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Modeling Environmental Sustainability and Presenting the Urban Ecovillage Pattern Based on Information and Communication Technology (ICT): A Comparative Study in Iran and France

Sima Saadi

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Sima Saadi. Modeling Environmental Sustainability and Presenting the Urban Ecovillage Pattern Based on Information and Communication Technology (ICT): A Comparative Study in Iran and France. Geography. Université Bourgogne Franche-Comté; University of Tabriz (République islamique d'Iran), 2023. English. NNT : 2023UBFCH012 . tel-04198156

HAL Id: tel-04198156

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**Modeling Environmental Sustainability and Presenting the Urban
Ecovillage Pattern Based on Information and Communication Technology
(ICT): A Comparative Study in Iran and France**

By

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Abstract

Given the world's environmental problems and climate change, as well as unsustainable lifestyles, research into environmental sustainability and the provision of an urban ecological village based on information and communication technology is required. Furthermore, this issue has provided the necessary foundation for the transformation and acceptance of society in the face of climate change and the transition to sustainability. Ecovillages are grassroots intentional communities focused on the shared values of environmental sustainability and community-building and truly sustainable, community-oriented housing options that are economically empowering, socially just, and enhance the ecology of place by building all forms of economic, social, and environmental capital. Therefore, this research explores the suitable model for achieving environmental sustainability based on ecovillage urban design to improve the design of current and future ecovillages and to use it as a design model for building sustainable communities. The objective is to compare Iran and France in the following categories: (1) Identify the most important features of ecovillages based on general resident preferences in cities; (2) Determine ICT development in relation to environmental sustainability; (3) Analyze the relationship between sustainable development and ICT to reach urban ecovillage communities; (4) Evaluate the possibilities of transforming traditional villages into ecovillage lifestyles; (5) Evaluate the studied villages' business spaces and suitable solutions for their sustainability with the goal of becoming an ecovillage; (6) Assess of current ecovillages' responsibility to a sustainable lifestyle in France. and finally (7) Providing an appropriate model for achieving urban-rural sustainability based on Ecovillage and ICT. In terms of methodology, 1100 respondents were obtained using the quantitative method with a questionnaire in urban areas. For statistical data analysis, IBM SPSS, SEM with AMOS, and R programming were used, and GIS was used for spatial analysis. The qualitative method with semi-structured interviews, on the other hand, was used to collect data from rural areas, and MAXQDA software was used for data analysis. The results show that the respondents in the cities of France and Iran had more similarities than the respondents in the villages. In other words, the villages of France and Iran had more differences than the cities. In general, achieving sustainability through ecovillage and ICT can vary depending on needs, infrastructure and policies, culture, and society in each region, according to the final research model. However, it is crucial to concentrate on reconfiguring residents' perspectives, values, attitudes, and lifestyles toward sustainability. This includes altering corporate strategies and putting into practice, sustainable business models. In addition, the significance of the government's role in accelerating the changes and supplying the required infrastructure. The development of plans and projects centered on green construction, for instance, or expanding the number of safe and quick cycling routes. Finally, the transformation of current societies, both urban and rural, will pave the way for the future sustainability and adaptability of urban-rural societies to climate change.

Keywords: Sustainability, Lifestyle, Urban Ecovillage, ICT, Spatial and Statistical Analysis, Iran, France.

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Introduction

As climate change continues to deteriorate, the importance of sustainability philosophy has grown in recent decades. Without a doubt, immediate action is required to save the planet (Smith et al., 2021; Wals, 2017; Tvaronaviien, 2021). Sustainability in societal policy must evolve into an approach that emphasizes the sustainability of the city and rural areas, as well as the protection and recycling of the natural environment. Furthermore, decision-making in these communities should lead to increased environmental benefits while reducing or eliminating negative environmental effects. Hence, urban residents and villagers should be aware of their impact on the natural environment and assume responsibility for reducing or eliminating these negative effects (Siracusa et al, 2008; Zaheri & Saadi, 2018). Preparing communities for the effects of climate change is an important strategy for mitigating climate change (Klenert et al., 2020; Rueda et al., 2021).

Therefore, with the aim of combating environmental challenges, Environmental sustainability is a concept that has been raised in conjunction with the increase in threats caused by climate change, the destructive environment, and the increase of global concerns about human health and the environment. Environmental sustainability is also frequently defined as balancing environmental protection, economic feasibility, and social equity, and it can correspond to a variety of interconnected issues. The concept of community sustainability places these ideas in the context of urban and rural landscapes. Sustainability is very important in cities because of the increasing population, pollution caused by transportation, and greenhouse gas emissions, and in villages due to the direct relationship with the environment.

This theme demonstrates the significance of human relations as critical factors in achieving environmental sustainability goals (Stocker & Kennedy, 2009). Thus, sustainable communities can act as mediators to encourage environmentally responsible decision-making and this act as a focal point for promoting environmental commitment among residents. In the meantime, one of the most critical and necessary factors is ICT, which facilitates a better understanding of global warming, climate change, and other environmental issues (Warren II et al., 2018).

Finally, this study emphasizes two major issues arising from the unsustainable living pattern and achieving sustainability. The first focuses on alternative sustainable communities and the contribution they can make in achieving this sustainability, while the second focuses on the

role of ICT technology in environmental sustainability, as well as the improvement and development of infrastructure for instance, waste management, public transportation, energy-efficient alternative transportation, environmentally friendly building design, etc., required to accelerate the sustainability process.

Problem Statement

Increased urbanization and migration from rural to urban areas, resulting in a reduction in rural population, increase the environmental pressures. On the one hand, this places an additional burden on the urban environment and many issues will arise, including the need to protect the environment and the health of citizens, deal with heavy traffic, noise pollution, air pollution, and the lack of adequate facilities for citizens. On the other hand, a decline in rural population results in a loss of employment opportunities and economic vitality, instability and a disregard for natural ecosystems, a decline in agricultural output, etc. Therefore, adaptability, flexibility, and sustainability are critical in rural and urban human settlements. Despite this, many environmental problems arise from unsustainable lifestyles, as well as a lack of awareness among urban and rural residents about their role in these challenges. Hence, human societies' economic, social, cultural, and political activities have aggravated these concerns. This is why issues concerning people's lifestyle changes and sustainable transformation are critical to achieving sustainable development. Knowledge and new technologies, such as ICT, can assist in accelerating the transformation of sustainability in fields such as renewable energy, alternative transportation systems, sustainable agricultural methods, public health, construction, and urban infrastructure. Technological innovation, on the other hand, must evolve alongside social and institutional structures. Attention to this social-technological fusion is required to understand and manage sustainability transitions.

However, due to different stages of development, exogenous configuration, and starting conditions, not all cities benefit immediately and directly from ICT. Cities use and develop information and communication technology in different ways, which is referred to as the digital divide and is defined as unequal access and use of information and communication technology. Digital divides occur naturally among cities due to huge disparities in access and use of ICT, and they have become problematic for regional development (Philip et al., 2017).

Finally, transferring to a more sustainable development model necessitates accountability, ethics, and social responsibilities, as well as appropriate technology and infrastructure. Regardless of social, economic, or environmental differences between countries, everyone

must work toward the same goal. Every country should define its change strategy, identify its problems, and discover its potential. This change can differ not only between countries but also between urban and rural communities. Natural resource availability, local people's level of awareness, motivation, flexibility, necessary infrastructure, government cooperation, and so on can vary depending on the population.

Solutions

1. Sustainable Communities: Sustainable communities have been the focus of a lot of theoretical and empirical research in recent years, particularly in response to a push to implement sustainable development in a more integrated way (Dalal-Clayton & Sadler, 2014; Lyden et al., 2018; Singh et al., 2019; Masuda et al., 2022). Due to this, Cultural, institutional, structural, and technological changes are necessary for societies to be sustainable (Jansen, 2003). Global problems are largely the result of life's irresponsibility. Environmental pressures that humanity is currently facing are a result of consumerist lifestyles and excessive wealth, power, and land accumulation (Mollison, 1998). It should be considered how to use the planet's precious resources and how to slow down the rate of destruction of the natural world. Scientists and politicians have proposed solutions to these issues; however, they have not had a significant impact unless every single person in a city or village changes their life style (Ardzijauskaitė, 2009). The necessity for an alternative lifestyle and the development of settlements with an economic and social lifestyle compatible with the environment was taken into consideration in the 20th century because of the environmental problems caused by the unsustainable living pattern. Regarding this, the ecovillage¹ model has been used since the 1980s in designing and planning for the sustainability of societies, it is currently being embraced as a response to environmental, social, and economic challenges imposed on by unsustainable living patterns (Kennedy, 2004). Rebuilding the environment in urban and rural areas has become regarded as one of the most crucial environmental issues, including both terms of regional and national policy-making (Kirby, 2003).

Furthermore, there is a widespread belief among advocates for sustainable communities that the best visions of a sustainable community that can embed the ideas of a sustainable lifestyle are ecovillages/urban ecovillages, which are widely regarded as a strategic approach to transitioning to a sustainable society. These discussions on ecovillages/urban ecovillages as a

¹ Ecovillage and all complex word will be defining in the end of introduction.

long-term sustainability strategy have far-reaching implications for sustainable development of communities (Xue, 2014, Demaria et al., 2013; Owen, 2012; Jenkins et al., 2020).

Therefore, ecovillages that act as experimental community models have the potential to help society achieve sustainability by developing alternative sustainable living possibilities. Their contribution is proved by demonstrating viable alternative solutions that can be replicated on a wider scale in the broader community and across all geographic locations (Price et al., 2020). Hence, over 1000 ecovillages in rural, urban, and suburban settings throughout the world are now members of the GEN (Global Ecovillage Network), which serves as a hub for sharing and disseminating knowledge to ecovillages worldwide (GEN, 2022).

Some sites have accomplished such objectives within, but also outside, the confines of the ecovillage, by reviving local traditional knowledge and practices (Losardo, 2016; Waerther, 2014). Ecovillages, as Dawson (2006) points out, are transforming their local landscape, physical infrastructure, governance, population, skills, and culture in ways that improve the quality of life of communities both inside and outside the ecovillage and in each geographical location (Price et al., 2020).

2. ICT and sustainability: ICT is essential for enhancing social inclusion, promoting economic development, and enabling better environmental protection, which is specifically taken into account as ways to achieve Sustainable Development Goals (SDGs), highlighting their transformative potential across various domains (Chen et al., 2020; Hartono, 2020). These tools have an impact on how we interact with one another and communicate, and they are essential for the growth of industries like health, economy, and education (Nevado-Pea et al., 2019). Consequently, while ICTs have an impact on people's daily lives on an individual level, they also aim to reduce poverty and improve health, education, and quality of life for a large number of people on a macro level (Fernández-Portillo et al., 2020). In addition, ICTs have evolved into crucial tools for achieving this goal and addressing various societal needs by changing educational practices (Del Cerro Velázquez & Morales Méndez, 2018). When there is equality of opportunity, digital tools can help reduce social and economic inequalities in society and promote digital inclusion (Carrión-Martnez et al., 2020). This is possible due to a variety of factors, including cost reduction, technological flexibility, and, ultimately, a decrease in the digital divide. The significance of using ICT to prepare urban and rural areas for sustainability has increased the urgency that this issue must be acknowledged. This is because, in today's world, and due to population growth, it is impossible to achieve sustainability goals

without considering new technologies. They play an important role in the sustainability of urban and rural communities, from communication development and energy conservation to new transportation and the construction of smart cities.

In other words, ICT can help reduce the emission of greenhouse gases by enabling digital cities, transportation systems, electric grids, and industrial operations. Such that, The ICT for sustainability perspective sees ICT as a potential solution to many environmental concerns and moving forward environmental sustainability. There is a lot of hope that ICT will play a big role in dealing with climate change and other environmental issues (Elliot, 2011; Melville, 2010; Watson et al., 2012; Gholami et al., 2013; Klimova et al., 2016; Aón Higón et al., 2017).

The advancement of information and communication technologies, as well as global interconnection, have the potential to significantly accelerate human progress, bridge the digital divide, and foster knowledge societies. This will justify the research's interest. Hence, the motivation for this section of the research is to document how ICT can promote more sustainable urban development, comparing case studies from very different geographical contexts (French and Iranian cities) (Giesenbauer & Müller-Christ, 2020; González-Zamar et al., 2021).

Purpose and Necessity of research

In light of the significance and necessity of sustainable societies in addressing the upcoming environmental issues, the overall objective of this thesis is to emphasize a sustainable lifestyle (ecovillage) based on the necessary innovations and technologies (here ICT) to accelerate the process of sustainability. In other words, the objective is to understand how ICT and the ecovillage lifestyle can sustain environmental sustainability and a sustainable future including both urban and rural areas in Iran and France. Each of these subjects will be covered in more detail below.

1. Sustainable Communities: Given that there are various definitions of ecovillage based on region, society, and culture, the important dimensions of achieving ecovillage and transforming communities into this sustainable lifestyle are also different. Recent studies, however, have classified the ecovillage and the essential features that must be present in it into five major dimensions: economic, social, ecological, cultural, and architectural (GEN, 2022, Szabó et al., 2021; Rubin, 2021). Due to a more comprehensive and detailed analysis, we divided these five

dimensions into eight: ecological, cultural, economic, agricultural, social, individual, architectural, and transportation-access dimensions.

Therefore, the goal is to determine how residents think about the Ecovillage and its various aspects, as well as what type of lifestyle they prefer and which dimensions are most important to them. In other words, identifying the critical aspects of the transformation to an ecovillage from the perspective of urban and rural residents is based on where participants live. Hence, predicting residents' preferences for sustainable lifestyles necessitates understanding how different residents value different aspects that comprise their preferences (J. Caplan et al., 2021; Liu & Kontou, 2022; Apostolopoulos et al., 2022).

Aspects and preferences may differ depending on whether they live in an urban, rural, small, or big area (Madison, 2018; Stebbins, 2019; Kajosaari et al., 2021; Orejon-Sanchez et al., 2022). These distinctions seem to be determined by lifestyles, needs, values, beliefs, infrastructure, technology, policies, and governments. For example, to reach sustainability in their region, some residents may prioritize the social and cultural dimensions, while others may prioritize the economic, infrastructural, and ecological dimensions. Furthermore, some people may prefer to live in or near big cities in neighborhoods while maintaining a sustainable lifestyle (e.g. the Urban Ecovillage in downtown Los Angeles, although living in a large metropolis, has chosen a sustainable lifestyle). Some residents, on the other hand, prefer to live in smaller cities or villages to avoid the hustle and bustle of big cities. Residents clearly have comparative preferences for these features.

