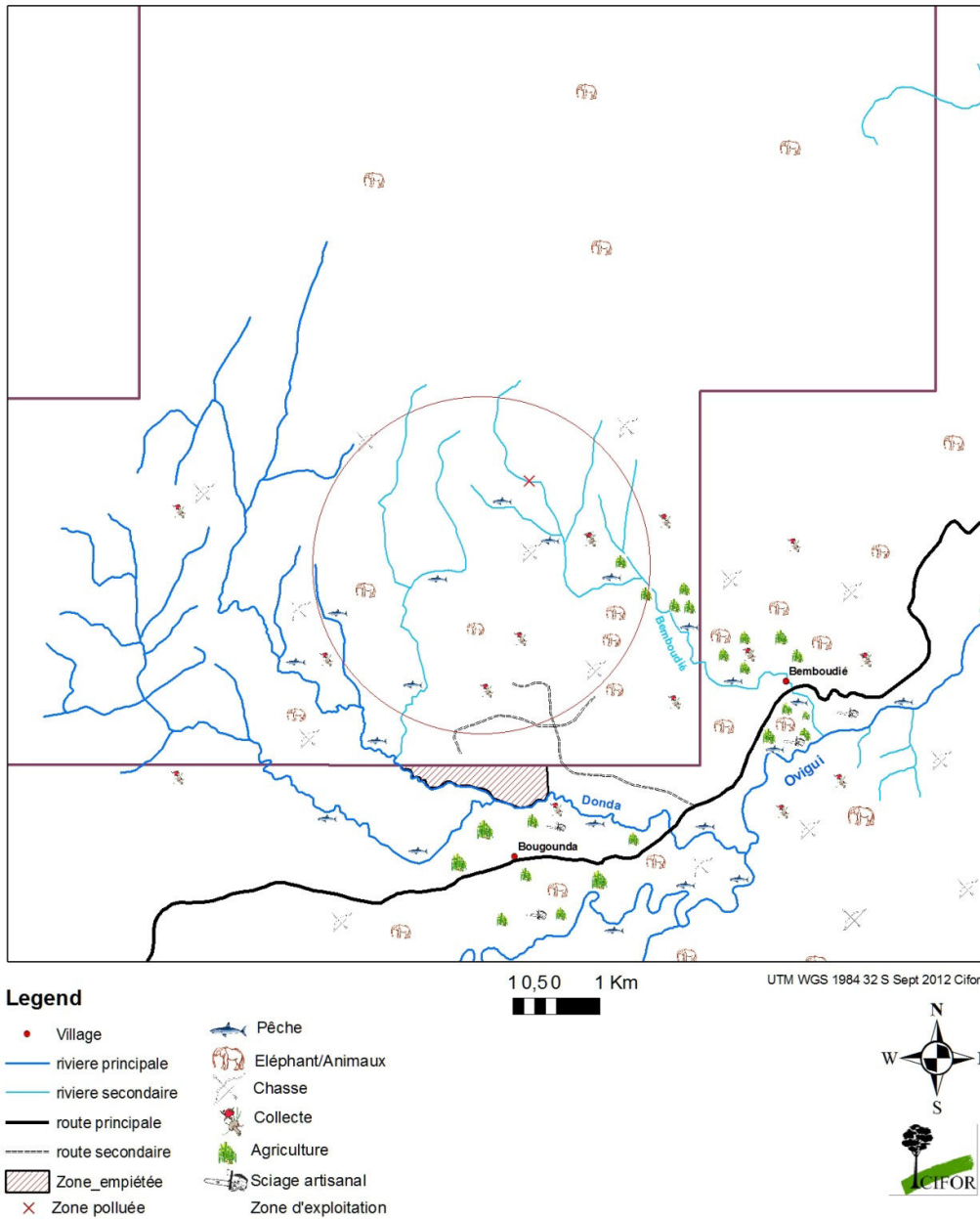
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 10: **First and Second Differences Calculation without covariates _SMP Effect**

VARIABLES	(1) conflict	(2) opportunity	(3) Threat
SMP finalized	0.0434 (0.0292)	-0.00587 (0.199)	0.279 (0.548)
Periode	0.0318 (0.0211)	0.168 (0.270)	0.289 (0.404)
DID (After#smp))	0.0704** (0.0284)	0.417* (0.214)	1.239*** (0.452)
Age	-0.000482 (0.00123)	-0.00262 (0.00738)	-0.00700 (0.0139)
genre	0.0285 (0.0274)	0.0126 (0.135)	-0.627* (0.346)
educ	-0.0218 (0.0140)	0.0412 (0.0902)	0.152 (0.276)
hh_size	0.0142 (0.00888)	-0.000327 (0.0445)	0.0853 (0.110)
status	0.0130 (0.0103)	0.0340 (0.0979)	-0.0775 (0.226)
Constant	-0.0689 (0.0792)	1.572** (0.669)	2.572* (1.510)
Observations	224	224	224
R-squared	0.042	0.034	0.075

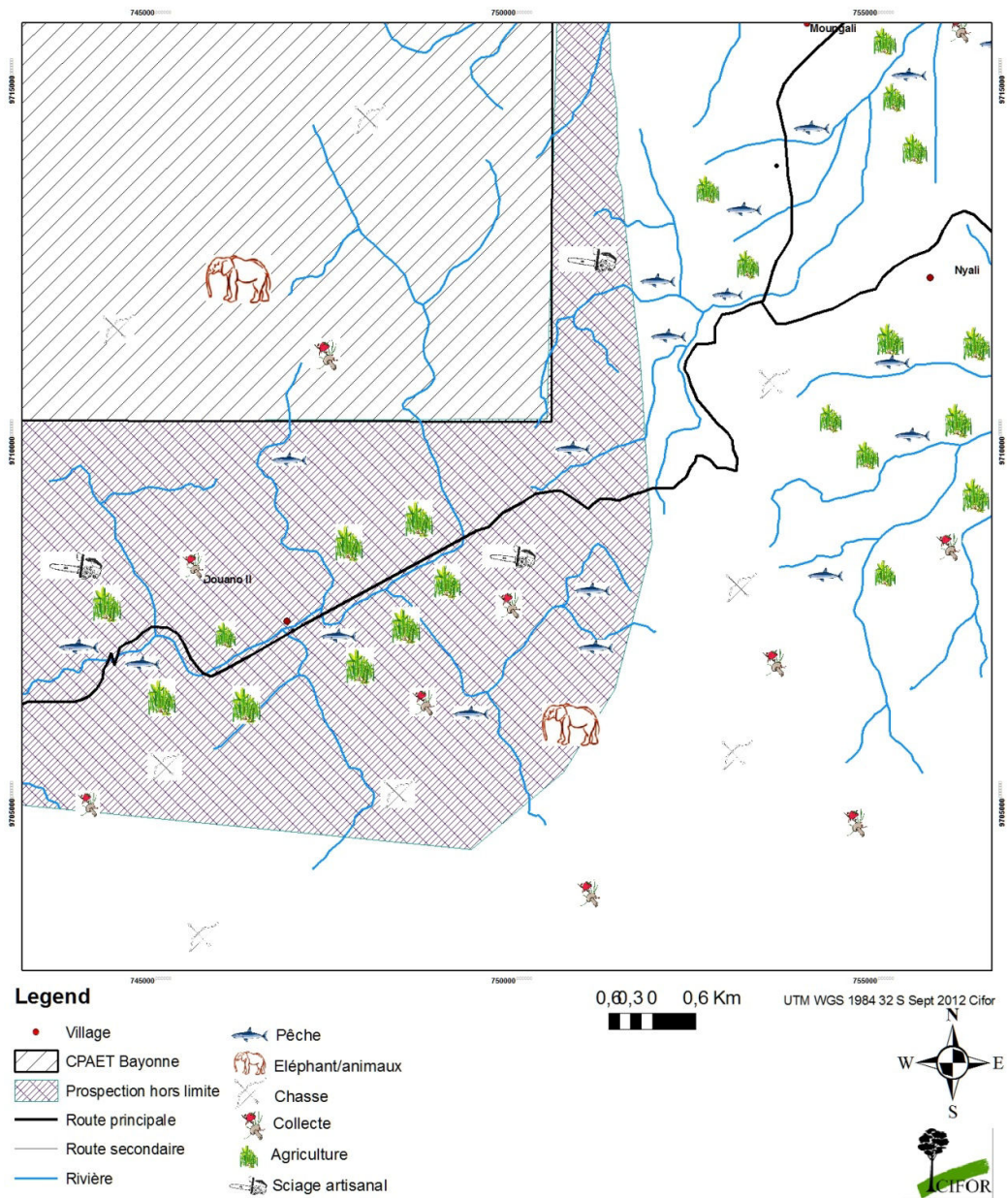
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 11: DID estimation with control variables _SMP Effect