Finally, individuals' desire for a sustainable lifestyle or Ecovillage is demonstrated by their distinct passions, status, and behavioral tendencies. Each citizen's decision and actions will determine whether a sustainable lifestyle becomes well enough and spreads in various areas (Cheng et al., 2019). For this reason, understanding the perspective of residents in various areas in the direction of transformation towards ecovillage will be discussed here. It is hoped that this will represent an introduction to how Ecovillage will be portrayed in different communities when approaching planning, policies, projects, and programs in Iran and France.

In this regard, despite global efforts over the last two decades to develop ecovillages and healthy, sustainable cities, no comprehensive action has been taken in Iran to support these fields in a way that takes into consideration all of their dimensions. The actions related to the nature of ecovillage implemented in some sustainable villages and cities in Iran are mostly

scattered and pilot projects that have been implemented in fields such as biogas, waste and compost management, solar energy, and wind energy use.

On the other hand, in France, hundreds of alternative intentional community projects have developed during the last decade in rural areas. Many other radical experiences include "transition" communities, sustainable housing cooperatives, and many others. Many individuals, particularly young people, are dissatisfied with prevailing urban living models focused on consumption, hypermobility, and debt as a means of obtaining housing and basic necessities. As a result, they are more in touch with nature, in a society that is less consuming and stressful, and they are seeking alternative lifestyles, which has historically been one of the most appealing alternative lifestyle projects. According to GEN, France has over 19 Ecovillages, with the majority of them located in the south (Bobulescu & Fritscheova 2021; Sattler, 2021). However, no comprehensive and in-depth research has been conducted on the progress and status of these communities' commitment and responsibility to nature, as well as residents' satisfaction with this lifestyle.

In terms of actions regarding cities, France has paid more attention to sustainable and green cities in the past years than Iran. So, it not only plans to make Paris the greenest city in Europe by 2030, but five French cities, Angers, Nantes, Metz, Amiens, and Lyon, are also known as green cities. However, given that France is a sustainable model in Europe, these measures have been insufficient. Hence, some actions have failed due to a lack of attention to the needs of society and a lack of preparation for upcoming changes, as well as a lack of centralization regarding a sustainable lifestyle. Therefore, the opinions and preferences of urban and rural residents in Iran and France have been discussed in this study with the purpose of examining their acquaintance and consensus with changes and sustainable lifestyles. Thus, in addition to the importance of infrastructure and technologies, societal opinions and preferences are extremely important.

2. ICT and sustainability: Given global environmental concerns, it is critical to maintaining community sustainability and the existence of adaptation policies in the future. This raises the need and demand for the collection, management, and use of spatial information and reliable communication technologies, to ensure the integrated sustainability of policies used to address the global, national and local environment. As an illustrative example, the COVID-19 pandemic, in which the entire world struggled, demonstrated the importance of ICT in increasing public awareness and facilitating prevention, surveillance, diagnosis, and treatment.

In these situations, distance learning relied on digital resources, ICT management, and the development of digital skills (Manco-Chavez et al., 2020; Zaman et al., 2020). In order to achieve long-term sustainability, it is essential to emphasize ICT as being among the most important skill in the expansion of communication and digital technologies. In this context, ICT is essential to the digitalization, monitoring, and management of numerous sectors. Recently, attention has been focused on both sustainability as a goal for smartization and ICT as a useful tool or as the key to solving smart processes (Meijer & Rodriguez-Bolvar, 2015). Moreover, Building smarter cities, transportation systems, electrical grids, and industrial processes can all help to reduce emissions (Añón Higón et al., 2017). The 'ICT for green' perspective sees ICT as a potential solution to many environmental issues. There is a lot of hope that ICT will play a significant role in addressing climate change and other environmental issues (Elliot, 2011; Melville, 2010; Watson et al., 2012; Gholami et al., 2013).

One issue to take into account is that countries with extensive ICT use and development are starting to significantly outpace countries still building their ICT infrastructure and industries. New knowledge and technologies do not necessarily develop everywhere and at the same time. Consequently, the gap between countries that use ICTs extensively and those that are still developing them could broaden exponentially, creating a digital divide that would cut across a significant portion of the globe. While ICTs have enormous potential for use in the field of sustainable development, more attention must be given to ending the global digital divide otherwise sustainable development will struggle. These inequalities can vary between developed and developing countries, as well as between large and small cities. For this reason, a comparison of large and small cities in France and Iran will make in this study to assess the differences and similarities in geographical locations. Over the past ten years, Iran, a developing country in its early stages, has made progress toward sustainable development by building its ICT infrastructure. France, on the other hand, is a country with the required ICT infrastructure and a proven record of sustainable development initiatives and projects both within the European Union and internationally (such as the Law on Energy and Climate to introduce the objective of carbon neutrality by 2050, and the Sustainable Development Agenda by 2030).

In order to create sustainable smart cities and understand the connection between ICT and sustainable development, we will examine how ICT development relates to environmental sustainability. This is why the association between ICT and sustainable development will be assessed, as well as the level of ICT using the indicators of "device ownership," "internet

access," "computer skills," "social media," "e-commerce," and "the impact of epidemics on the use of ICT."

For this reason, the following objectives are investigated in this thesis in order to understand the differences and similarities between Iran and France in the subjects mentioned above:

O1. Identifying the most important features of ecovillages based on general resident preferences in cities, and then compare these dimensions to Iran and France's geographical regions.

O2. Determining ICT development in relation to environmental sustainability in order to create sustainable smart cities.

O3. Analyzing the relationship between sustainable development and ICT to reach urban ecovillage communities.

O4. Evaluating the possibilities of transforming traditional villages into ecovillage lifestyles.

O5. Evaluating the studied villages' business spaces and suitable solutions for their sustainability with the goal of becoming an ecovillage.

O6. Assessment of current ecovillages' responsibility to a sustainable lifestyle.

O7. Providing an appropriate model for achieving urban-rural sustainability based on Ecovillage and ICT.

Research Questions

The research questions are as follows, in accordance with the objectives stated above:

Q1. What are the most essential Dimensions of ecovillages based on residents' preferences in Cities?

Q2. What is the state of ICT development in relation to environmental sustainability in order to build smart cities?

Q3. What is the relationship between sustainable development and ICT to reach urban ecovillage communities?

Q4. How can traditional villages transform into ecovillage and adopt ecovillage lifestyles?

Q5. What is the state of the studied villages' business spaces, and what solutions are suitable for their sustainability with the goal of becoming an ecovillage?

Q6. How committed and responsible are the current ecovillages to a sustainable lifestyle for a sustainable future?

Q7. Can we define a model for achieving urban-rural sustainability based on Ecovillage and ICT?

Definition of concepts

Sustainable communities

The term "sustainable communities" refers to communities planned, built, or modified to promote sustainable living. Sustainable communities tend to focus on environmental and economic sustainability, urban infrastructure, social equity, and municipal government. The term is sometimes used synonymously with "green cities," "eco-communities," "livable cities" and "sustainable cities" (Macdonald, 2020).

Ecovillage

Ecovillage is an intentional or traditional community that can be a city, village, or suburb, which is consciously designed to regenerate social and natural environments through a local participatory process in all aspects of sustainability (social, cultural, ecological, and economic).

ICT

Information and communication technology (ICT) is a diverse set of technological tools and resources used to communicate and create, disseminate, store and manage information. Moreover, ICT is a technological means of collecting (inputting/gathering), collating (processing/analyzing), and conveying (outputting/transferring) information via technology (Agarwal & Alam, 2018; Kendall & Dearden, 2020).

Smart City

A smart city is, broadly speaking, an urban setting that makes use of ICT and other complementary technologies to improve the effectiveness of routine city operations and the quality of services offered to urban residents. In addition, a smart city connects its physical, social, business, and ICT infrastructure to increase the city's intelligence (Harrison et al., 2010; Silva et al., 2018).

Sustainable smart city

A sustainable smart city is one that uses modern technology to meet the current needs of its residents without jeopardizing the ability of other people or future generations. As a result, it does not exceed local or global environmental limits, emphasizing each city's global responsibility by claiming sustainability and ICT as a tool to achieve sustainability and solve local and global environmental problems (Höjer & Wangel, 2014).

Business environment

The term "business environment" refers to the sum or collection of all internal and external factors such as employees, customer needs and expectations, supply and demand, management, clients, suppliers, owners, government activities, technological innovation, social trends, market trends, economic changes, and so on. These factors have an impact on the company's function and how it operates, either directly or indirectly. The sum of these factors influences the environment and situation of the company or business organization (Taouab & Issor, 2019).

Research Process

Figure 1 depicts the research process based on the purpose of the study. In order to achieve a suitable model for urban-rural sustainability based on Ecovillage and ICT, the existing problems, solutions that the researcher is considering, goals and questions, as well as concept definitions, were discussed in this section as an introduction. Following the introduction, the next step discusses how to become sustainable using Ecovillage and ICT. In other words, the relationship between Ecovillage and ICT and sustainability is taken into account. Following that, the methodology, data collection, and tools required to analyze the desired data were determined. The method and measurement tool were chosen based on the goals and nature of each question. The method of Structural Equation Model (SEM) was used for statistical analysis for the first question, which is to determine the most important dimensions of the ecovillage from the perspective of the residents, and the tool of spatial statistics of hot spots was used for the spatial analysis of the studied areas. R programming was used for data visualization in the second question, which is the level of ICT development, and the IDW interpolation spatial statistic was used for spatial analysis. For the third question, the role of ICT in sustainable development, the T-Test technique in IBM SPSS was used, as well as the data visualization in the R program. The qualitative method based on semi-structured interviews and MAXQDA software was used to answer the fourth, fifth, and sixth questions.

The seventh question also displays the results of each part (or question) as a model, followed by the final model.

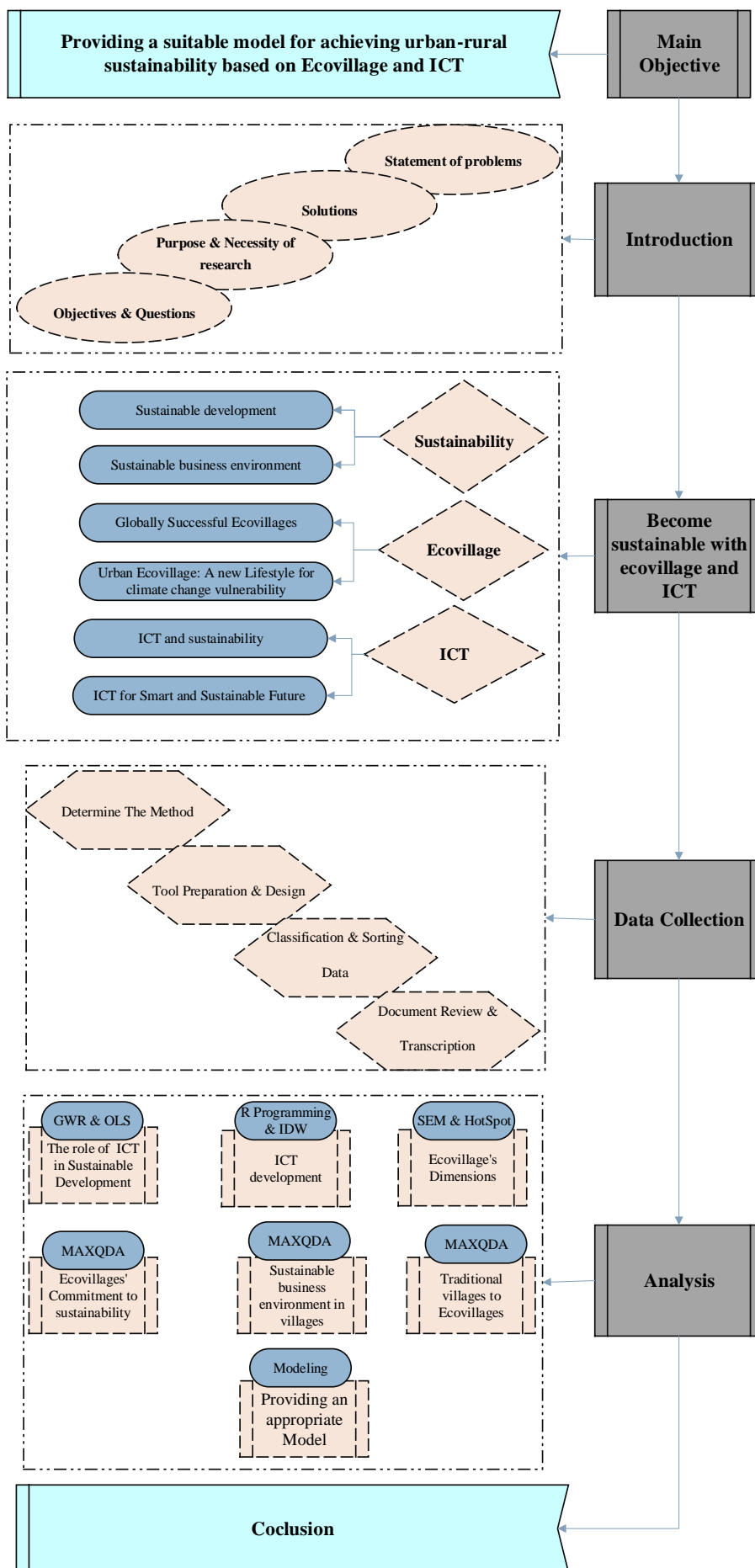


Figure 1. Research Process

Chapter 1: Become sustainable with ecovillage and ICT

This chapter examines three sets of research literature that have been selected as the most relevant for sustainability with ecovillage and ICT. The three sets of literature reviewed here are:

Sustainable development: Given that the primary focus of this research is on societal sustainability, it is necessary to address the concept of sustainable development. Furthermore, because the sustainability of business spaces affects the sustainability of societies, and the fifth research question is in this field, this topic was covered in this section.

Ecovillage: Since ecovillage is one of the key concepts in this research for sustainable communities, this section discusses the history of its origin, concept, views, successful ecovillages around the world, and ecovillage experiences in Iran and France.

ICT: Given that ICT has played an important role in regional development and as a means of achieving sustainability over the last decade, I have focused on the connection and role of sustainable development, as well as the role of a smart future. It is also constantly researched and investigated.

The following diagrams depict the general structure of this chapter and the theoretical framework.

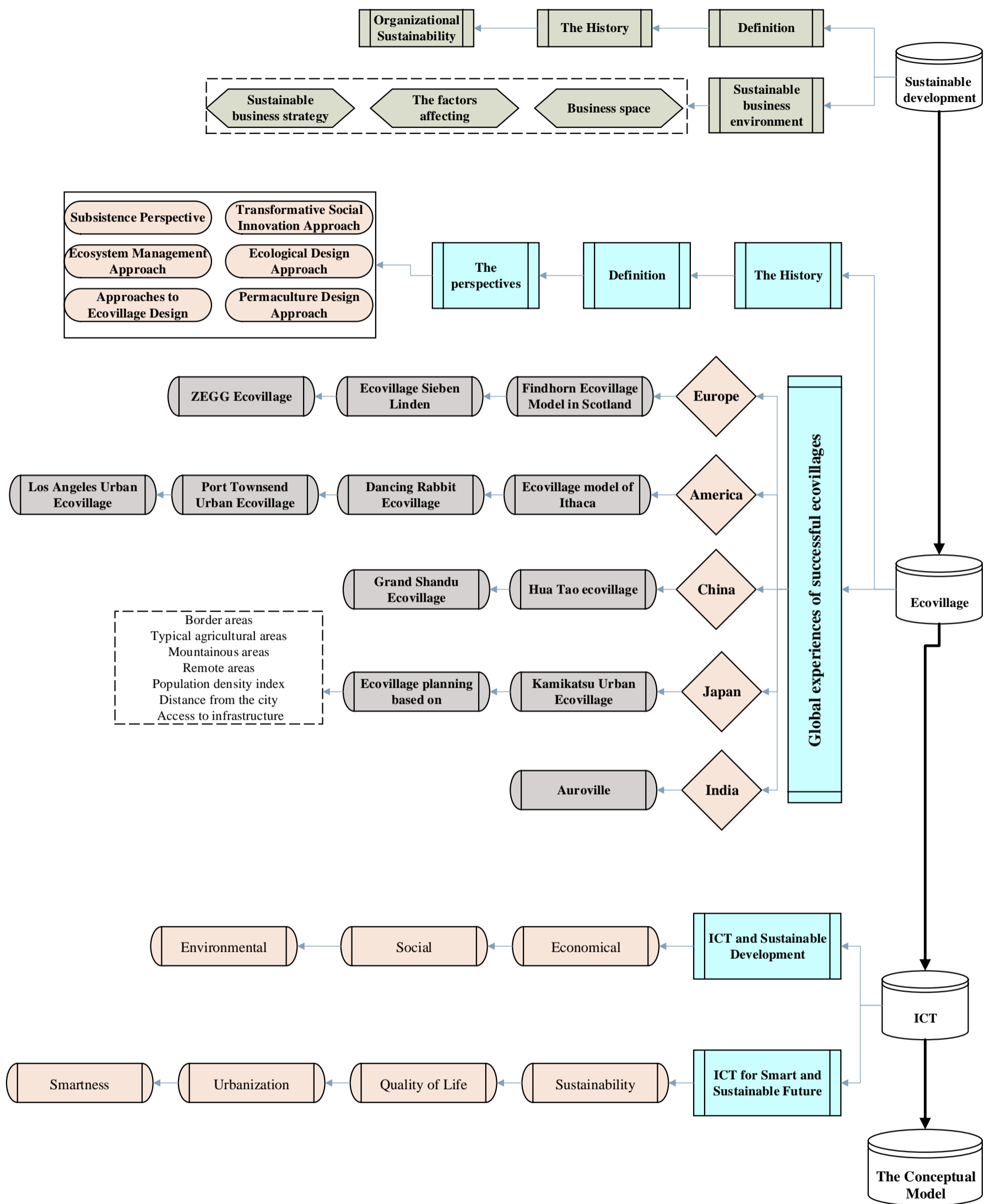


Fig.1.1. Theoretical Framework of the thesis

1.1. Sustainable development

Since its appearance in the Brundtland Report in 1987, the concept of sustainable development has become a reference for scientific research on the environment and has acquired a paradigm character for development (Alvarado-Herrera et al., 2017; Gore, 2015). Since the Rio de Janeiro Earth Summit in Paris, the concept has become hegemonic and has been incorporated into international treaties as well as many countries' national constitutions and laws (Luke, 2005; Redclift, 2005). It has also been used in business (Hashim et al., 2015), agricultural production (Gouda et al., 2018), industry (Mayyas et al., 2012), and urban development (Shcherbina et al., 2017), and has become the conceptual foundation of theoretical approaches such as green economy (Wanner, 2015) and circular economy (Schroeder et al., 2018). As evidenced by the literature, the concept of sustainable development is frequently associated with the concept of sustainability, and thus both terms are used as synonyms, even in academic and scientific fields (Olawumi & Chan, 2018; Whyte & Lamberton, 2020).

According to several authors, the concept of sustainable development emerged in the early 1970s, when various works warned about the need to set limits to the Western development model. The debate that erupted during those years resulted in the emergence of the concept of eco-development (Estenssoro, 2015; Wanner, 2015; Hashim et al., 2015; Gouda et al., 2018; Whyte & Lamberton, 2020), an approach that attempted to reconcile social development with the respect owed to ecosystems in order to preserve the planet's habitability conditions. Although the concept of eco-development did not become a dominant force in international policy, it was the forerunner of a new concept that linked development with sustainability. The World Commission on Environment and Development's 1987 report "Our Common Future" defined sustainable development as "...development that meets the needs of the present without jeopardizing future generations' ability to meet their own needs..." (WCED, 1987). Sustainable development is a set of actions guided by the sustainability philosophy. Actions and activities are continuously analyzed and evaluated from the standpoint of sustainability principles in this type of development (Gilman, 1996). According to the definition above, sustainable development is development that meets the world's current needs without jeopardizing future generations' ability to meet their own needs. Some have proposed three major pillars for sustainable development: environmental (ecological), economic, and social sustainability. Any system's efficiency is determined by all three dimensions of sustainability (ecological, economic, and social) (Shriberg, 2002). The following are the general concepts that determine sustainability.

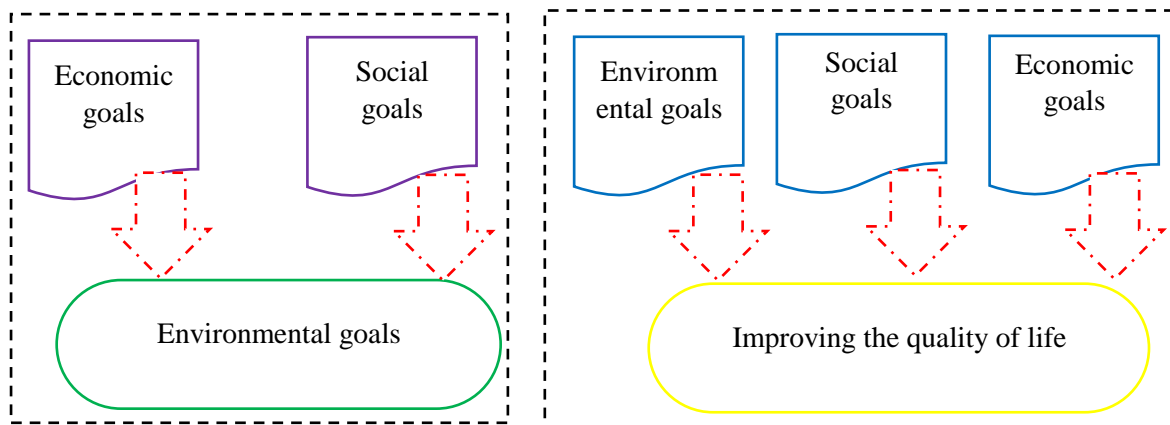


Fig.1.2. Concepts that determine Sustainability, Badri and Eftekhari, 2003.

Today, the topic of sustainability is very important, particularly in the field of economic activities. Natural resources are being depleted as the world's human economic activity has increased eightfold since 1950. As a result, much attention has been paid in recent decades to the discussion of sustainability in the agenda of economic activities. Hence, in addition to the traditional business requirements such as cost reduction, value enhancement, and quality improvement; an increasing number of organizations are attempting to integrate sustainability into their business activities and examine environmental, economic, and social performance indicators in their management activities and evaluation processes (Milne & Gray, 2013; Garcia-Alvarez et al., 2016). Therefore, special attention has been paid in recent years to the discussion of organizational sustainability in business processes, so that technological advances have forced organizations and management policies to undergo changes such as market dynamics, the environment, technology laws and regulations, and sustainable measures and innovations. To promote organizational sustainability (Mostafa & Negm, 2018) and achieve organizational sustainability, environmental priorities should be integrated into current business models. However, in addition to organizational sustainability (Fig.1.3), sustainability innovation has been proposed in recent years to preserve the existence of human species, the resilience of economic systems, and the preservation of capital stocks as well as natural capital (Zhong Wang et al, 2019). In the figure below, the organizational sustainability assessment framework is drawn.

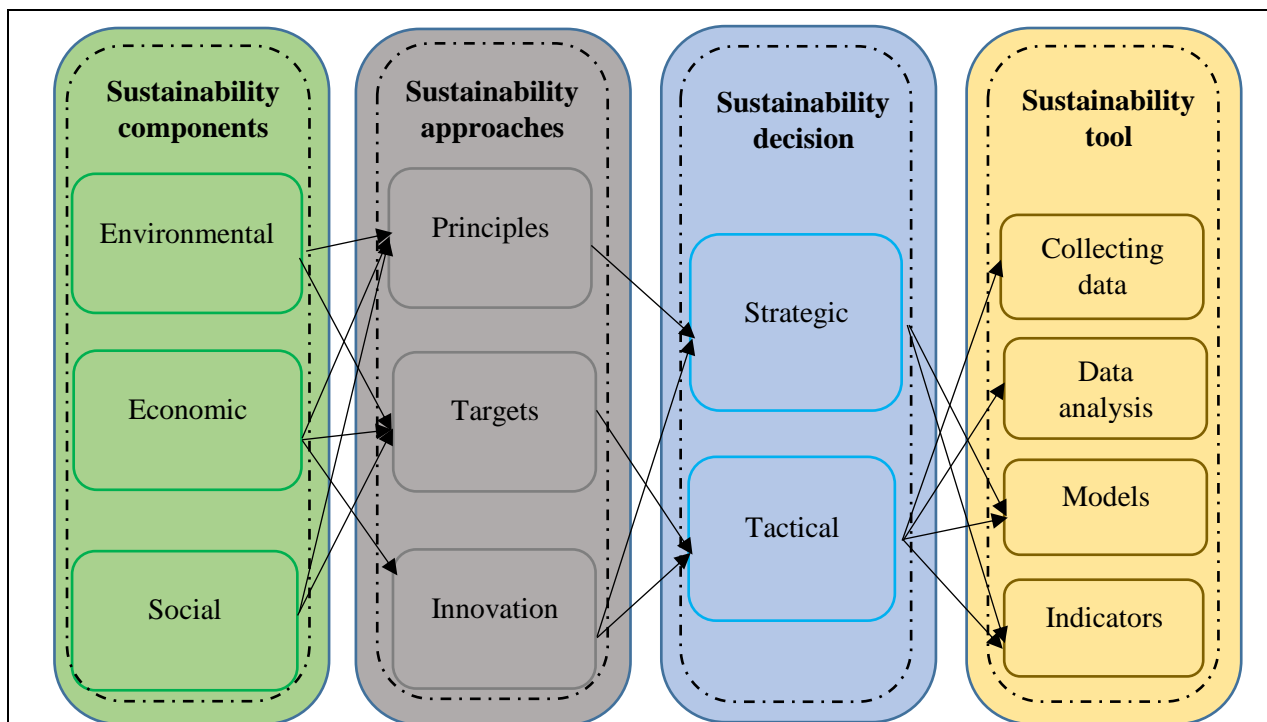


Fig.1.3.Organizational Sustainability Assessment Framework

Mostafa & Negm, 2018.

Given that, economic and business activities have a significant impact on environmental sustainability. The sustainability of business spaces is discussed further below.

1.1.1. Sustainable business environment

The definition of business environment is similar to what is referred to as quality inputs or social infrastructure in economic literature. In other words, the meaning of the business environment is the factors influencing the reaction of economic units, such as the quality of governance institutions, the stability of laws and regulations governing these spaces, the quality of infrastructures, and so on, and changes in this field go beyond the scope of this field. It is the authority and power of economic enterprise managers (Hall & Wagner, 2012). Every person is somehow connected to and influenced by these spaces; on the other hand, business units are also influenced by and have an impact on the environment. Faizpour (2013), on the other hand, defines the business environment as the political, institutional, and behavioral environment that influences the efficiency and risks of economic activities and investments. Give the Figure below depicts the general atmosphere of the company at a glance.