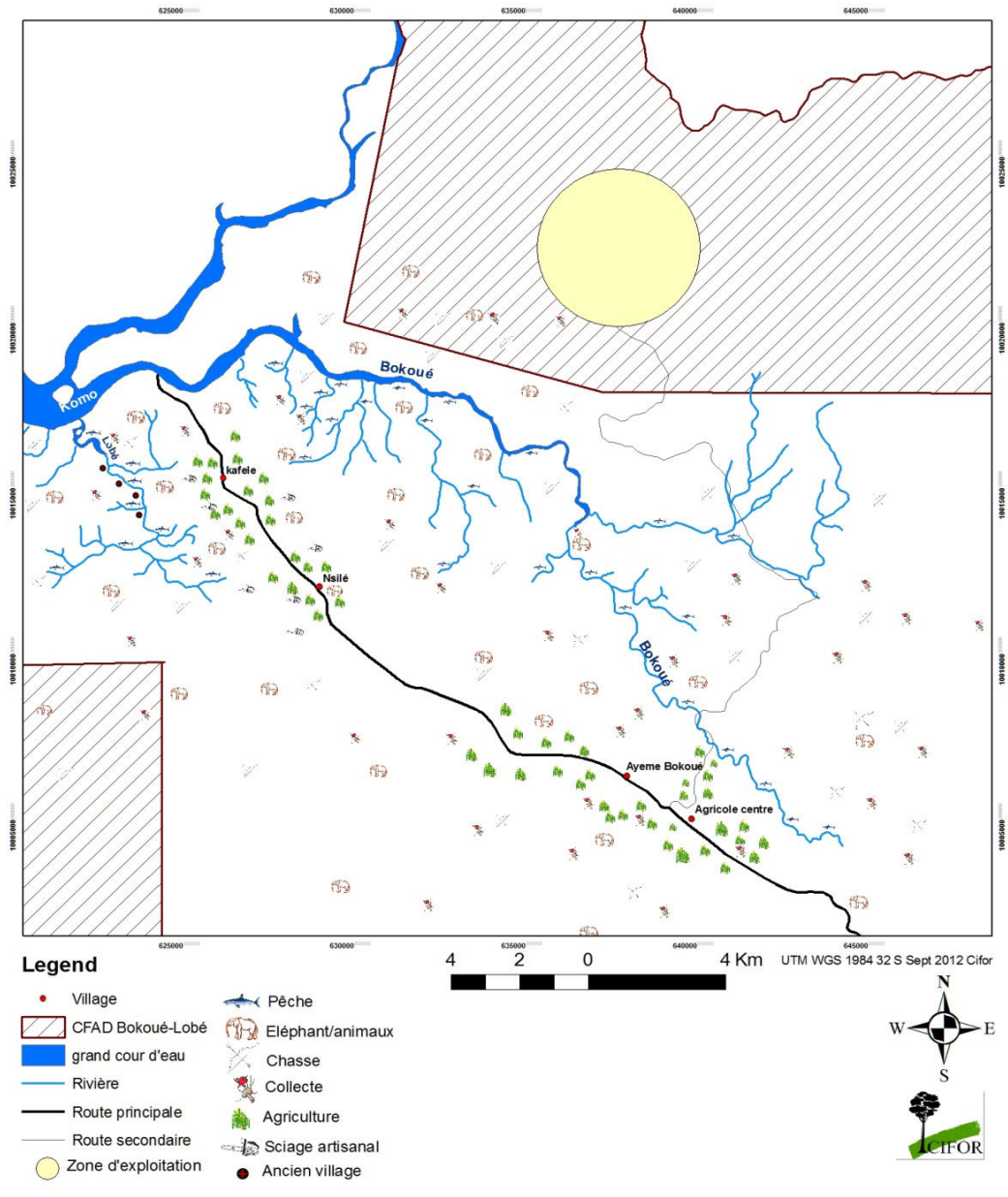
Source : Author data. Participatory mapping with willagers of Douano and Nyali_ July 2013

FIGURE 6: Concession without finalized SMP (CPEAT)



Source : Author data. Participatory mapping with willagers of Boungounda and Benboudié_ July 2013

FIGURE 7: Concession without finalized SMP(CPAET)



Source : Author data. Participatory mapping with willagers of Kafélé and Nsilé_ July 2013

FIGURE 8: Concession with finalized SMP (CFAD)

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Chapitre 3

Agro-industrial production and revenue distribution : The Case of Natural Rubber Plantation in Gabon

Abstract

Natural rubber production is in line with Gabon's natural resource-based development. It was promoted in the Northern part of the country since the 80's with the support of international institutions funding, namely the World Bank. The establishing of rubber plantations along with a rubber transformation unit was thought to bring regional economic development and generate additional exportation revenues. Some local farmers were enrolled in the so-called villager program and became rubber producers - also called outgrowers. At the same time, the rubber sector became the first source of employment in the region. The present study compiles data from different sources and analyzes the economic situation of both workers and outgrowers. It reveals that the potential revenue improvement of being a rubber outgrower (versus being a worker) is undermined by the monopolistic position of the recently privatized firm.

3.1 Introduction

Gabon is no exception to the land conversion occurring in other middle-income countries endowed with tropical forest. Among the different land-based development activities requiring forest land conversion (agricultural expansion, cattle, quinoa cultivation, palm oil plantation, cacao cultivation) rubber trees plantation or hevea plantation is the most common in Gabon. Palm oil plantation and cocoa cultivation exist but both are marginal compare to hevea. Also, hevea cultivation has a longer history and is more entrenched in Gabon, especially in the northern part of the country (Woleu-Ntem province). The common ground between production of such cash crop plantation and logging is that both induce economic development through export revenue increase. However, unlike industrial logging, rubber plantation results in deforestation as it consists of the *conversion* of forest and woodlands to rubber tree plantation¹. The second major difference between these two activities is the impact on local population. Rubber cultivation is actually very labor intensive when logging is essentially capital intensive. As a result, the economic revenue distribution is split between profit and wage. Besides, the outgrowing model of production consists in outsourcing a part of the production to local farmers, which translates into more comprehensive inclusion of local people in the development of the sector. This chapter focuses on the second difference and gives an insight of the ways local workers and framers participate to and benefit from rubber plantation. The idea of building a strong and competitive agro-industrial sector in Gabon originated from the middle of the 60's. Climatic conditions, land availability and the perspective of an increasing international demand for natural rubber (Chamon, Mauro, and Okawa, Chamon et al., Fischer et al., 2008) led the government to implement a vast program to boost rubber cultivation with the intent to become a leading rubber producer in the sub-region. Thirty years after the launch of the first rubber project, rubber cultivation is still in the government's agenda. However, the institutional framework and the scale of rubber implementation have changed. The unique company of the sector was state-owned and became private after being purchased by the Belgium group Siat. In 2013, the government has reached an agreement with Siat, who has been authorized to undertake a significant scale-up of its rubber

1. See literature on deforestation (Pfaff, 1999, Barbier and Burgess, 2001, Geist and Lambin, 2002, Ferreira, 2004, Chimeli et al., 2012).

plantations area while the Singapore-based multinational Olam obtained 50,000 ha of land for the establishment of a rubber plantation. The Gabonese government willingness to facilitate private corporations' access to land coupled with the increasing volume of FDI's in Gabon results in a new model of development where multinationals are given a predominant role in cash crop production which used to be state-owned sectors.

The process of collecting rubber tree sap (which after being processed in factory becomes natural rubber) is known as tapping. It can only be done by workers as there is no mechanization of this work. Input production heavily relies on labor productivity. The straightforward way for a company to increase its input provision is to acquire new land, hire more tappers (natural rubber collectors) and train them (the process of tapping requires learning and training ([Aso, 2011](#))). This option involves extra costs for the company as it has to provide meals and accommodation to the workers who would be a part of the time living on the plantation site (which are located far from city centers). That option facilitates monitoring and control of the production.