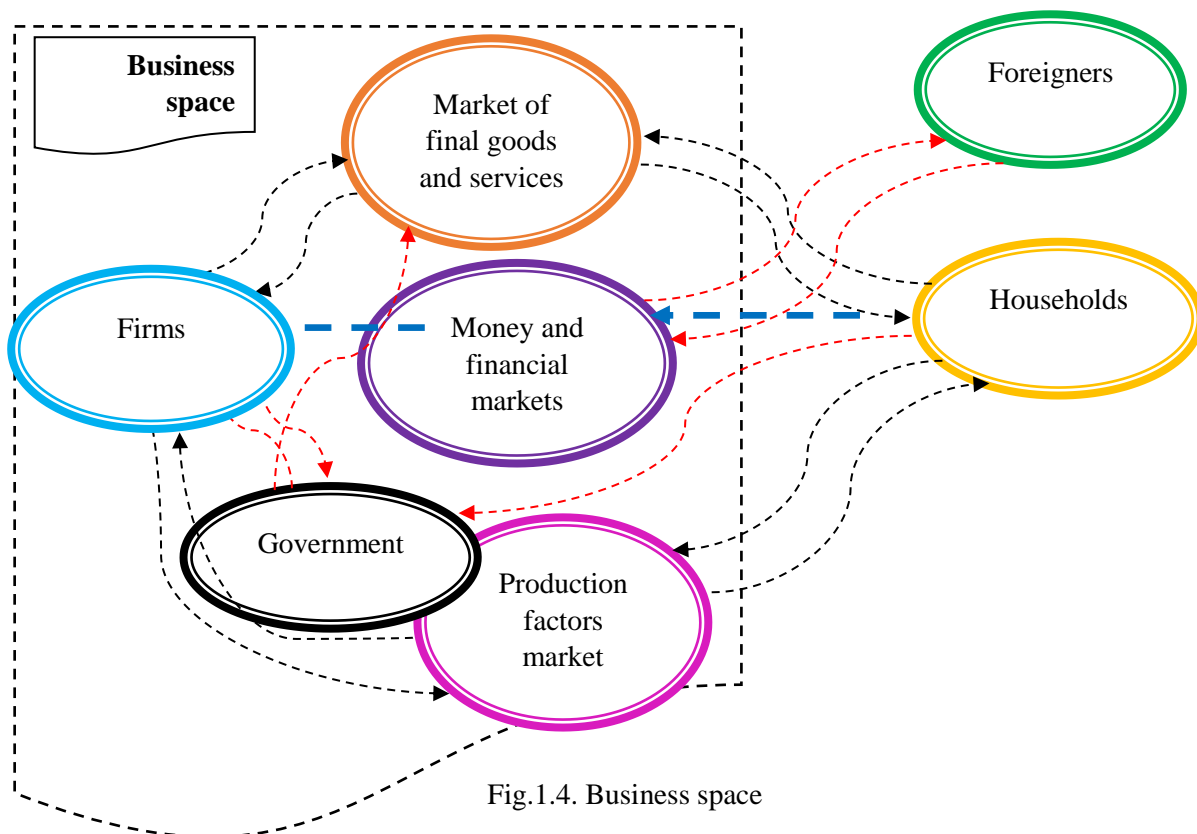


Fig.1.4. Business space

Karimzadeh, 2010.

To ensure the success of these spaces, people's abilities, capabilities, and experiences, as well as the use of group decision-making models, successful and sequential planning methods, the existence of alternative programs, and free education that leads to the development of knowledge are critical (Cabrera-Suárez & Martín-Santana, 2012; Zhang et al. 2021). De Man and Luvison (2019), on the other hand, described how to manage and coordinate between business spaces, implement diverse and unique services and products, increase company capacity, provide successful business models, manage risk, and assign roles and responsibilities to capable people in this field. They have mentioned critical factors that will ensure the success of these spaces Kurt et al. (2020) believe that trust, adherence to ethical principles, solidarity, participation in society, spirituality, personal beliefs, business, social, and cultural relations between countries, and the existence of business networks all play a role in the success of these organizations. Now, some other researchers believe that the existence of social capital, which has increased the field of social relations and connections between entrepreneurs, is the most important factor in achieving an ideal business environment; this issue has provided the foundation for creating new job opportunities and social trust (Pratono, 2018; Agyapong et al., 2017; Clarke et al., 2016; Akintimehin et al., 2019). In general, the factors that have the greatest influence on business spaces can be classified in the Figure below.

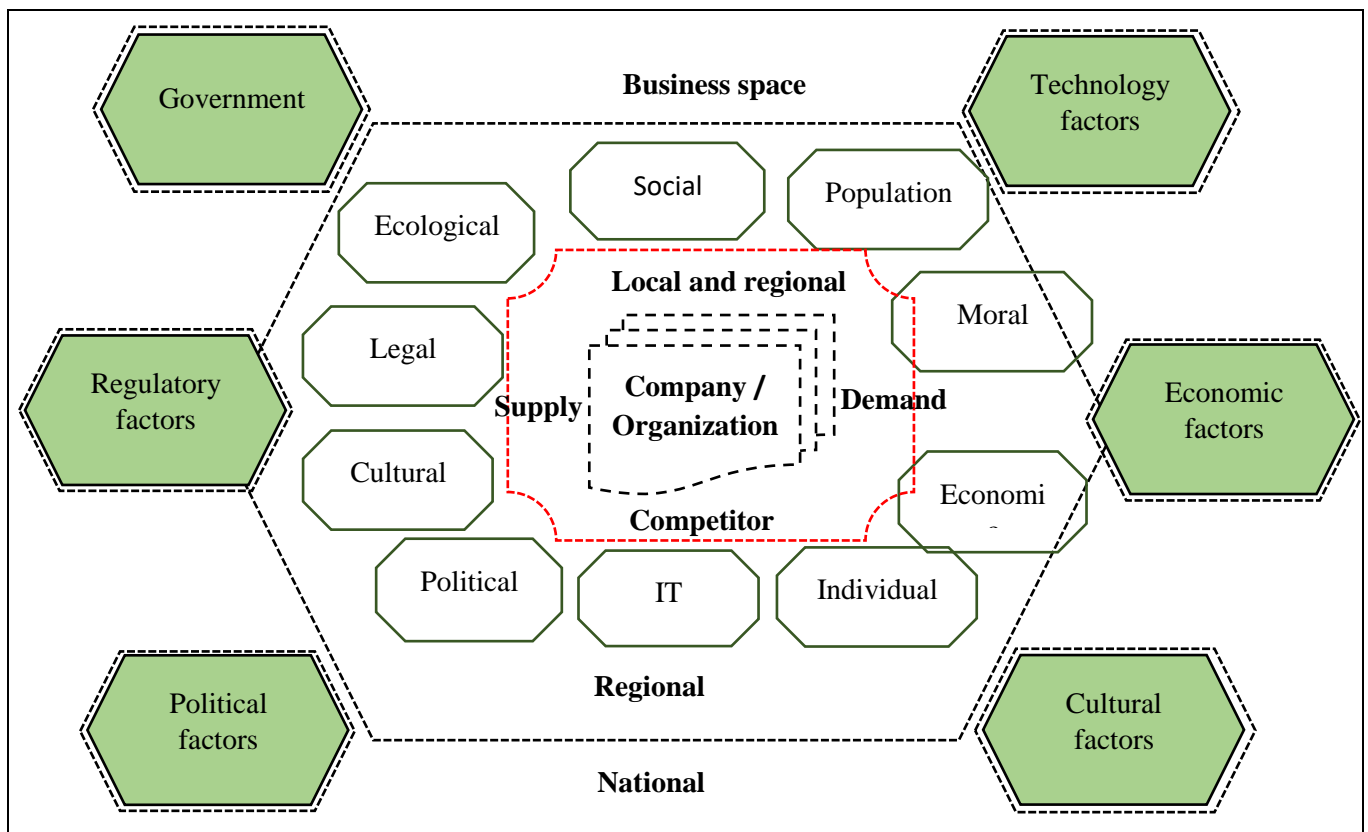


Fig.1.5. A summary of the factors influencing the business environment.

Despite the fact that the concept of sustainability was first used and popularized in response to human-caused environmental destruction, business development has faced serious challenges in recent years, particularly due to an overemphasis on economic dimensions and profit maximization. The concept of sustainability has also been included in the business literature as a tool for balancing and reconciling the ecological, environmental, and social aspects of businesses with their financial and economic aspects, and the concept of business sustainability has increasingly attracted the attention of various researchers and experts. This issue considers not only financial sustainability, but also social and environmental sustainability, and in order to achieve it, we must pay attention to businesses that are more environmentally friendly, as well as sustainable supply chains (Brehmer et al., 2018). Achieving this level of sustainability necessitates extensive collaboration among various actors and provides a clear framework for the business environment (Yang et al., 2017). On the other hand, the concept of sustainable business incorporates socially responsible business, which entails the establishment of a company with positive relations with the society and environment in which it operates, and the company's relationship with society and the environment is a key factor in its ability to function effectively (Eftekhari, 2014). Indeed, numerous studies and researches have been conducted in the field of company profits from the implementation of sustainability methods. In terms of

competitive debate, a suitable sustainable strategy must first be a suitable business strategy that is compatible with the company's value and its opportunities and threats, and the issue that has been confirmed in the field of sustainability, the discussion of strategic theories, and its practicability (Mirchindani & Ikerd, 2008). Organizations' business sustainability is now influenced by identifying and measuring their people (employees, customers, shareholders, etc.). In this case, some researchers have introduced a sustainable strategy, but only a few empirical studies of researchers have determined what specific characteristics can help us achieve sustainable business implementation (Epstein, 2008). Heller and Wizander (2011) have explained how to achieve a sustainable business strategy in the following figure.

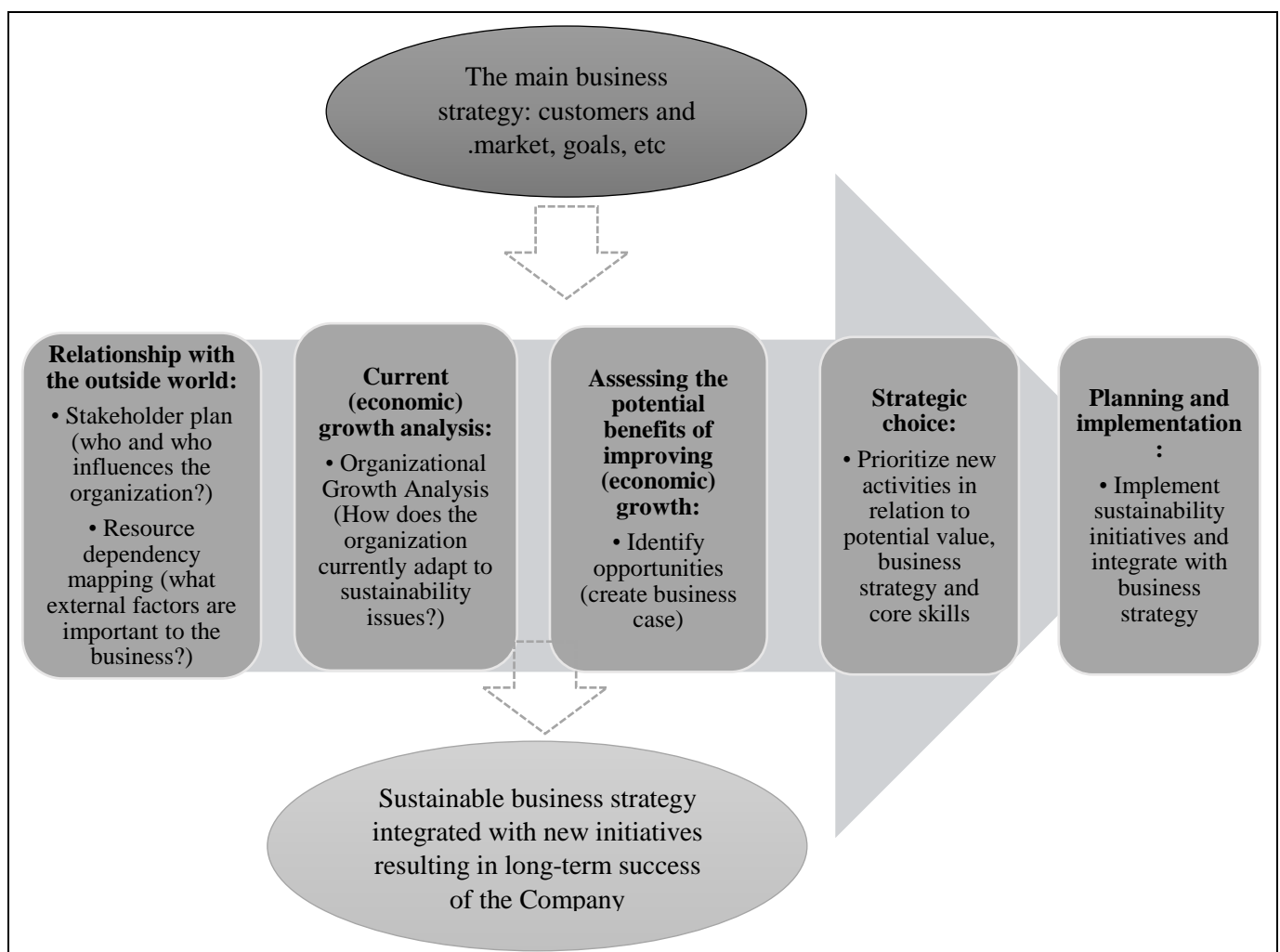


Fig.1.6. Sustainable business strategy

Heller & Wizander, 2011: 47

This is why business researchers place an emphasis on describing and identifying factors influencing the sustainability of business spaces (Johnson et al., 2008). Furthermore, a more systematic concern is the extent to which the modern economy is harming the environment, as

environmental and social costs of production are rarely factored into profit calculations. Solutions based on government policy that seek to reduce environmental costs have made little progress (McKinnon et al., 2010; Paavola, 2007).

It should be noted that these concerns and unsustainability are not only a result of economic activity but also social, cultural, and political activity, as well as the way of life that people lead (Casey et al., 2020; Price et al., 2020). Due to this, the focus on leading a sustainable lifestyle has been replaced with efforts to build a sustainable society and sustainable business environments. To achieve a sustainable lifestyle economically, socially, and environmentally, sustainable societies have therefore received a lot of attention in the past ten years.

To achieve this sustainability, a specific pattern must be followed. Ecovillage, the world's most recognized and significant example of sustainable bell style, is discussed here (Kirby, 2004; Kasper, 2008; Hall, 2015; Dawson, 2015; Adalilar et al., 2015; Zaheri & Saadi, 2018; Barani et al., 2018; Khorasani & Saadi, 2020; Casey et al., 2020; Almeida Fonseca et al., 2022).

These communities are experimenting with ways of living that prioritize ecologically, relationally, economically, and socially sustainable practices. Ecovillages have demonstrated ways of living collectively in community economies as sites of experimentation and adaptation to sustainable lives in diverse local contexts (Roelvink & Gibson-Graham, 2009).

1.2. Ecovillage

Joining the emergent set of civil society regenerative and localized solutions (Wahl 2019; Norberg-Hodge 2019), the ecovillage movement proposes a feasible whole system design toward sustainable ways of living (Global Ecovillage Network – GEN 2020). Meanwhile embodying potential pathways to promote greater connection with oneself, with others, and with nature itself, ecovillages are being recognized for prefiguring small-scale transition possibilities toward a resilient, equitable, and ecological society (Trainer 2000; Jackson, 2004; Waerther, 2014; Hong & Vicdanb, 2016; Dias et al, 2017; Casey et al., 2020). Therefore, grassroots initiatives are increasingly receiving attention from the international scientific community, although they are still being neglected by public policies to address such objectives (Roysen et al. 2021). Therefore, in this section, we will discuss the history of its origin, concept, Perspectives, successful ecovillages around the world, and ecovillage experiences in Iran and France.

1.2.1. The history of the Ecovillage

In the first step, we discuss the causes of the global emergence of ecovillages, which, according to studies and research, have been influential in the emergence of this model. The emergence of various movements such as the feminist movement, the environmental movement, the anti-capitalist movement, and so on is one of the primary reasons for this.

In this regard, the emergence of the ecovillage model can be based on a critical approach in the ecological, feminist, and anti-colonial movements, as well as against consumerism culture, which is based on the living model of societies with current models based on traditional development (modernism) and program. There have been some rational criticisms, which have been mentioned.

Indeed, it could be argued that the Ecovillage movement emerged as a green and sustainable living model for planning and developing communities because of the preceding movements (Vazin, 2011). Hence, the first ecovillage conference was held at the 1995 annual conference in Scotland, which was attended by hundreds of supporters of this movement. Following the conference, many of the participating communities formed the Global Ecovillage Network. This movement began with a group of 25 people from various countries, and Denmark provided the network with its initial capital for the first five years (Kasper, 2008). The goal of establishing such a network was to support and sustain a sustainable way of life in human communities while also connecting different cultures and countries. The goal of establishing such a network was to support and sustain a sustainable way of life in human communities while also connecting different cultures and countries. Among the many goals of this network is the facilitation of the exchange of knowledge and information about ecovillages around the world, the sharing of information via the Internet, the expansion of common social programs and activities based on fundamental values, the strengthening of global cooperation and joint activities, the creation of a village network compatible with the global environment, physical and planetary projections with various cultures that are united in close proximity, and the creation of a village network compatible with the global environment (Adalilar, 2015; Jackson, 2004, GEN, 1995).

In general, the Ecovillage concept emerged in 1996 with the goal of developing and establishing communities based on ecological, environmental, social, and economic systems, as well as the principles of sustainable development (Kasper, 2008; Farkas, 2017). Finally, the United Nations included Ecovillages in its top 100 list of desirable models for sustainable living

for the first time in 1998. In addition, the United Nations concluded in 2000, based on UN reports, 850 scientists, and more than 30 environmental institutions, that current conditions are unsustainable and intolerable (Whang & Woolee, 2006). Repeated activities and efforts are made in this direction to form these ideal and sustainable societies, which are discussed further below.

- ❖ In the 1960s, a plan and a project in this field were launched, including Findhorn in Scotland and Farm in Tennessee (state) (Hu & Wang, 1998; Adalilar, 2015).
- ❖ Many activities were carried out in Jiande, China, in the 1980s to change lifestyles, reduce environmental impacts, increase activity and social environments, and achieve self-sufficiency in rural areas (Hu & Wang, 1998). The Wangsanit Ashram project in Thailand was founded with the goal of changing consumption patterns and alternative lifestyles, environmental sustainability, and cultural diversity. In addition, the Panya project worked to broaden the spiritual, emotional, and social realms in order to ensure the long-term viability of rural communities. In Japan, however, a plan to develop an eco-village model based on border rural areas, remote mountainous areas, and exemplary agricultural areas has been proposed (Takeuchi, 1998; Boonkaew & Roongtawanreongsri, 2018).
- ❖ In 1991, Robert and Diane Gilman presented a report on new forms of sustainable global communities in the Gaia trust, with the goal of broadening the environmental movement's mainstream (Rubin, 2019), and this action was pivotal in the development of the Ecovillage model.
- ❖ The Canadian Ecovillage Network was established in 1997 with the goal of promoting rural sustainability. In the same year, the Sieben Linden project was launched with the goal of protecting the environment and natural resources, reducing energy consumption through technology and innovation, and increasing village self-sufficiency (Global Ecovillage Network, 2005; Jackson, 2004; Bate, 2003).
- ❖ GEN participated in the International Habitat Conference in Istanbul and the World Summit in Johannesburg in 2000.
- ❖ The Bingzhong Ecovillage project in China was founded in 2002 with the goal of promoting eco-agriculture and organic farming. This project used farm effluents and designs to implement biogas (Duan et al, 2011).

In general, activities and projects involving ecovillages increased significantly between 2000 and 2020. Among these activities are the "international conference of the global ecovillage

network of Oceania and Asia" with the goal of sustainable development, as well as the "meeting of global ecovillages in Sangam," where 1400 traditional villages were converted into ecovillages based on their location and environment. These meetings and conferences laid the groundwork for a greater emphasis on the discussion of sustainability and the Ecovillage model. Hence, thousands of ecovillages have been established in various countries based on their location and natural environment. Among these countries are the United States, Scotland, Australia, India, Sri Lanka, Tibet, Argentina, Mexico, Brazil, Senegal, and others.

1.2.2. The Definition

An ecovillage is typically a small community united by a unified social structure and founded on environmental, social, and spiritual values. Depending on the circumstances, these communities could be urban or rural, with one having a high level of technology and the other having a low level of technology. What these two societies share is a deep appreciation for nature and humans as integral parts of the natural cycle. The goal of Ecovillage is to integrate the social, environmental, economic, and sustainability dimensions, with human societies as an integral part of the ecological approach (Bates, 2003: 4). Dawson, on the other hand, believes that ecovillages are extremely diverse and that it is impossible to describe a model that encompasses all cases and characteristics. The reason for this is due to socio-cultural and environmental differences (Dawson, 2015). Finally, in this regard, the following definitions can be advanced:

- ✚ Ecovillages are more concerned with lifestyle, emphasizing the reduction of environmental impacts, social changes, and appropriate new and innovative technologies (such as waste management technology, renewable energy, and so on) (Wagner, 2012; Würfel, 2012).
- ✚ Ecovillage is a deliberate, rural or urban community that integrates sustainable environmental, economic, social, and cultural dimensions in order to restore social and natural environments (Dias et al, 2017).
- ✚ Aside from attempting to establish a sustainable lifestyle, ecovillages seek to achieve exchanges and up-to-date world experiences, as well as to improve the state of technology and communication (Litfin, 2014; Lockyer, 2010).
- ✚ Ecovillage is a human-scale development in which human activities are integrated into the natural environment, with the goal of minimizing the effects of human activities on

the environment and the interaction of people in society (Gilman 1991; Kirby, 2004; Litfin, 2014).

- ✚ Ecovillage is institutionally defined by the Global Ecovillage Network as an “intentional, traditional, or urban community that is consciously designed through locally owned participatory processes in all four dimensions of sustainability (social, culture, ecology, and economy) to regenerate social and natural environments” (Global Ecovillage Network – GEN 2022).

To provide a comprehensive description, we must acknowledge that numerous definitions of these communities exist, as each ecovillage is unique in terms of geography, culture, and community. But the most comprehensive and precise definition is that an ecovillage is an intentional, traditional, or urban community that uses local participatory processes to integrate ecological, economic, social, and cultural dimensions of sustainability in order to regenerate social and natural environments. Environmental, residential, economic, and social metrics are interrelated (GEN, 2022; Gilman, 1991; Aoki Bissolotti et al., 2006; Waerther, 2014). According to several research and instances of ecovillages around the world (Esteves, 2017; Pickerill, 2017). The lifestyle of an ecovillage defines these commonalities not just as shareable areas, but also as a social activity governed by a commitment (Pickerill, 2016).

Therefore, Ecovillage emphasizes all aspects of a settlement as well as all aspects of sustainability, as well as an integrated and holistic approach to achieve a consistent and sustainable model. Many authors believe that the ecovillage model integrates environmental, economic, and social ways of life in settlements (Gilman 1991; Jackson & Svensson, 2002; Bates 2003; Jackson & Karen, 2002). As a result, Hong and Vicdanb proposed the following as part of a sustainable lifestyle in the Ecovillage.

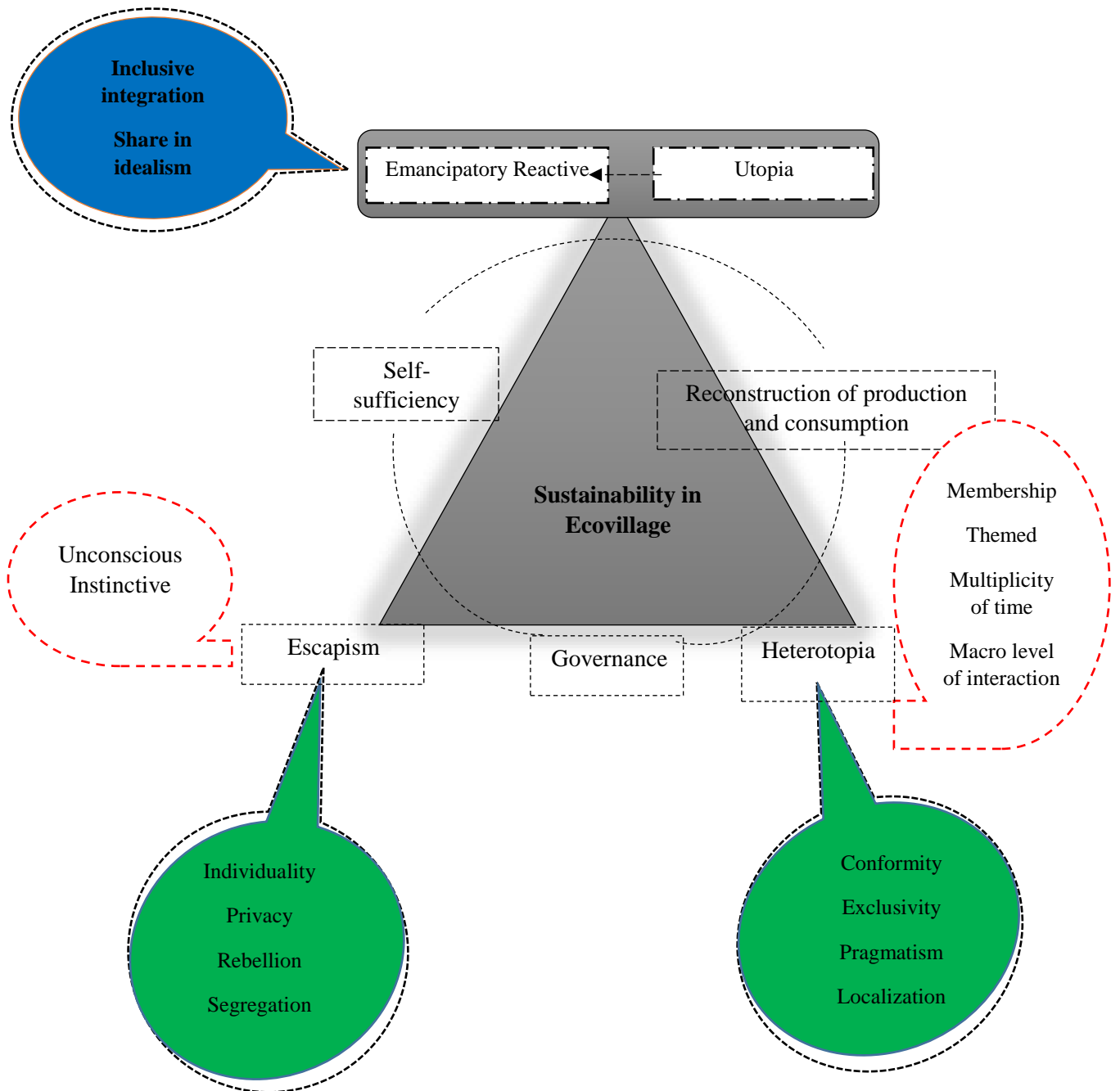


Fig.1.7. Part of a sustainable lifestyle in Ecovillage, Hong & Vicdanb, 2016.

In general, ecovillage is an important and key concept in creating sustainable settlements and human habitats around the world and in all nations. When it comes to environmental issues, most of the solutions proposed are on a global scale, despite the fact that the problem exists at all levels of society and that solutions should be implemented on a smaller scale (Breton, 2004). Ecovillages are local rural or urban communities that strive to achieve a combination of a supportive social environment and a low-impact lifestyle. They combine various aspects such

as ecological design, green products, alternative energies, and many other topics to achieve this goal. In other words, an Ecovillage is a society that is consciously designed to recover the social and natural environment through ownership, local rights, and collaborative processes (Duan, 2011). According to the cases mentioned, ecovillages are communities that strive to achieve socio-cultural and economic sustainability by reducing environmental impacts. Finally, as an integrated model, these societies are concerned with the sustainability of societies in ecological, economic, social, and cultural dimensions.

According to researchers, there are ten basic characteristics of a successful ecovillage (Kasper, 2008, Joseph and Bates, 2003; Sevier et al, 2008; Jackson, 2004; Svensson, 2002):

1. There is a conscious effort in every ecovillage to develop the social environment, create a sense of belonging, and meet people's social needs.
2. Using the latest technologies. For example, using solar and wind energy.
3. Standardization of all development aspects.
4. Creating job opportunities for the people who live in these communities.
5. The requirement for well-planned architecture and landscaping.
6. Careful planning to protect the environment (not using a motor vehicle and instead using a bicycle, etc.)
7. Appropriate social management initiatives.
8. Increasing residents' purchasing power and affordability.
9. Concern for nature and its preservation.
10. The participation of local governments is required to sustain ecovillages.

In general, the compatibility with the ecovillage environment is depicted in the figure below based on its main dimensions.