The second option is to convert local landowners or local farmers, initially farming their plots for agriculture for instance, in rubber producers and to buy their production. In this case, monitoring of the production is left to the producer himself. He will also have to bear the production costs. The main advantage of that option is to increase the plantation surface without having to undergo the costly administrative process of acquiring new land. From the tapper perspective, being employed insures a fixed revenue and it guarantees coverage of basic needs. It is also a stable source of income for his household and could conveniently be coupled with more variable revenues, such as the ones from farming. On the other hand, becoming an outgrower could yield a sizable increase of income but it also means bearing the risk of price and production fluctuations. The question is then, in the current context of rubber production expansion, which of these two co-existing models is, in the long run more, beneficial for the local population. Shall the government promote an extension of the villagers program or further promote the development of industrial rubber plantation allowing more firms to have more land and generate more employment?

The data and information displayed in this analysis have been collected in Gabon between October and November 2013 through interviews with corporate representatives

of Siat-Gabon and villagers in Woleu-Ntem province. In addition, focus groups were organized in villages around Siat concessions.

Based on collected data I estimate and compare worker and outgrower revenues. This comparison is also taking into account some qualitative element on life satisfaction based on the interviews conducted during field work.

The following section gives an historical background of rubber cultivation in Woleu-Ntem region and presents the key figures of rubber production evolution, section 3 presents the data and details the empirical strategy, section 4 gives the revenue estimations compiled with the data and finally section 5 discusses the results.

3.2 Project history and planning : From national to private ownership of rubber production

History of rubber tree plantation in Gabon began in the middle of the 20th century during the colonial time. The Second World War and the following reconstruction considerably increased Europeans allies demand for natural rubber and led to the introduction by the French colonial authorities of hevea cultivation in the province of Woleu-Ntem in Northern Gabon and in Southern Cameroon. In Gabon, between 1942 and 1945, 710 hectares of land had been converted into rubber cultivation in the form of multiple small-holders rubber plantations located around three cities of the province : Oyem, Bitam and Minvoul (Ovono Edzang 2008). The idea was to first get farmers to learn and adopt rubber cultivation and then expand it to an industrial dimension in the province and throughout French Equatorial Africa². This ambitious project never resulted in the sought industrial rubber cultivation but has nonetheless paved the way for the establishment of the actual rubber industry in Gabon.

At the end of the 70's, as part of its rural development program and to ensure the necessary conversion of the economy in prevision of the post-oil era, Gabonese Government decided to reinstate rubber cultivation. The objectives were to introduce an economic activity in rural areas, create jobs in rural areas and by doing so to increase local incomes,

2. French colonial territories include the actual Congo, Central African Republic, Gabon and Tchad

and generate higher growth at a national level through the export revenue of a cash crop.

Only 200 hectares of plantations remained from the 710 hectares established between 1942 and 1945 (Ovono Edzang, 2008). Most of them disappeared over time, supplanted by cacao production during the 50's or by local traditional-crop production such as banana or cassava. But even if rubber-related activities were then marginal in Woleu-Ntem, the region continued to be the historical center of rubber cultivation and the only part of the country where some people, however very few, have experienced rubber tree plantation and latex harvesting.

Also, Woleu-Ntem is a province of Gabon with a long tradition of agriculture (MEZUI 2009) which makes it a potentially good place to start an agro-industrial activity. It has not suffered so much from the rural exodus that has progressively emptied the countryside of other parts of Gabon during the post-independence decades. This is partly due to cultivation of export crops such coffee and cacao that had taken place in the province during the second part of the last century and allowed the emergence of rich farmers possessing large fields. Besides, the region borders Equatorial Guinea and Cameroon, which facilitates across countries exchange all the more so that people of the area are from the same ethnic group. Labor exchange is particularly important through migration flows of workers between the countries and rubber cultivation is labor intensive (Nguema Engo 1997). In 1981, the Gabon Rubber Cultivation Development Corporation Hévégab was created with its main site in Mitzié, Woleu-Ntem. It was a public limited liability corporation : the state owned over 90% of the capital. Hévégab was entrusted with the establishment of industrial plantations and with the implementation of the villagers program (VP).

3.2.0.0.1 Development of the industrial block Gabon obtained a loan from the ADB, the main donor³, of nearly 40 million USD (African Development Bank 1994)⁴ to finance Mitzié Rubber Project which had an initial target of planting 10,000 ha of forest land with rubber trees. The donors, deeming that goal too ambitious given financial resources it would have demanded at the time, required a reduction of the objective at

3. The Rubber Development Program in Gabon was mainly financed by ADB with smaller contribution of the France's Caisse Centrale de Coopération Economique (CCCE) and the Development Bank of the Central African States (BDEAC).

4. This value is expressed in current USD of 1981 not in constant USD.

3,300 ha. This target of 3,300 ha was achieved satisfactorily, so Hévégab received more financing from the donors to extend the project with the construction of the factory in Mitzié and the establishment of a 2,000 ha plantation in Bitam and another 2,000 ha plantation in Kango see table 5. Mitzié was and remains until now, the industrial core where the whole production from Bitam, Kango and individual producers is ultimately transformed into crumb rubber and exported. Between 1993 and 1998 the production of Hévégab had been fluctuating but showed an overall increasing trend (table 1); in 1995 the annual production was of 5,100 tons, it progressed by 42% increase to 8,214 tons in 1996 and culminated at almost 10,511 tons in 1998 (African Development Bank 2003). Despite this fast-growing production, Gabon had hardly a share of 1% of the total world rubber production (Nguema 2005), the South Asian countries were challenging competitors while Gabonese rubber industry still relied heavily on its donors financing. In 1998, the contraction of the rubber demand in Europe led to a decrease of 23% of the international price of rubber (from 389 CFA/kg to 297 CFA/kg). The corporation was not strong enough to survive this adverse shock and ended up facing substantial liquidity problems. The corporation failed in reimbursing its loan and could not even pay the wages of the staff. In 1999 Hévégab produced only 4,000 tons of rubber. In 1999, donors withdrew from the project and stopped their financing. The financial situation was such that the corporation had to stop all the activities in March 2000. Privatization of the agro-industrial firms, including Hévégab was in discussion since 1998 given their poor performance. In 2004, Hévégab was finally sold to the Belgian group Siat, after four years of non-activity.

3.2.1 The villagers program

Hévégab's target was also to re-introduce rubber cultivation within the local agriculture and to develop a network of small holders' rubber plantation, hence the elaboration of the VP launched in 1988. The program consists in assisting the villagers enrolled in the program to maintain the immature crops and provide the necessary training for tapping once the crops are mature.

The farmers eligible to be part of the VP could be either men or women, between 21

and 49 years old. The candidate-farmer must be based in the village where the plantation is established or else have relatives living in the village who can take care of the plantation. Also, the land villager intends to use for the plantation must be registered - i.e. it should be a formally titled property, recognized as such by the chiefs of the village and the district administration. Villagers enrolled in the VP would be provided with complete assistance in the planting of the stumps and the maintenance of the rubber trees. Besides, they would receive a loan of 2 million CFA per hectare to sustain incomes during the maturation period of the trees. The loan was interest free and reimbursable in 7 years.

A special part of the villager program was dedicated to bigger land owners who do not live in the village but have sizable fields in the countryside. They would have to dedicate at least 10 ha of land to rubber cultivation and must pay a lump sum of 150 000 CFA per hectare to Hévégab. In return the corporation is detaching a group of workers to fully taking of care of the establishment of the plantation. These workers were paid by Hévégab, the landlord only has to provide them with food and accommodation.

In order to keep the outgrowers' income from fluctuating as much as the international market price might do, Hévégab instituted a stabilization fund for which the farmers were asked a monthly contribution of their rubber revenue⁵. The only counterpart that Hévégab is asking from the farmers is their commitment to sale their production to Hévégab only.

The relatively high rate of enrollment in VP amongst the farmers (Table 1) owes to the comprehensiveness of the support it provides to the outgrowers. However, despite the first positive response of local people to the re-introduction of rubber in the region, there is a common mistrust of the ability of the state to sustain such a program in the long run; the privatization of Hévégab will prove them right. The experience of the failure of cacao has shown the local producers the uncertain and unpredictable nature of the revenue coming from export-dedicated cultivation; therefore they expect a permanent support of state (through Hévégab) in bearing the high risk associated with cash-crop cultivation.

When Hévégab was sold to Siat in 2004, the agreement between the Belgium group and the Gabonese authorities specified that all the outgrowers part of the VP would

5. Information from the author's field work interviews.

continue their activities. Siat committed not only to purchase all the production of the existing outgrowers but also to expand the production through village plantation. But the Belgium company made it clear that it would not maintain the VP in its form : the financial weight of the VP was considered prohibitive by the new owner.

As for the industrial plantations, Siat inherited a long-term land use right over all the plantations of Hévégab with emphyteotic leases as land is the exclusive property of the state in Gabon, ownership of the land cannot be private. Not only did Siat receive the land use right over the area under production but also on the area where Hévégab planned to plant but never achieved to expand its activity.

The bankruptcy of Hévégab and the other SOE in agro-industrial sector is illustrative of the failure of Gabon to initiate a sustainable industrial development strategy based on public funds. The achievements of Hévégab are in many aspects far below the initial targets. Indeed Gabon's rubber production master plan aimed at 28,000 ha planted by 2002 and a production of 13,000 tons of rubber per year, but when the activity stopped in 2000 less than 9,000 ha were under production and the production highest level was of 10,000 tons per year (Table 1). As a result the contribution of rubber to the overall economic growth remained marginal (Nguema 2005). All the production of rubber was exported but Gabon stayed far behind the biggest African rubber exporters namely Ivory Coast, Liberia, Nigeria and Cameroon (Ovono Edzang 2008).

In terms of job creation, Hévégab had created 1,200 jobs including maintenance workers and tappers over the 3 sites of Mitzic, Bitam and Kango but these jobs were not permanent and paid less than the income provided by banana or cassava cultivation on a one-hectare field. Therefore there were no significant shift of the activity from traditional agriculture to rubber cultivation or rubber-related work. The VP relative success, according to the completion rate (table 2), was mitigated by its heavy reliance on public funding and the failure to attract as many big land owners as it was designed for in the first place.

3.2.2 Data

The data were collected in between October and November 2012. The majority of the production figures and prices come from SIAT records. In addition, focus groups gathered the workers on SIAT plantations and outgrowers in four villages around Mitziac and Oyem. The data on production of both plantation production and villagers' production come from SIAT record. For the period 2006 to 2012 the annual production of Siat-Gabon rubber increased (see graphic 2) and the entire production was exported mainly to Europe and the US. The contribution of outgrowers to the total rubber production was 15% in 2012 of the total annual production. Table 6 displays the evolution of the outgrower cultivated surface between 2006 and 2012. The constant increase is due to new outgrowers enrollment and the rubber trees attaining their maturity. The production per hectare (see Figure 3) shows a constant increase of SIAT productivity over the period while outgrowers productivity experienced a slowdown between 2008 and 2012.

3.3 The theoretical framework

In order to decide which of status, worker or out-grower, should receive the most support and promotion from policy makers, it is critical to understand the hevea production process and the *constraints* associated with that process.

3.3.1 hevea plantation cycles

Rubber production is a cyclical production ; the productive time of a plantation is of 30 years, which is the natural life time of an hevea tree. The productive age of a rubber tree is between 5 years and 30 years, past that age, the tree does not produce rubber anymore. The trees should then be cut and replanted in order to have a productive plantation again, 5 years later. Moreover, the production of natural rubber is not steady through time : it increases until it reaches a peak and then becomes a decreasing function of time ; the older the trees get, the less rubber they produce.

This production cycle mimics the bell shape of any natural (exhaustible or renewable) resources. Following the rule of optimal exploitation of such natural resources, the way to

obtain maximum production is to establish a form of rotation and have several plantations planted at different moments in time and whose cycles are conveniently overlapping each other ensuring a smoother production through time. In that aspect, Hevea cultivation resembles Faustmann model of optimal forest rotation (Peyron and Maheut, 1999, Viitala, 2006), where optimal production is obtain by rotations between different plantations. The diagram in Figure 1 illustrates the cycle of production of a rubber plantation.

However this ideal configuration is not always feasible. Indeed, in reality, such a planting scheme requires land availability and land access.

On that note, Siat had somehow benefited from the legitimacy of being the successor of Hévégab which has facilitated its establishment and its access to more land. The Belgium company's social policy to invest 1% of its annual revenue for in infrastructure for the villagers (road, dispensaries, schools and water poms, supply facilities) is inherited from the former state owned Hévégab and is somewhat the compensation of its extensive land appropriation. In prevision of its extensions, Siat started early 2013 a consultation of the villages around the new concessions in Kango with the aim of achieving the signature of a Free, prior and informed consent (FPIC) by the end of 2013. Siat rubber plantations (except for the one the concession in Kango) are located at more than 8 km away from the road and from the villages which helped to maintain social peace. But Siat had encountered social problems around its palm plantations where conflicts on land use with villagers are still unsolved and blocked the extension of the project. In that case, the new concession literally covers villager's agricultural plots and some of them were destroyed as Siat proceeded to the forest cutting. The owners of the ravaged plots were paid compensations but that was not enough to overcome villager reluctance to even negotiate with Siat.

The episode illustrates how difficult -and costly- it might be to acquire land and be able to secure a constant production, following an optimal plantation scheme (i.e to anticipate the decline of one plantation's production and to have a new one coming to maturity, compensating the losses of the old one).

Given this state of affairs, I will analyze in the following parts the strategy of the firm and the resulting situations of the worker (tapper) and the outgrower.

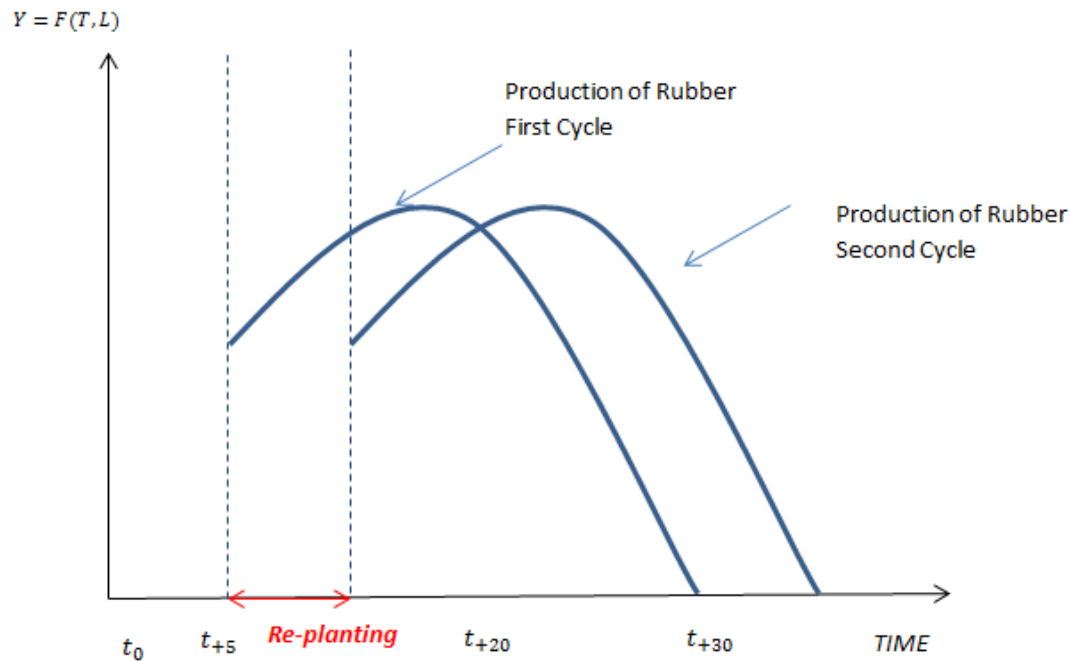


FIGURE 3.1: The rubber plantation production cycle

3.3.2 Actors strategies

The firm

Because of the difficulty to access land for large scale plantation, production from the outgrowers is a crucial adjustment variable.

The enrollment of outgrowers used to be a matter of local development. Since the privatization of the firm, it became the outcome of an arbitrage between the price paid to the outgrower for his production and the total cost of production for the firm (including the land acquisition cost).

In other words, the price paid to an outgrower for a kilogram of rubber should not exceed what the firm's production cost is for that same kilogram of rubber *plus* the spared opportunity cost of not having to pursue new land.

The production is very labour intensive; the main cost of rubber production is the tapping cost. For simplification, I therefore assume that the production cost for the firm is equivalent to the worker(tapper) wage.