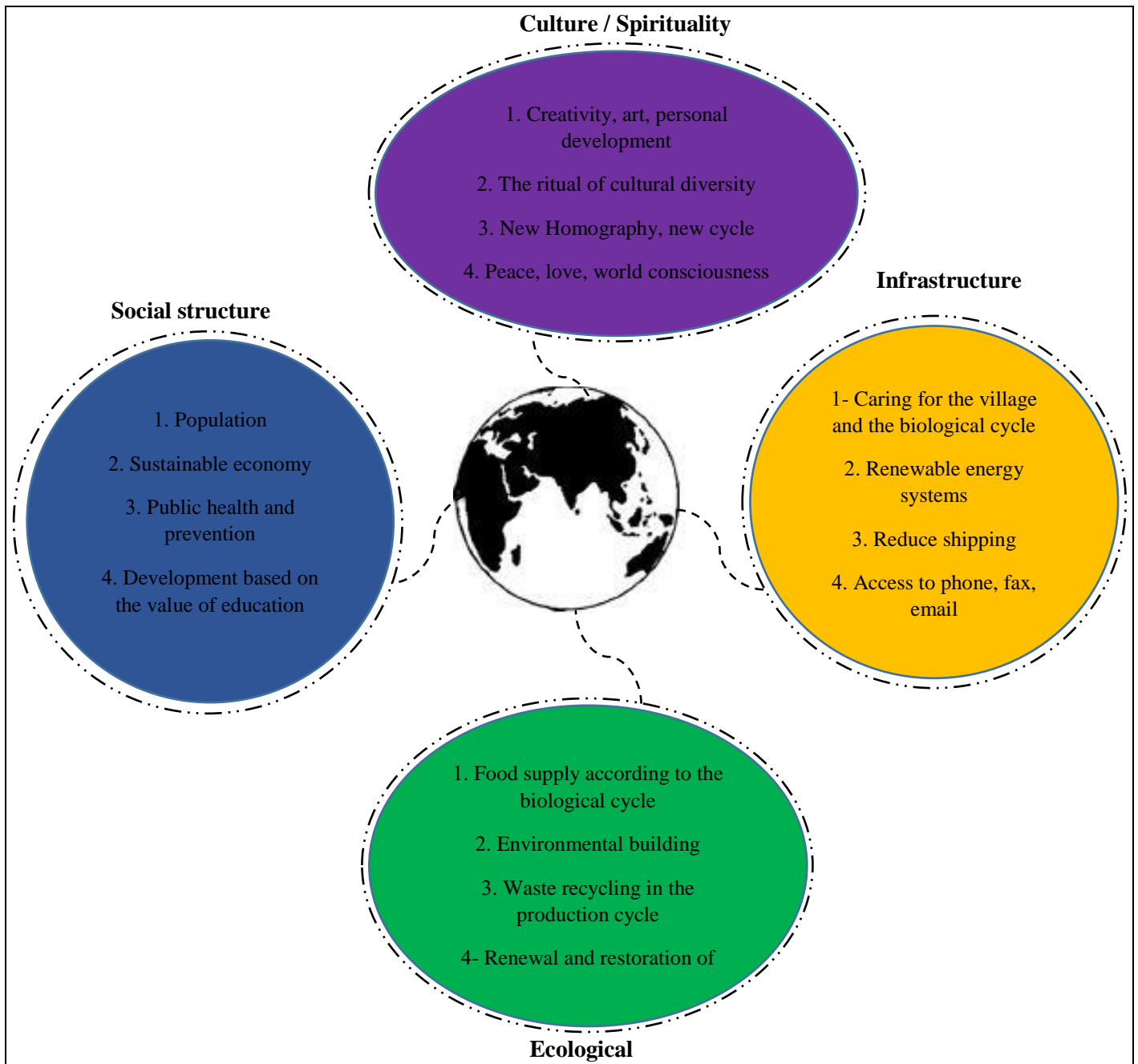


Fig.1.8. Adaptation to the Ecovillage environment, Jackson, 2004.

1.2.3. The perspectives

Many ideas and perspectives have played a role in the formation and emergence of the ecovillage model, according to studies and reviews, and we will analyze and review the most important of them here.

Subsistence Perspective

Since the idea of global economic growth was legitimized by development policy, the concept of "subsistence" has been opposed to the concept of globalization. During this time, the fight

against the subsistence economy had become the goal of development policy; on the other hand, development policy had made economic profit the main axis of every decision, and consumerism had replaced traditional culture. This problem resulted in industrialization and social instability. Although this viewpoint was proposed as ecofeminism in 1993 by two theorists named Maria Mies and Vandana Shiva, and in 1980 Carolyn Merchant wrote an article titled "The Death of Nature" in which she reformulated ecofeminism to critique colonialism, exploitation, and paid patriarchy, which had laid the groundwork for the destruction of natural and environmental resources and, ultimately, the death of nature (Bennhold-Thomsen, 2014). Therefore, Mies and Bennhold-Thomsen, two German sociologists, formally proposed the Subsistence approach in 1999. They consider subsistence to be a set of basic human needs for daily life. This viewpoint seeks freedom, self-sufficiency, and autonomy, as well as a holistic life model, spirituality, and human dignity. In general, this point of view has emphasized the ecological principle and bottom-up politics while opposing the modern industrial system, colonialism, patriarchy, and so on (Rosenblatt, 2005).

The following are briefly emphasized by the subsistence approach (Bennhold-Thomsen, 2014; Bennhold-Thomsen & Mies, 1999):

Emphasizing satisfaction and basic needs over capital accumulation and profit accumulation,

Preventing privatization and exploitation of nature,

Focusing on subsistence production rather than commercial-industrial production,

The emphasis is on decentralized and regional-local economies,

Supporting feminist and anti-racist viewpoints,

Minimizing environmental impacts and respecting nature,

Emphasizing organic farming.

Many characteristics of Ecovillage, such as preventing privatization, emphasizing the local economy, the dominance of feminist and anti-racist views, and so on, have been derived from the subsistence approach, according to the above. The theory of ecosystem management, which we explain below, is one of the approaches that played a role in the formation of ecovillages.

Ecosystem Management Approach

Human activities, population growth, and industrialization have all had a negative impact on ecosystems and natural resources over the last few decades. Traditional methods of natural resource management and management approaches, on the other hand, have frequently produced unfavorable results and have prioritized short-term sustainability and economic profit over long-term sustainability (Pavlikakis & Tsihrintzis, 2000). This issue served as the impetus for focusing on new natural resource management strategies. Many theorists and scientists became aware of the ecosystem-based approach in 1980, and in 1988, Agee and Johnson published the first book in the field of ecosystem management, in which they presented the theoretical framework of sustainability in ecosystems (Neace, 1999; Haeuber and Franklin, 1996). Subsequently, many scientists considered it an approach in 1991. In general, the ecosystem management approach was proposed in order to reduce the pressure on natural resources, the extinction of biological species, and the environmental effects. This method is a strategy for the integrated management of land, water, and living resources that serves as the foundation for their protection and long-term use. The theorists proposed this theory with the goal of reducing environmental pollution, developing new technological solutions to eliminate pollution, improving biodiversity, and so on (Valavanidis, 2018). Finally, the main goal of this perspective can be considered the socio-cultural understanding of environmental issues and the solidarity between people and nature. So that it adjusts the role of humans in nature and the environment (Mazmanian & Kraft, 2009). The ecosystem management approach is founded on principles (Pirot et al, 2000; Grumbine, 1994; Yaffee, 1996).

- ❖ Hierarchical Context: Biodiversity should be considered at multiple scales and at all levels (ecosystems, landscapes, etc.),
- ❖ Environmental boundaries: First, the complexities of ecosystem boundaries (including sub-regions) must be defined using political, environmental, and geographic boundaries,
- ❖ The use of ecological models and correct ecological integrity is emphasized.
- ❖ Management results should be monitored on a regular basis using clear and operational objectives,
- ❖ Economic activities: emphasis on economic activities and sustainable business spaces, as well as minimizing negative environmental effects,
- ❖ Managers must decide how to implement plans and achieve long-term goals through adaptive management,

- ❖ Collaboration: Inter-organizational collaboration is required for management integration.
- ❖ Ecosystem management must identify economic issues, human interests, motivations, and values that affect the ecosystem and its inhabitants,
- ❖ Aquatic ecosystem biological diversity, agricultural biodiversity,
- ❖ Forest biological diversity.

In general, this theory emphasizes the importance of natural resources in urban-rural communities, as well as the restoration of ecosystems for socio-cultural development. Ecovillages, on the other hand, place a strong emphasis on preserving and revitalizing ecosystems. Hence, this approach has played an important role in the establishment of ecovillages. Another aspect of ecovillages' existential philosophy is the enhancement of social development interaction in human societies. The issue of social interactions in these societies is so important that Iris Kunze proposed a theory in relation to ecovillages called the theory of Transformative Social Innovation.

Transformative Social Innovation Approach

Iris Kunze proposed this theory in 2015, arguing that the most important goals of ecovillages are innovation and change. Along with innovation, he has frequently used the phrase "A new culture," and he believes that ecovillages have a wide range of goals for regulating this new culture. The slogan "Unity in Diversity" is one of these objectives. This term refers to the incorporation of various cultures (religiously, racially, ethnically, etc.) into a single culture. This theory, on the other hand, believes that ecovillages can connect agriculture, government, ecology, and society. Individual empowerment, according to Kenzo, is the main pillar of ecovillages' existential philosophy, and ecovillages are fundamentally self-organized and based on responsibility. In other words, empowerment causes people to resist environmental and economic crises, resulting in self-sufficiency and independence in the local economy. Finally, they believe that increasing awareness (in terms of culture, worldview, social, economic, and ecological) and social skills, as well as improving access to educational fields, are necessary and essential in order for an ecovillage to be successful. In general, he depicts Ecovillage's dynamism and social innovation as follows (Kunze, 2015).

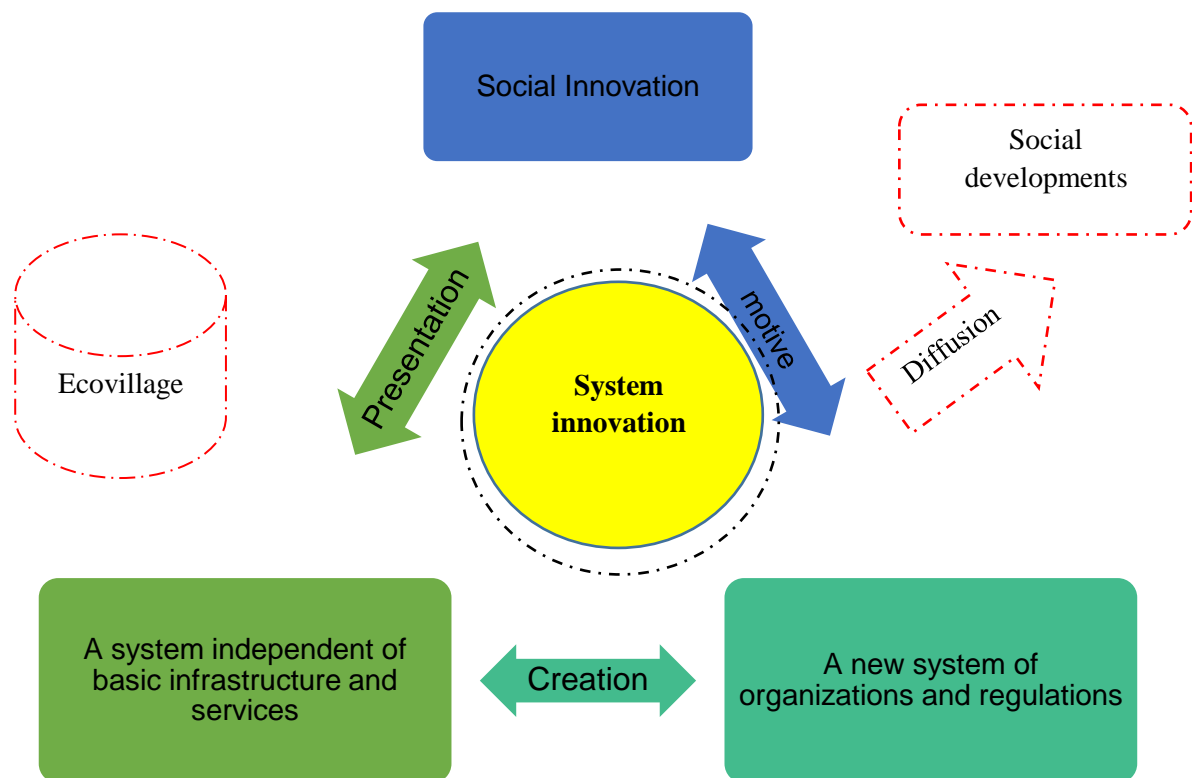


Fig.1.9. Dynamics and social innovation in ecovillage, Iris kunze, 2009.

Ultimately, since the ecovillage model is a model for designing sustainable societies, it is critical to focus on design approaches in this field.

Approaches to Ecovillage Design

As previously discussed, the ecovillage model suggests a type of design that can be suggested based on the indicators studied, management and planning, strategy presentation, pattern design method, and so on. Various approaches and opinions have been presented in this context, and we will discuss the most important of them in the following, namely the two approaches of ecological design and the approach of permaculture design (Vazin, 2011).

Ecological Design Approach

The ecological design approach was proposed in order to deal with environmental crises, increase damage to ecosystem biodiversity, and develop environmentally harmful economic activities. Shu-Yang et al. (2004) believe that some ecological design ideas have ancient roots; for example, in the past, they have placed a high value on more sustainable agricultural methods, biodiversity preservation, and land quality preservation. Apol (2010) also believes that this approach incorporates the human-nature relationship in the direction of environmental

sustainability. In general, this approach can be defined as a component of sustainable development, which necessitates the design of energy-efficient settlements and the selection of appropriate and long-lasting materials (Edwards, 1999: 124). In addition, this approach emphasizes sustainable production and consumption, organic farming and local food production, appropriate water and energy technology, and green construction in order to achieve sustainability (Gegg & Wells, 2017). Finally, the following are the basic principles of the ecological design approach (Gegg & Wells 2017; Kim and Rigdon, 1998; Apul, 2010):

- A holistic system approach to ecological design;
- Appropriate water system technology;
- An emphasis on local and sustainable food systems
- Green and durable construction: use of locally available materials;
- Resource conservation; life cycle;
- Improving the interaction of humans and nature.

Therefore, this viewpoint is multifaceted, emphasizing green architecture, sustainable agriculture, and environmental restoration, with an emphasis on human creativity, flexibility, participation, and adaptation to environmental changes (Gegg & Wells, 2017).