In the instance, the firm is in a monopolistic position; there is no competitors that could possibly take some of the potential outgrowers away from it - by offering a better

price per kilogram.

As there is no competition (yet) the firm is price maker, and therefore sets the unitary price according to its profit-maximizing strategy. For the firm, this means maintaining the price just slightly above the wage (its production cost). The price *has to be slightly above the wage to create an incentive to be an outgrower*. In this case, the firm is not taking any risk as the outgrower revenue is directly proportional to the production, there is no agent-principal problem inherent in farming contracts (Glover, 1990a,b, Key and Runsten, 1999). The production is not paid ex-ante and there is no ownership sharing or rent involve in their relation (the outgrower is owner of his plot). The risk of not producing enough, regardless of what is that sufficient level of production, is entirely supported by the outgrower.

The outgrower

The villager is producing rubber and has to make an investment in order to clear out the forest off his land plot, buy the stumps (the trees roots), plant them and insure a careful maintenance until the trees are grown enough to start producing some latex. Amortization I of the initial investment is considered a fixed cost evenly distributed on each year of exploitation and discounted at the rate r , assuming a 30 year old cycle of exploitation. For simplification, the cost of maintenance for the plantation to grow during the 5 first years is included in I .

In reality this payment is made at once. This is one of the crucial point, becoming an outgrower implies to either have enough savings to make the first investment or to have access to credit. The lack of effective credit markets being a strong limiting factor to investment in the developing countries is a well-known issue (Stiglitz and Weiss, 1981, Williamson, 1987, Rosenzweig and Wolpin, 1993, Ray, 1998, Mookherjee, 1997). The case of rubber outgrowers in Gabon illustrates the problematic : Hévégab did not only support the outgrowers technically it was also providing them with loans. SIAT does not offer that possibility any longer. This results in a natural selection amongst the population : those eligible for being outgrowers are those who have enough financial capital or social capital⁶.

6. The capacity to raise fund from the family or the community (by being involved in a tontine, for instance) depends on the social capital

The second pre-requisite to become an outgrower is to have a permanent access to a plot. Land ownership or free access are in this case equivalent⁷ as long as tenure security is granted. The sine qua non condition for a villager to be eligible as an outgrower, is the insurance that he cannot be evicted from the land he is working on. Once these two conditions are fulfilled, the question for the villager is whether or not he will be better off becoming an outgrower which could be rephrased as *what is the opportunity cost of becoming an outgrower?* The opportunity cost of becoming an outgrower is the forgone revenue of whatever other activity the villager would have to give up in order to become an outgrower. If the choice is between working as a tapper or becoming an outgrower, the opportunity cost is the wage⁸.

If the wage w is known, which is assumed to be the case, then the opportunity cost is known as well. The revenue of the outgrower is the price p at which the company is purchasing each unit of the production Y . The company decides the price per kg of latex. This price fluctuates without any minimum guarantee price⁹.

The farmer is indifferent between being a worker or an outgrower when for each period of time t

$$Y_t \cdot p = I/30(1+r)^{30} + w_t \cdot Y_t$$

or

$$p = I/Y30(1+r)^{30} + w$$

Graphically, the revenue differential B has to be superior to the initial cost A discounted at the rate r . The villager is better of being an outgrower if at any point time p is exceeding the wage and the fixed cost (amortization of the initial investment).

7. For further developments on free land access and ownership, see ([Ostrom, 2000](#)) and her answer to the famous Harding's article *The tragedy of commons* ([Hardin, 1968](#)).

8. If we keep time for leisure and its attached value out of the model for simplification. We assume here that SIAT is the only company demanding labor in the region, which is pretty much the case.

9. During Hévégab time, there was a minimum guarantee price. The vulnerability of commodity producers to international price variation has led to the idea that setting a floor price is the best way to reduce uncertainty of revenue. However other instruments such as futures could work as well as demonstrated by Lence in his very good article "Do Futures Benefit Farmers?" ([Lence, 2009](#), [Assemblée-Mvondo et al., 2013](#), [Key and Runsten, 1999](#))

Stated differently, the outgrower chooses to be an outgrower if the price he receives is higher than the wage he would be paid as a tapper and covers the initial cost of starting the plantation.

The worker

The tappers are hired and trained by the company ; they lived on the site in the workers camp and are lodged and fed by the firm. The firms controls there daily production : each worker brings back the harvested rubber of his day of tapping, this volume is recorded and at the end of the month, the worker receives his wage which is calculated per kilogram.

The tapper revenue is not a fixed wage but is a linear function of his productivity which in turns depends on the plantation production.

The average land productivity is decreasing over time to reach zero after 30 years. It represents how much of latex one hectare of rubber trees produces per day. The tapper revenue is following that same trend (as a linear function of the production).

The average productivity of the tapper is *constant and maximum* as long as one hectare of land produces per day *more* than what a worker can tap in one day. As long as the tapper production is not binded by the limits of the trees production (due to the aging of the plantation), he will collect as much hevea as he possibly can in order to maximize his wage.

The moment the trees production of hevea starts to decline, around 20 years after the plantation has been planted, the tapper cannot work at his full productivity anymore and his workforce is being underused.

The level of wage is the highest at t_{+20} ¹⁰, after this time the production per hectare starts to decrease. Past the critical point, a price adjustment occurs on the labor market and the wage is expected to fall. According to this theoretical model, the worker income is the highest during the first two decades of the plantation and then decreases due to the price adjustment on the labor market.

The equilibrium

The monopolistic position allows the firm who decides both purchasing price of the

10. According to the technical staff met during th field work, the plantation production started to decrease since 2010 and SIAT imposes a rationing to the tapper collection

outgrower and wage of the tapper. The firm strategy is to minimize its costs and to maintain its pool of outgrowers. The firms minimize its cost by regulating the tappers production when the plantation starts to produce less and by keeping the purchasing price just slightly above de wage.

The outgrower wants maximize his revenue. As there is no other companies to whom he could sell his production at a higher price, the only way he can increase his revenue is by producing more. As the outgrower can only adjust the quantity, he as an incentive to potentially convert more land into hevea plantation.

The tapper wants to maximize his revenue by producing as much as he could within the limits imposed by the firm.

In such equilibrium, the labor force (of the tapper) is being underused and the revenue (of the outgrower) is being underpriced. The equilibrium can remain stable only in monopolistic conditions.

The following section estimates and compares the revenues of workers and outgrowers, using the available data to verify the facts stated above.

3.4 Results

3.4.1 Industrial plantation versus outgrower production

Rubber production dry production ¹¹ between 2006 and 2012 is given by Figure 5, based on SIAT figures. It shows an increasing trend until 2012 of the total production (i.e the cumulated production from outgrowers and from the industrial plantations). The production data from the Ministry of Economic Affairs (Figure 6) displays the production of natural rubber and its dry rubber equivalent (i.e. after processing) from 2009 to 2016. The graphic indicates a change in the trend of the production of natural rubber in 2012, before that year the production increased while after there is a constant and steady decrease. The production of dry rubber follows that trend, even though the evolution is smoother.

The reversal point of cycle of production where the production starts to decrease

11. After being collected, natural rubber (or latex) is processed in factory and come into dry rubber either in the form of granulate

due to the aging of the trees is 2012, almost twenty years after the beginning of the exploitation (see Table 5).

The production of the outgrowers shown on the Figure 5 is the production from the 600 villagers enrolled in the villagers program in 1988¹². The maturity of their rubber trees is similar to the one of the industrial plantation - the first bleeding started in 1993. Their production increases as well between 2006 and 2012. There is no data available for the outgrower production after 2012, but it is safe to assume that the production has followed the same decreasing trend than the industrial plantation since they were planted at the same period of time. Between 2004 and 2012, SIAT contracted with 102 new outgrowers, for an additional 313 hectares of rubber plantations. The newest of them were still at the very early stage of planting at the time of the study while the earliest farmers had started to collect rubber for two to three years. Because of this non-homogeneity in the stage of their exploitation, these new comers are left out of the comparison exercise. I only use the sample of the 600 initial outgrowers.