Permaculture Design Approach

It became clear at the end of the nineteenth century that a more efficient agricultural system was required to provide food. As a result, despite the green revolution and the use of pesticides, chemical fertilizers, and modern machinery, agriculture made no progress in the 1960s (Krebs & Bach, 2018). As a result, theorists and scientists worked to shift the paradigm from industrial agriculture (guided by the Green Revolution) to sustainable agriculture based on ecological principles (Altieri, 1989; Callicott, 1987). The groundwork for paying attention to permaculture was laid from that point forward. Until Bill Mollison and David Holmgren proposed this approach in 1974. This term is a combination of sustainable agriculture and sustainable culture. Permaculture is defined as the design of thoughtful landscapes that are consistent with natural relationships and standards, as well as increasing local food to meet basic needs (Holmgren, 2002). Permaculture is thus a design science that employs an innovative system to consciously design landscapes, human settlements, and agricultural systems and integrates them with systems of nature compatibility, biodiversity, and biology. According to this viewpoint, sustainability is achieved when a system generates more energy than it requires to function (Brush, 2013). Furthermore, this approach has greatly aided in the

development of the ecovillage model, and its significance began with the emergence of the ecovillage (Bang, 2005). Finally, the following are the basic principles of this viewpoint (Mollison, 1991; Bang, 2005; Brush, 2013; Bohler, 2017):

- A tool for integrating the design of sustainable systems;
- Link to the design of the analysis system to detect the comprehensive pattern;
- Designing sustainable transportation systems to protect the environment and improve waste management;
- The cultivation and existence of a flexible culture in order to design sustainable systems;
- Developing an educational program that adheres to moral principles, respect for nature, and respect for the same species.

Permaculture design is, in general, a multifaceted, integrated, and environmentally friendly approach to human-centered landscape design. Human-centered means that an ideal plan for achieving culture can achieve many of the needs of a human family or community in its immediate surroundings in an efficient and sustainable manner (Bohler, 2017).

In general, the design of an ecovillage in any country's urban-rural communities is one of the environmental issues that not only influence people's consumption patterns and lifestyles but also play a significant role in achieving these communities' long-term development. This issue affects not only local communities but also regional and national communities.

1.2.4. Global experiences of ecovillages

In this section, for a better understanding of well-known ecovillages around the world, a brief introduction to ecovillages in various countries is discussed.

1.2.4.1. Findhorn Ecovillage Model in Scotland

Findhorn Ecovillage, which is nearly 30 years old, can be considered the world's first ecovillage and is known as 'the mother of all ecovillages' (Liftin, 2014). This village was built with the goal of being environmentally friendly, and its first activity was the installation of wind turbines, which cost 75,000 pounds. This 75 kW wind turbine (Vestas-V17 type) supplied 20% of Findhorn's electricity needs and 10% of the residents' total energy. Because of the installation of this turbine, the villagers received less electricity from the national grid. The people of Findhorn were able to fully pay for the turbine's purchase and installation within 5 years by taking advantage of the resulting financial savings. On the other hand, activities in the

field of solar systems and the implementation of organic agriculture led to it becoming England's first and largest ecovillage in 1994. It also received the United Nations' best village award in 1998. (Sevier et al, 2010). As a result of the organization's success in using appropriate technologies in the restoration of natural resources, healthy population nutrition, green entrepreneurship with small industrial workshops, and renewable energy production as a suitable model for spreading the principles of local development around the world, The United Nations is acknowledged and invited to collaborate with UN education and research. Overall, this ecovillage presents itself as an inspiring and long-term solution to eradicating poverty and environmental degradation while also providing a sustainable social and cultural environment (East, 2018).

Another distinctive characteristic of this model is its distinctive architecture, which Findhorn exemplifies. Among the construction features in Findhorn are the following (East & Dawson, 2003):

Use of passive solar features such as window orientation and placement;

Use of solar panels to heat domestic hot water;

District heating system that uses gas density for maximum fuel efficiency;

Use of energy-saving lamps throughout the village;

Non-toxic organic colors and wood preservatives;

Use of natural clay tiles;

Using wooden suspended floors for air circulation.

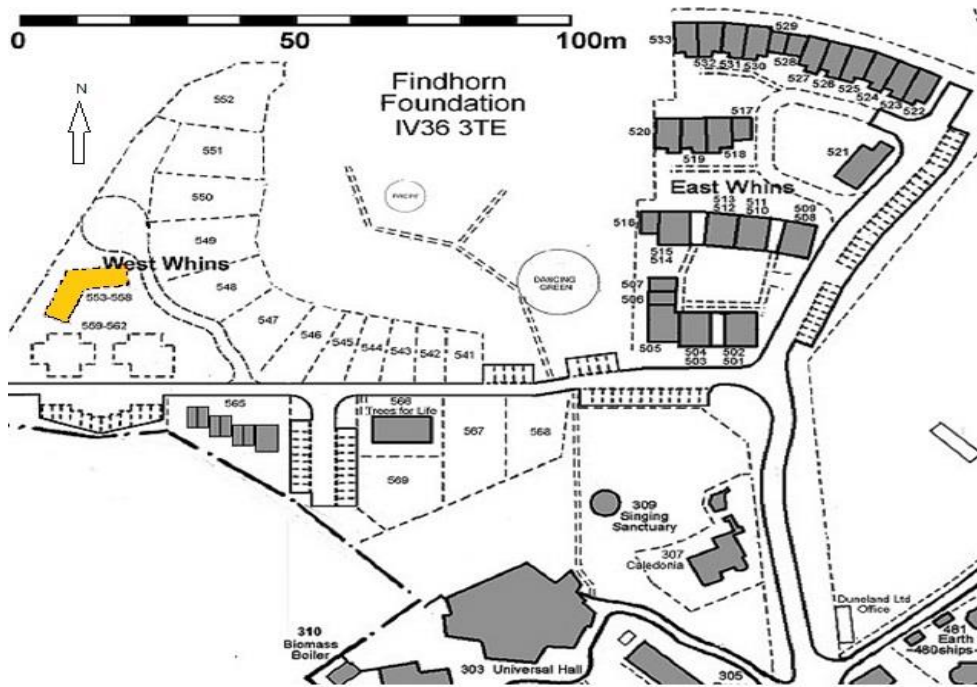


Fig.1.10. Ecovillage model design in Findhorn (Findhorn hinterland.org).

The settlement has improved its nature corridors over the last two decades, with woods, orchards, and berry bushes separating individual areas, connecting them to the surrounding landscape, and providing biological enrichment and orientation. The Hinterland Trust promotes conservation, education, and community building, as well as providing recreational facilities and activities for schools and the surrounding community. It also manages the first Green Burial Site in this part of Scotland (Findhorn Hinterland Trust, 2018).



Fig.1.11. Findhorn Ecovillage: landscape view



Fig.1.12. Findhorn Ecovillage: ecological houses

1.2.4.2. Ecovillage Sieben Linden

The Ecovillage Sieben Linden was founded in 1997 in the community of Beetzendorf in the Altmark - District Salzwedel, Saxony-Anhalt, Germany. Sieben Linden is today one of the best-known ecovillages in Germany. Its goal is to create collaborative and holistic sustainable lifestyles that link a small ecological footprint with a high quality of life (GEN, 2021; Andreas et al., 2012).

Sieben Linden Ecovillage aspires to be both a village and a community that is socially and environmentally progressive. The settlement is intended to house and employ 300 people of various ages and social/cultural backgrounds. The ecovillage's goal is to enable its residents to live as self-sufficiently as possible through self-governance (Andreas & Wagner, 2012).

The ecovillage's structures, which are mostly large houses, are built with high environmental standards and local materials, many of which are made with straw bale insulation and mud plastering. So that the most important factor in this ecovillage's reputation can be considered a wide variety of ecological buildings built on natural building principles. The majority of the energy needs are met by solar panels on the roof, and heating is done with a massive wood-burning stove that efficiently heats all buildings via an integrated system of pipes. All of the toilets on the property are compost toilets, and the water is primarily supplied by their own well and water catchment system. Plants in the waste water system clean water waste.



Fig.1.13. Co-Housing in Sieben Linden Ecovillage

They also have a council system in place that allows all members to participate in decision-making while also striving to be efficient. It also incorporates the two components of environmental protection and social solidarity. Everyone who lives here works hard to build manageable and transparent social structures that promote cooperation and connection between humans and nature (Bocco et al., 2019).



Fig.1.14. Sieben Linden Ecovillage: landscape view

1.2.4.3.ZEGG Ecovillage

ZEGG is an ecovillage on the outskirts of Bad Belzig, Germany, about 80 kilometers (50 miles) south of Berlin. It is a planned community and an international seminar center dedicated to developing and implementing practical models for a socially and environmentally sustainable way of life. This is accomplished through the integration of personal development work, the establishment of a cooperative and environmentally friendly way of life, and participation in political issues. ZEGG, in particular, is interested in exploring novel approaches to love and sexuality, and it has developed and implemented tools for personal expression and trust building in large groups, such as the ZEGG Forum (Wei, 2010; GEN, 2022).

ZEGG was founded in 1991 on a 37-acre (15-hectare) site, with a community of 120 to 400 people depending on the season. An ecological sewage plant, a CO₂-neutral heating system,

an organic vegetable garden, some clay buildings, a meditation room, artists' studios, workshops, a guesthouse, the "Children's Building," and a variety of other rooms and facilities for events and seminars are available on site. ZEGG has been a non-profit organization since 2015. Throughout the year, ZEGG Community hosts several large festivals and numerous workshops. They cover topics like community awareness, communication, love and sexuality, nonviolent communication, the arts, and singing (Hall, 2015).

ZEGG's social goal is to promote a community-based way of life over time, and it has created its own social structure to accomplish this. Members of the community take part in social processes that promote communication, conflict resolution, and personal development. Regular discos, seasonal celebrations, internal lectures and discussion rounds, and other cultural events are also held. Many members of the community work in the seminar industry, which includes catering, lodging, event planning, and seminar delivery. The garden and the site maintenance team are two other areas where members work directly for the community. Members of the community are also self-employed; some work in the area while others work elsewhere. Members are also expected to participate in some community service (Kunze & Avelino, 2015).

The community other aims to get as much of its energy from CO₂-neutral, renewable, and local sources as possible. ZEGG produces all of its own heating. Moreover, a wetland sewage treatment system was constructed in 1992, purifying all of the wastewater from the site in a specially planted marshy area that also serves as a new animal habitat. Three wells provide direct drinking water access to groundwater. Furthermore, ZEGG employs Permaculture as a guiding principle in the development and use of its site. Mulch and green fertilizers ensure that the sandy soil's fertility improves over time. As the soil improved, higher-order creatures such as birds, hedgehogs, martens, toads, and squirrels appeared (Thompson, 2021; Koziol, 2020).



Fig.1.15. ZEGG Ecovillage: landscape view

1.2.4.4. Ecovillage model of Ithaca

The Ecovillage Ithaca (EVI) is located on the outskirts of the town of Ithaca, in upstate New York. The EVI was one of the first ecovillage models in the world, with the goal of improving social relations and interaction, becoming self-sufficient economically, and protecting the environment and ecosystems. This planning began in 1991, and construction of the first Ecovillage began in 1995. This ecovillage is situated on 176 hectares of low-slope land and is divided into 5 blocks, each with 500 residents. These houses are built with the environment and materials available in the area in mind. For greater efficiency, the heating and cooling systems in these residential units have been shared. Public transportation, on the other hand, is being used more to reduce air pollution caused by machinery (Kirby, 2003; Holleman, 2011).

Other actions in this village include the construction of a ski slope and a bicycle track within the village to reduce the use of transportation, the creation of new job opportunities and entrepreneurship, as well as training and meetings on environmental and social sustainability (Fischetti, 2008).

This ecovillage has been involved in many organic agriculture activities, leading to the formation of the Northeast Organic Agriculture Association (NOFA) with the goal of promoting and improving products with the goal of reducing negative environmental effects. Community Supporters of Agriculture (CSA) oversee these farms as well, connecting

agriculture to people and the land. The rural community uses 60% of the products produced on these farms, while 40% are sold in local and regional markets. Finally, this farm feeds a population of 1000 people. One of the reasons for this is Jin and Jan's unique soil cultivation method, which nourishes the soil with green manure and compost. It seeks to reclaim land that has already been degraded because of poor agricultural practices (Walker, 2005).

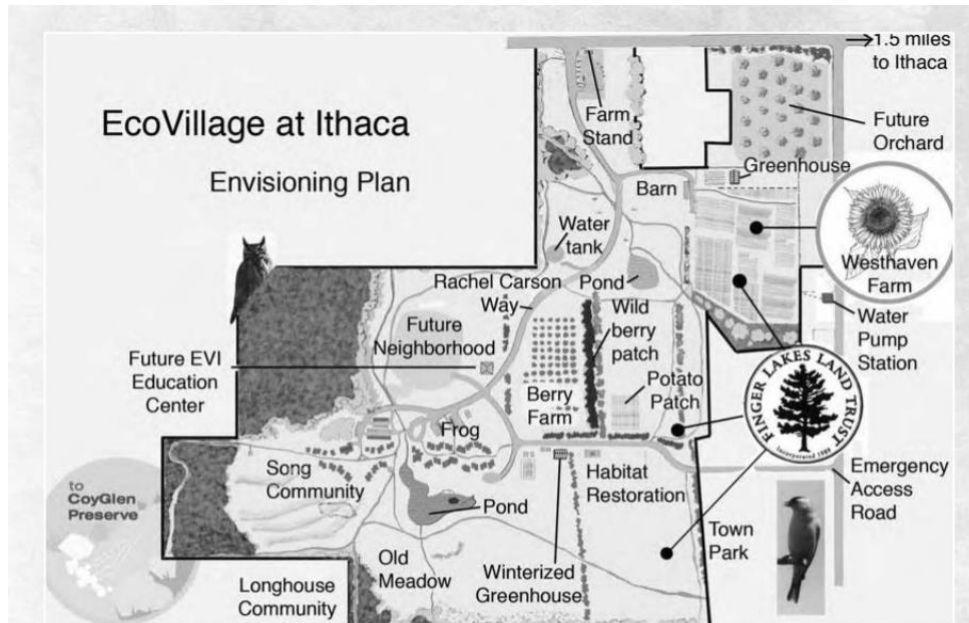


Fig.1.16. Ecovillage model design in Ithaca, Walker, 2005.