The productivity is the ratio of the final product (i.e. dry rubber) over the surface planted (in hectares). The comparison between outgrower productivity and that of industrial plantation (see Figure 7) shows that the company has better yield than outgrowers. The main reason of the productivity difference is the highest tree mortality amongst outgrowers resulting in an average of 300 to 350 trees per hectare in the villagers' plots against 500 trees per hectare in the industrial block. The reduction of the mortality would imply additional fixed cost (mainly consisting in labor for tree maintenance) and specific training as it involves a set of technical skills and knowledge the outgrowers do not necessarily have. This graphical evidence demonstrates that the rubber trees on both SIAT plantations and outgrower plots are at the end of their natural cycle of rubber production. The productivity between the plantation and the outgrower is only due to the highest mortality rate amongst trees in villager plantation. The company by enhancing the transformation process has a leeway to adjust the production to the price despite a very strong natural constraint of the rubber production.

12. All figures and data come from the author during field work in 2013, unless specified otherwise.

3.4.2 Who is better-off : Tapper or outgrower ?

The worker

In 2013, SIAT employed 300 workers at the factory (there is only one production unit) and 375 tappers working in the fields collecting latex. Using the information given by SIAT and the one coming from tapper interviews at the concession, the revenue of a tapper is computed as followed :

	Production (in kg)	Nb of trees	Average wage per kg (in)	total wage (in)
2013				
Daily	155	350	0.05	7.75
Monthly	3,875	8,750	0.05	193.75
2009				
Daily	221	500	0.05	11
Monthly	9,375		4,500	275

^a All the amount have been converted from CFA to using the fixed exchange rate of 1= 655,957 CFA and rounded up to the next highest number.

TABLE 3.1: Estimation of the tapper monthly wage

The tapping work consists in using a special tapping knife to shear off a thin layer of rubber tree's bark. The latex flows into the cup attached to the tree. By noon or early afternoon, the latex will have stopped flowing and the rubber tapper will then go back to each tree and empty the latex collected in the cups. This task can only be done by labor force as the process is not mechanized at all. In one day a worker could possibly do that operation to up to 850 trees if a second worker helps the collecting work. One single worker can thus possibly tap and collect the latex from a maximum of 500 trees (1 ha) per day¹³. However, as illustrated on Figure 2, the worker productivity depends on plantation age : the older the tree the less latex it gives. The cycle of production in this case is reaching its end, hence a rather low productivity. For that reason, the workers are limited to 350 trees per day. That production, payed at the average rate of 32 CFA (0.05) per kilograms of rubber. The legal minimum wage in Gabon is 80,000 CFA per month which is equivalent to 120 . The wage of a tapper is then significantly above the minimum wage. Besides this wage is obtained by tapping 350 trees a day, when a tapper average productivity could be of 850 trees but due the decreasing production of the trees

13. Estimation coming from interviews with tappers in Mitzik workers camp and confirmed with the operational manager in charge of tapping activity.

in the plantation. In theory, the wage could be up to 470 which is almost four times the minimum wage.

As expected in the model from the previous section, the aging of the plantation induces a severe wage decrease for the workers, it does not translate into a diminution of a wage *per se* but the restricting production per worker is in fact restricting wage, as the wage is exactly proportionate to the volume extracted. The way the wages are controlled is by setting a maximum volume of latex per worker.

According to SIAT records and tappers interviews, in 2009 the maximum production per worker was 500 kg per worker on average¹⁴, at the end of 2013 at the time of the survey, the maximum was lowered to 350 kg per worker on average. The revenue of the workers decreased by 30% in 4 years and is expected to decreasing again.

The outgrower

The cost and revenue of the outgrower are estimated for the year 2012. The average quantity harvested per month in December 2012 (the last record available in 2013) is displayed per percentiles in Table 3.2. The total production of the 2012 from the producers was of 2,920,000 kg (2,920 tons). The median annual production for that year is 5,157 kg per outgrower and the average annual production is 7,573 kg per outgrower. The estimation is done with the median production in order to capture a median revenue.

Percentiles	10%	25%	50%	75%	90%
Production	890	2,045	5,175	8,905	14,505

^a The data on production come from SIAT records from 2012. This table shows the annual production of natural rubber per producer in kilograms.

^b Only 377 producers have contributed to the overall outgrower production in 2012.

TABLE 3.2: Outgrower production in decile for 2012

The outgrower cost is composed of the investment I estimated at 500,000 CFA (converted in euros) and divided by 30 years. We assume that the discount rate r is of 0% - the

14. this is an average estimation as it changes from a month to another according to several parameters - in particular the factory capacity

Percentiles	10%	25%	50%	75%	90%
Area in (ha)	1.81	2.97	3.98	4.97	6.44

^a The data on outgrower come from SIAT records. The unit is in one hectare

TABLE 3.3: Areas planted by outgrowers

	Cost per kg	Quantity in kg	Total cost in
(1) Fixed cost $I/30$			26
(2) Annual Labor & transport cost	0.25	5,175	1,294
(3) Annual median gross income	0.8	5,175	4,140
(4)= (3)/12 Monthly median gross income	0.8	431.25	345
(5)= (3)-(1)-(2) Annual median net income	0.54	5,175	2,820
(6)= (5)/12 Monthly median net income	0.54	431.25	235

^a All the amount have been converted from CFA to using the fixed exchange rate of 1= 655.957 CFA and rounded up to the next highest number.

^b The estimates of the cost per kilogram have been done by outgrowers themselves.

TABLE 3.4: Estimation of an outgrower monthly revenue in 2012

opportunity of an alternative financial investment that would generate positive interest is unlikely. This estimate of an initial investment includes the cost of purchasing the stumps which are sold by SIAT at 350 CFA per unit and maintenance costs.

The calculus is made on the scenario of 1,000 trees (so 1,000 stumps) planted over 2 hectares of land. Labor and transportation costs account for the occasional hiring of additional workers for tapping or maintenance and transport is the cost of delivering natural rubber to SIAT each month (the transportation costs are entirely bare by the outgrower); the total of those costs is estimated at 164 CFA per kilogram (0.25).

The revenue depends on the price p and the production Y . The selling price varied during the year 2012 between 475 CFA and 750 CFA per kilogram, with an average of 550 CFA (0.8).

The unknown variable of the model is the forgone income of *not* using the land at all for 5 years. Theoretically, this variable is equal to the value of whatever agricultural product the farmer could have produced during the 5 first years where the rubber trees were growing. The methodological impossibility to evaluate this value mainly comes from the lack of information on the production capacity of the farmers.

Therefore the outgrower revenue as it is calculated is *overestimated* because it is not taking into account the opportunity cost of the 5 first years of the plantation.

At the moment where the production starts to decrease - in the instance in 2013 - a worker production is rationed, wage is around 200 a month. At the same moment of the production cycle, the (overestimated) median income of the outgrower is 235 per month. It appears that the differential is very small : 35per month. In fact the two incomes are equivalent. But when taking into account that the outgrower revenue is *less* than what

could be computed with the available data (i.e. without the opportunity cost of resigning farming activity) it is safe to assume that the half of the outgrowers below the media are worse-off in terms of income.

3.5 Conclusion

The company SIAT benefits from a monopoly position after purchasing a formal state owned company. It determines the earnings for both workers (the wage w) and outgrowers (the selling price p) with an implicit objective function aiming at profit maximization, hence the equivalence of both status in terms of earnings.

During the rubber price surge between 2009 and 2011, in the neighboring country Cameroon, natural rubber was purchased at 850 CFA (1.3), the substantial price difference between SIAT and Cameroon prices has led the outgrowers to wire out their production to Cameroon as much as they could. This is against the contract (or the implicit agreement) with SIAT stating that the company is the only purchaser. Beyond the political and social tensions this episode inevitably resulted in, it revealed how far below the market price SIAT set its purchasing price.

In fact in terms of cash revenue, being an outgrower or a worker is equivalent, so the determinants of being one or another only depends on social status. The large majority of the workers at SIAT are young males unmarried and without children and are migrants coming from Cameroon or Equatorial Guinea. They work and live in the plantation. The outgrowers on the other hand are natives and most of time they have a family to sustain.

The initial aim of Hévégab was to involve the local farmers into rubber production in order to trigger development in the region by creating a specialization in a cash crop activity. Since the company is no longer state-owned, another model is at work and serves a different purpose than the local development.

Annexes

1978	Gabonese Government approached the ADB to help financing Mitzic Rubber Project
1981	Beginning of Mitzic Rubber Project. Release of a first share of 20% of total loan for the plantation of 3,300 ha in Mitiz
1985	Completion Mitzic Rubber Project
1985	Elaboration of Rubber Program. Phase I consisting in 1700ha in Mitzic, 2,000 ha in Kango and 2,000 ha in Bitam and the construction of factory in Mitzic
1985	Approval for the Rubber Program. Phase I financing
1988	Starting of the Villagers Program
1990	Completion Rubber Program. Phase I in Mizic, Bitam and Kango
1990	Completion of the industrial installations in Mitzic
1993	Beginning of the first bleedings in Mitzic
1999	Loan default and withdrawal of the donors
2000	Interruption of all the activities of Hévégab
2004	Privatization of the rubber production, Hévégab is sold to the Belgian SIAT

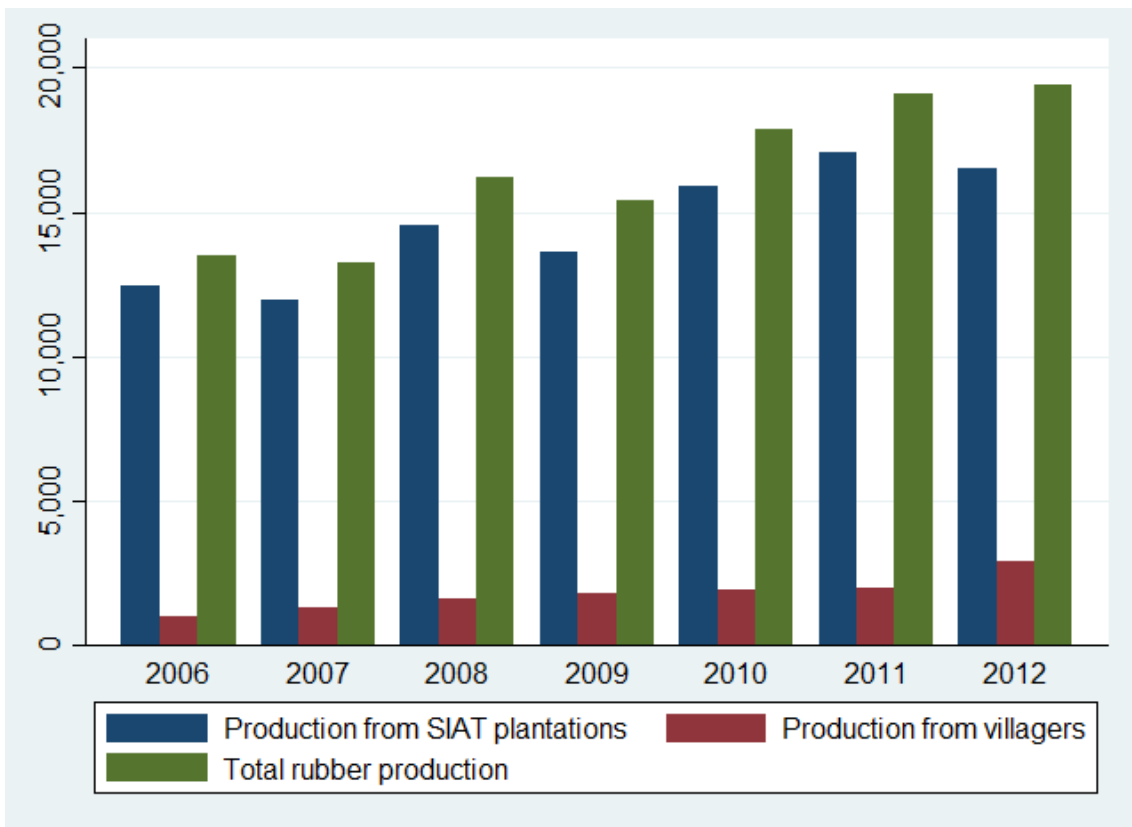
TABLE 5: Main dates of the Rubber Development Program

	Tapped Areas	Planted untapped	Areas Extensions (2013 and 2032)
Kango	2,089	140	7,500
Bitam	2,094	600	4,500
Mitzic	5,029	0	3,250
Nzile	0	0	5,000
TOTAL	9,212	740	20,250

TABLE 6: Siat-Gabon Rubber plantations in hectares

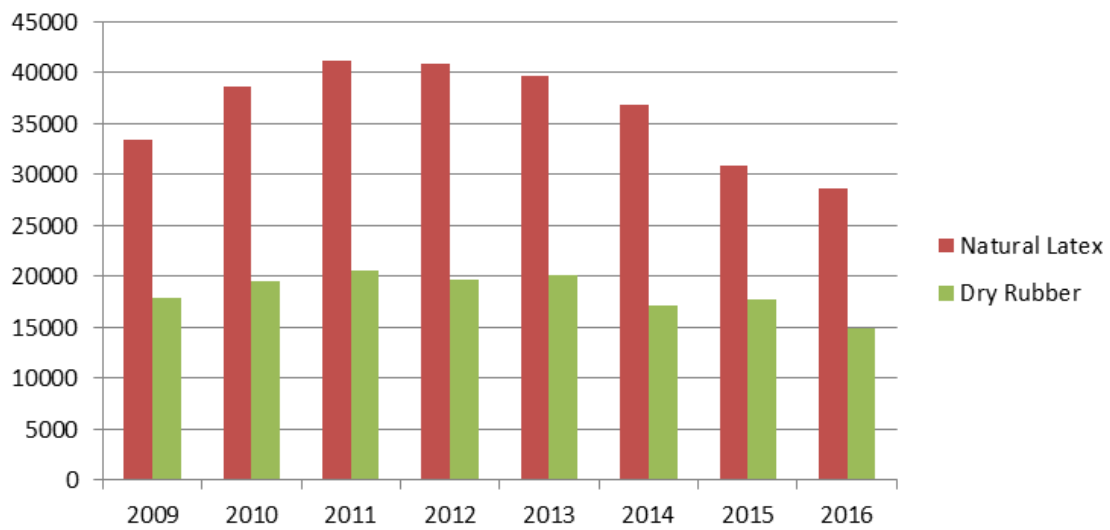
	2004	2005	2006	2007	2008	2009	2010	2011	2012
Kango					290	300	300	300	300
Oyem			213	170	284	485	445	717	587
Minvoul			72	132	160	269	240	249	257
Mitzic			130	200	320	288	282	382	382
Bitam			620	720	734	737	741	820	834
TOTAL			1,035	1,222	1,498	2,069	2,008	2,468	2 360

TABLE 7: Evolution of outgrower plantations in hectares



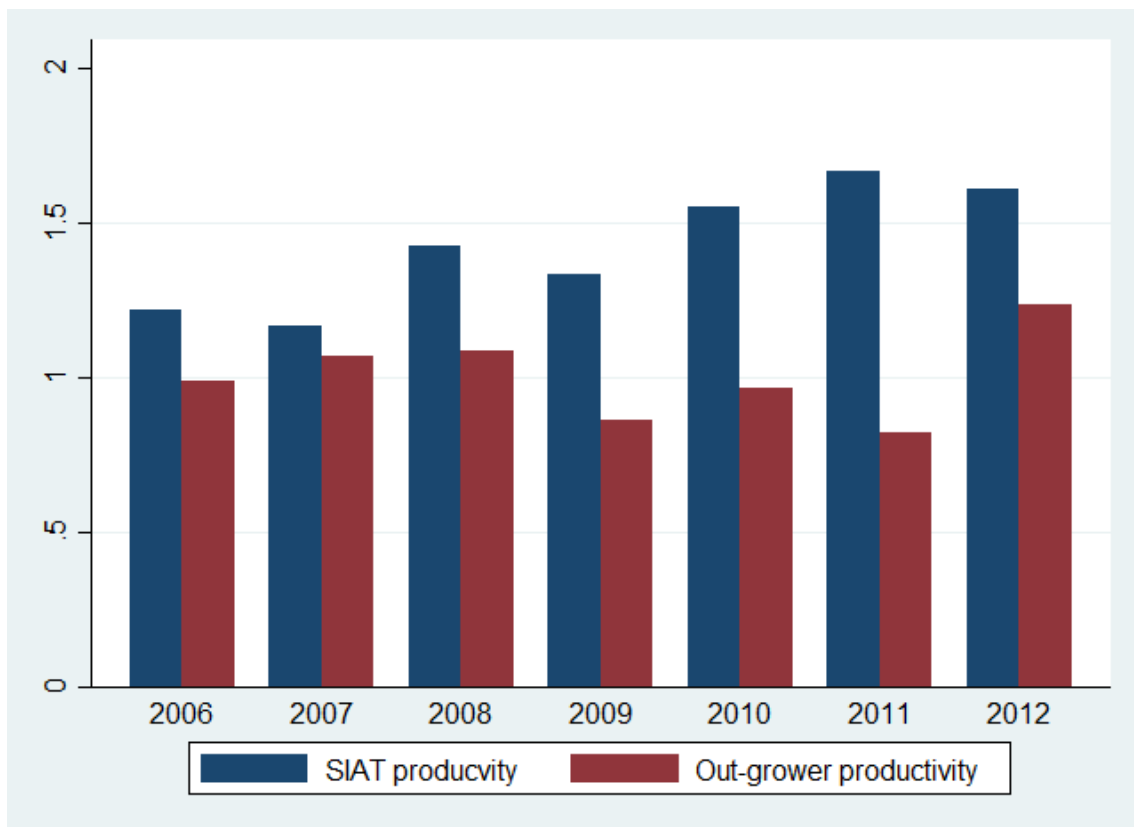
Source : SIAT_ November 2013

FIGURE 2: Rubber production between 2006 and 2012 in tons



Source : Focusstat_Gabon Ministère de l'Economie 2017

FIGURE 3: Rubber production between 2009 and 2016 in tons



Source : SIAT_ November 2013

FIGURE 4: Dry Rubber production per hectare planted - in tons

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Conclusion

Tropical forest management studies are challenging, they stand at the crossroad of environmental, development and international economics. We know by now, that the need for development is not only a moral imperative, it is a must, firstly for environment protection, in the instance for forest protection. The states of these forests in the coming decades totally depends on the economic orientations, land policies and land allocation choices made today. Given the vastness and the richness of Gabon natural endowment, the choice of a development based on natural resource exploitation is understandable. The low population density and the concentration in urban area make social conflicts over land use solvable. The orientation chosen by the state in favor of converting forestland into rubber plantations and palm oil plantation or logging concession with the objective to further development, is a legitimate aim. The whole contradiction resides in the fact that in the process, people land rights are neglected sometimes even denied. The failure to protect local communities' access and use of their lands renders void and unfruitful any development project. Furthermore, it will inevitably result, in a long run, in negative environmental effects.

The need for a relevant legal framework

The source of this problem is institutional; it is absence of an appropriate legal framework. The existing laws are not adapted to the recent changes of the forest use. Gabon's legal framework for timber logging activities might not be perfect but it at least exist. Private companies involved in timber logging know what rules they should follow and if improvements are to be made, the laws can be changed. In the case of rubber plantation (or palm oil) there is no specific legal framework to guide agro-business. The companies access land through a long terms lease of 50 years but even this lease contract is not

grounded on any general law. In other words, the corporate are given full land use rights with virtually no guidance in terms of social or ecological management. The social and environmental procedures are let at the discretion of the companies. The risk is to end up with very heterogeneous policies throughout the country, thus very different long terms impacts. If Gabon is to promote agro-business then a legal framework for land acquisition of large scale agricultural crop is needed, outlining a minimum set of guidelines regarding social and environmental management of the plantations.

The overwhelming presence of the multinational Olam in Gabon is particularly tangible in the sectors Palm oil and rubber plantations. Olam rubber plantation in northern Gabon should be operational in 2019, then the company will be in need of labor for its plantation. Likewise, Siat extension in Mitzic and Bitam will demand additional workers. Gabon population in northern provinces is not able alone to supply all the workers these plantation will need, there will be most certainly more workers coming from the neighboring countries Cameroon, Equatorial Guinea even from west Africa. The social consequences of these immigrants in the region should be taken into consideration by the national authorities from now.

Corporate social responsibility

Companies tend to make up for state's failure in public investment sector and to consider therefore that their social duty is done. Their commitment should be much more focus on finding ways to reduce at a minimum level their social and environmental impacts. Multinationals acquiring large scale land throughout the county are trading the population consent with school and dispensaries refurbishment but are not anywhere near to think of ways to repair the irreversible consequence of forest loss their activities provoke.

The second chapter addresses the questions of industrial logging, one of the pillar of Gabonese economy. Despite the fact that industrial logging remains the predominant form of forest use in Gabon, it mainly benefits to the foreign investors which are the main actors in logging and the State to certain extent but there is no trickle-down of the forest economic rent to the local population. The intended creation of a deeper wood sector including more transformation might change this state of affair but as to now,

forest rent and more generally growth generated by logging exploitation only benefit a small number of actors nationally. Considered from the perspective of local people participation, industrial logging is a rather poor local development inducer. Including local people in forest management by promoting community based forest management seem to be a sound option for the nearest future.

Improving human capital for value Added creation

The first chapter describe how the aim is of enacting log export restriction is to stop being only an input provider from wood products producers of the rest of the world. While I maintain that preventing the resource from flowing out the country through exportations, I say it is on a first toward the sought wood transformation sector. Moving upward along the production chain demands qualified labor as higher added value can only be achieved with higher human capital. At the moment local actors (excluding foreign companies) use sawnmill dedicated to the simplest transformation and are not strong enough to enter international competition, at least for now . If the means are gathered to train the coming generation to timber processing, a policy such LEB might very well be fruitful in the future.

Developing collaborative relation with Chinese investors

Chinese companies are currently an integral part of the forestry sector in Gabon and that it is in the general interest for there to be closer collaboration between the Gabonese administration and the Chinese operators. The Chinese managers we met in the course of this study are extremely aware of the poor reputation they have in forestry circles and most of them are prepared to make the efforts needed for this to change. The Gabonese authorities must help these companies towards a better management of taxation and the forest management procedures. Apart from SUNLY, the Chinese companies do not appear to have included certification, which continues to be an indicator of good management, in their medium-term plans. The mass influx of Chinese companies has given rise to competition which is often described as unfair (sometimes rightly) by certain com-

panies which have been involved in the wood sector in Gabon for longer. Acclimatising newcomers to the legal, environmental and social standards of Gabon is a process which has been drawn out by the operators' haste to obtain a return on their investment and the tolerance of the Gabonese authorities to practices of these newcomers which have not necessarily capitalised on the sufficient experience and expertise in the field of management. The "problem of the Chinese" does not, however, seem impossible to resolve. The solution calls for integrity and perseverance from the Gabonese government in the application of the texts and rules it has drawn up in order to protect its economic, social and environmental interests.

These are the lessons learnt from this highly instructive and meaningful journey in Gabon's tropical forest and they are the very reason of this thesis. They can surely relate with other tropical countries problematics and might probably be of some interest for future research on similar or related topics.

Résumé : Les trois essais suivants portent sur la gestion de la forêt au Gabon. L'hétérogénéité des pays et des contextes ne permet pas d'avoir un modèle unique d'allocation des terres forestières ni de gestion des terres forestières. Par conséquent, la validité externe des résultats de recherche spécifiques à un pays est fragile. Cependant, la difficulté à obtenir des résultats généraux ne devrait pas entraver la recherche monographique, car les politiques forestières doivent être évaluées dans leur contexte national. C'est pourquoi ce travail de recherche se focalise sur un pays un particulier : le Gabon. Elle propose au travers de trois essais, une réflexion sur la difficile conciliation des enjeux de développement économique et l'allocation des ressources forestières. La thèse est structurée comme suit : un premier chapitre analyse la politique d'interdiction des exportations de grumes et ses résultats, le deuxième chapitre étudie le lien entre les pratiques des sociétés forestières et leurs impacts sur la population locale, enfin le dernier chapitre examine la situation des travailleurs du secteur du caoutchouc naturel et celle des producteurs indépendants.

Mots clé : forêts, économie, développement, exportations, bois, Gabon

Summary : The following three essays focus on forest use in Gabon. The heterogeneity of countries and contexts does not allow for a single model of forest land allocation or forest land management. As a result, the external validity of country-specific research findings is fragile. However, the difficulty of obtaining general results should not hinder monographic research, as forest policies must be evaluated in their national context. That's why this research work focuses on one country : Gabon. It proposes, through three essays, a reflection on the difficult reconciliation of economic development issues and the allocation of forest resources. The thesis is structured as follows : a first chapter analyzes the policy of log export ban and its results, the second chapter studies the link between logging companies the practices and their impacts on the local population, finally the last chapter examines the situation of the workers in the natural rubber production sector and the one of the outgrowers.

Key words : forestry, economics, development, exportations, wood, Gabon