Fig.1.17. Ithaca Ecovillage: landscape view

1.2.4.5. Dancing Rabbit Ecovillage

Dancing Rabbit is an ecovillage near Rutledge, Missouri, in the United States. This ecovillage is an experimental intentional community. The Dancing Rabbit Land Trust purchased 280 acres (1.1 km²) of land in northeast Missouri in 1997, establishing the community. Its current on-site population is around 75 people, with plans to grow to a small, locally self-sufficient town of 500 to 1000 people. Dancing Rabbit members all agree to follow ecological covenants and sustainability guidelines. Residents are in charge of their own finances, food, shelter, and other necessities. Residents have the option of joining one of several co-ops. These co-ops provide vehicle, food, health care, showers, phone, and internet services. There are egalitarian communities, cohousing, and individual households in the town. Dancing Rabbit aspires to create an environmentally and socially sustainable culture. Feminism, respect for the arts, consensus decision-making, nonviolence, and nonviolent communication are all part of the community's culture. All Dancing Rabbit decisions are guided by a shared desire for environmental sustainability. The community promotes itself as a viable example of sustainable living, with the goal of spreading its vision through visitor programs, internships, work exchanges, academic and other publications, and speaking engagements (Lockyer, 2017; Lockyer et al., 2012; Demmer, 2017). The following are some general characteristics of this ecovillage:

1. Members will not use or store personal motorized vehicles in Dancing Rabbit.
2. At Dancing Rabbit, fossil fuels will not be used for vehicle power, space heating and cooling, refrigeration, or domestic water heating.
3. All gardening, landscaping, horticulture, silviculture, and agriculture on Dancing Rabbit property must adhere to OCIA [Organic Crop Improvement Association] organic procedures and processing standards. Furthermore, no petrochemical biocides may be used or stored for household or other purposes on DR property.
4. All electricity produced at Dancing Rabbit shall be from sustainable sources. Dancing Rabbit exporting enough on-site, sustainably generated electricity to compensate for the imported electricity must offset any off-site electricity imported.
5. All lumber used in Dancing Rabbit construction must be reused/reclaimed, locally harvested, or certified as sustainably harvested.
6. Dancing Rabbit's waste disposal systems must reclaim organic and recyclable materials.

7. Dancing Rabbit will approach sustainability issues holistically in order to create a sustainable culture that considers all consequences of its actions and works to preserve the Earth for future generations.

8. Dancing Rabbit will work to preserve and rebuild healthy ecosystems, thereby improving biodiversity.



Fig.1.18. Dancing Rabbit Ecovillage

1.2.4.6. Los Angeles Urban Ecovillage

Los Angeles is the second largest city in the United States, and the Los Angeles Ecovillage (LAEV), a two-block, 11-hectare community dedicated to intentional, "whole-systems" sustainable living in the heart of the city, has 500 residents and works to strengthen communities by bringing neighbors, art, and environmental action together. It intends to 'reinvent how we live in the city'. The LAEV emerged because of a community crisis. One group of people who had planned to build a new eco-community on the outskirts of Los Angeles changed their minds and decided to locate their utopian project in a central neighborhood. It was to ban an "intentional community," which can refer to a variety of shared living situations in which "people live together on the basis of explicit common values." This iteration would be notable for its emphasis on fostering a sustainable community, the advancement of bicycle culture, the development of more sustainable urban living practices through education, and an alternative economy for a sustainable economic system. This

ecovillage is committed to various forms of diversity, including racial, cultural, and religious diversity, in addition to environmental sustainability, sustainable transportation, and respect for nature and humans (Lugo, 2015; Lugo, 2012; Ellen, 1999; GEN, 2020).

LAEV believes that the success of an ecovillage is dependent on all residents' participation, their skills, knowledge, and ideas to ensure sustainability, and how it is connected to the rest of Los Angeles. To achieve the development of a sustainable urban society in this society The legal framework for the intentional community and its properties is formed by three nonprofit organizations: the Urban Soil-Tierra Urbana limited equity housing co-op, the Beverly-Vermont Community Land Trust, and LAEVI (the initial and ongoing organization for new development in the neighborhood). The community's small home-based businesses and various activity centers, such as tool shops, art studios, gardens, gyms, food co-ops, and bicycle shops, contribute to the community's resilience. More than a dozen former LAEV intentional community members have taken the lessons learned and started their own ecovillages, eco-co-op houses, or neighborhood retrofits, both in Los Angeles and throughout the state, country, and world. The City of Los Angeles Planning Department included LAEV as one of its programs in its Housing Policies. Today, there are many shared streets, open streets, pedestrian streets, bicycle streets, and traffic calming initiatives, which are implemented through regulation as well as by neighborhoods simply taking over their streets for longer and shorter periods. Many networks and construction projects have been planned and implemented in response to LAEV, with the goal of saving energy and reducing environmental impacts in other parts of the city. Furthermore, city officials are becoming more interested in issues such as sustainability, resilience, and the circular economy (Arkin, 2020; Benfield, 2017; GEN, 2022).

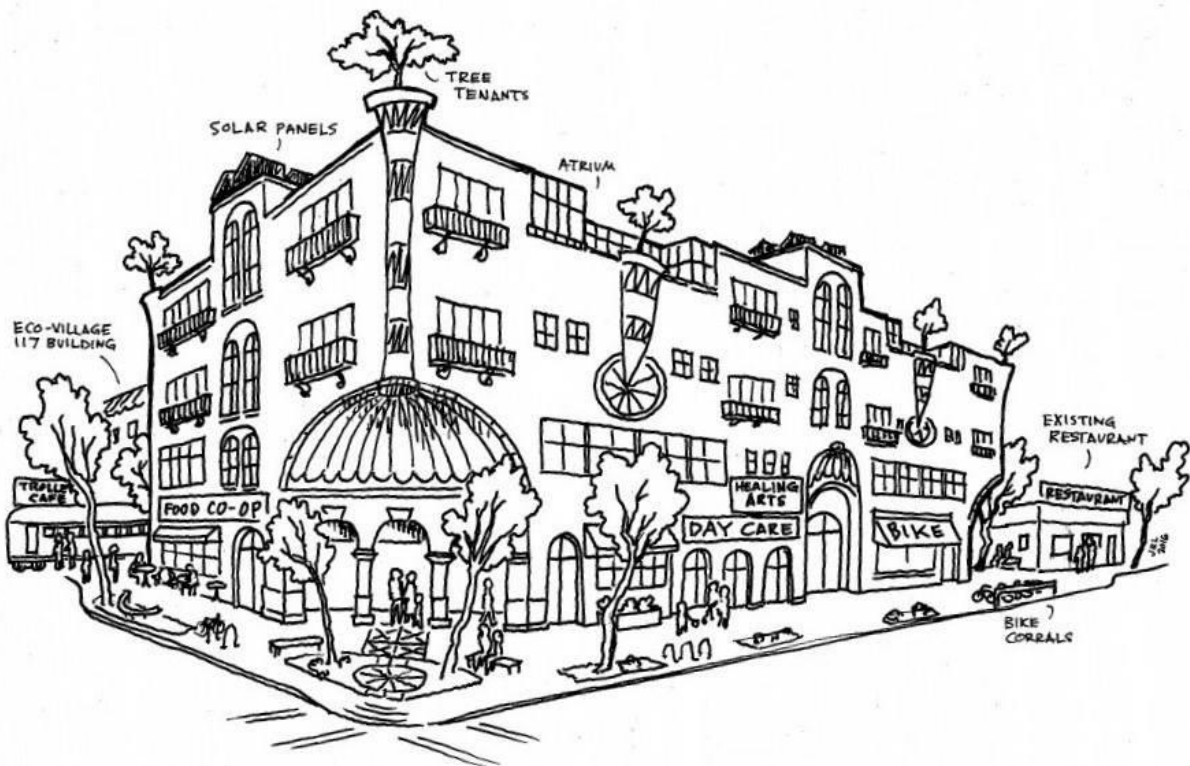


Fig.1.19. The LAEV's partial design view

1.2.4.7. Port Townsend Urban Ecovillage

Port Townsend is a city in Washington that is known as an urban ecovillage with a population of 10,000. The ecovillage is strategically located within an urban area where residents attempt to change local city housing regulations, raise environmental awareness, and be “a model” of sustainable living for local citizens. However, residents often find themselves constrained by the larger community because of slow-moving bureaucracies and some citizens’ resistance to change. Regardless of these constraints, the City has persevered. The ecovillage is embedded within a unique neighborhood that is characterized by overgrown lawns, lavish fruit trees, herb garden-lined sidewalks, and houses with colorfully painted, wooden frames, which are situated within conventional, square, grid blocks. The dwellings follow a similar path, situated around the perimeter of the five parcels. The assorted lodging varies from small, wooden cottages to naturally built, earthen apartments, to individual-sized geodesic domes built from weather-protected cardboard. Many materials that make these homes are scavenged from city waste, including abandoned building sites and dumpsters. In general, residents in this ecovillage value the collective identity of non-hierarchical relationships and community solidarity. As a result,

it can lead to the development of all-around participation, environmental sustainability, and, ultimately, urban sustainability of a sustainable culture. The authorities in this city are attempting to reduce the negative effects on the environment through the use of new technologies. House construction, waste management, and organic agriculture are examples of such technologies. They also emphasize the importance of environmental issues and the necessity of a sustainable lifestyle in the form of an ecovillage to children from the start in their educational centers (Ergas, 2010, GEN, 2022). The figure below shows a photo of the urban ecovillage in Port Townsend.



Fig.1.20. Urban Ecovillage in Port Townsend

1.2.4.8. China

Ecovillages in China have different backgrounds and origins than international ecovillages due to different social-economic and political settings (Gao, X. et al., 2019). The emergence of ecovillages in other countries reflects how people in developed countries relate to nature in the post-industrial era (Barani et al., 2018; Westskoget al., 2018). Residential communities with low environmental impact (Sherry, 2019), a sustainable economy (Price et al., 2020), and strong community cohesion (Sherry, 2019; Barani et al, 2018; Yulastuti et al, 2017) can be formed through the construction of ecovillages (Liang et al., 2012; Adalilar, Alkibay, & Eser,

2015). In comparison, Chinese ecovillages are a policy-guided phenomenon based on national conditions that aim to develop the rural economy, protect the rural environment, and solve social problems (Liu et al., 2021). In China, ecovillage projects are mostly government-led, with financial and policy support, and are designed to address a variety of increasingly serious rural issues (Gao et al., 2022). China has taken numerous steps in the last two decades to transform traditional villages into ecovillages. Among these measures are the implementation of training courses, raising villagers' awareness of environmental protection, increasing the motivation of entrepreneurs and farmers, and so on (Anja Joubert, 2016). In China, nearly 100 ecovillages have been established (GEN, 2020).

1.2.4.8.1. Hua Tao ecovillage

Hua Tao ecovillage is in Chongzhou, Chengdu, the land of abundance. Hua translates to China, Chinese tradition and culture, whilst Tao refers to the way, which represents nature and innovation. Hua Tao is therefore the pathway to inheriting and innovating Chinese civilization. People who engage with this community learn how to share and cooperate with each other in a harmonious ecology. Hence, Hua Tao has now become a pioneer in promoting the restoration of the environment, morality, and economy (GEN, 2022).

There are several interesting places around the community including Anren, an ancient town, Confucius International School, and an agricultural base. The ecovillage is comprised of a living area with green buildings and is approximately 9 acres in size; meanwhile, the surrounding farmland is about 40 acres. The density of buildings here is 39.6%, and the green coverage is 45.9%. The residential buildings have been built to adopt the traditional Chinese courtyard style of western Sichuan and contain individual family apartments and communal open spaces and kitchens (Gao et al., 2022).

Hua Tao applies a very sustainable and sophisticated living system to its resource management, which includes regional biodiversity, green planning, water retention, energy conservation, and the refusal of unnatural land treatment. All these measures make us an ecological community that provides a better environment both inside and outside of our community (Liu et al., 2020).



Fig.1.21. Design of the Hua Tao ecovillage



Fig.1.22. Hua Tao Ecovillage: landscape view

1.2.4.8.2. Grand Shandu Ecovillage

This plan was put in place to promote sustainability and local development in Jiande and Zhejiang province. This project was proposed with the goal of improving the villages' economic situation and adapting to nature and the environment, developing the local economy and self-sufficiency, improving the surface soil, reducing the use of poisons and pesticides, promoting forestry, and so on. Much progress has been made. In general, the following measures have been implemented in this village to improve infrastructure and sustainability (Liu et al., 2021; Rusong, 2007):

- Emphasis on agriculture that is compatible with the environment, in other words, the agricultural ecosystem
- Local economic development and production increase
- Using new technologies for organic farming
- Improving environmental health and education for its awareness
- Promotion of the local-indigenous culture of the villagers
- The design and architecture of the village are based on the materials available in the village
- Improving social interactions to managing the relationship between nature and humans.



Fig.1.23. Co-Housing in Grand Shandu Ecovillage



Fig.1.24. Hua Tao Ecovillage: landscape view

1.2.4.9. Japan

With an increase in population and economic activity, as well as environmental damage in rural areas, attention to the ecovillage model became more important in Japan. Among the measures taken in this field are educational programs to raise people's awareness, national and international conferences to evaluate and recognize ecovillages around the world, utilizing the experiences of creating ecovillages in European and American countries, creating a culture of respect for nature (Dregger, 2016). The primary goal of these projects is to improve economic, social, and cultural interaction between city dwellers and villagers. In general, Japan has been paying attention to the issue of ecovillage since 1995 in order to be environmentally friendly (Takeuchi, 1996). In general, ecovillages in this country are divided into border areas, typical agricultural areas, mountainous areas (population density of 100 people), and remote areas based on population density index, distance from the city, and access to infrastructure. Each of them is described briefly below (Rezvani, 2015; Takeuchi, 1998):

The ecovillage model was chosen for areas near the city because villages with a population of more than 1000 people and an area of 100 hectares were selected. Out of the 100 hectares mentioned, 30 hectares have been designated for residential areas, and the remaining 70 hectares have been designated for the expansion of gardens and rice and non-rice fields. Among the characteristics of this model are the use of a waste recycling system (garbage shredders), the development of the local economy, the improvement of water supply to villages, the

improvement of the sewage system, the cultivation of plants and forestry, an increase in social participation, and so on (figure no.) In these villages, waste recycling systems are used to create agricultural fertilizers. This model's agricultural activities include urban residents as well.

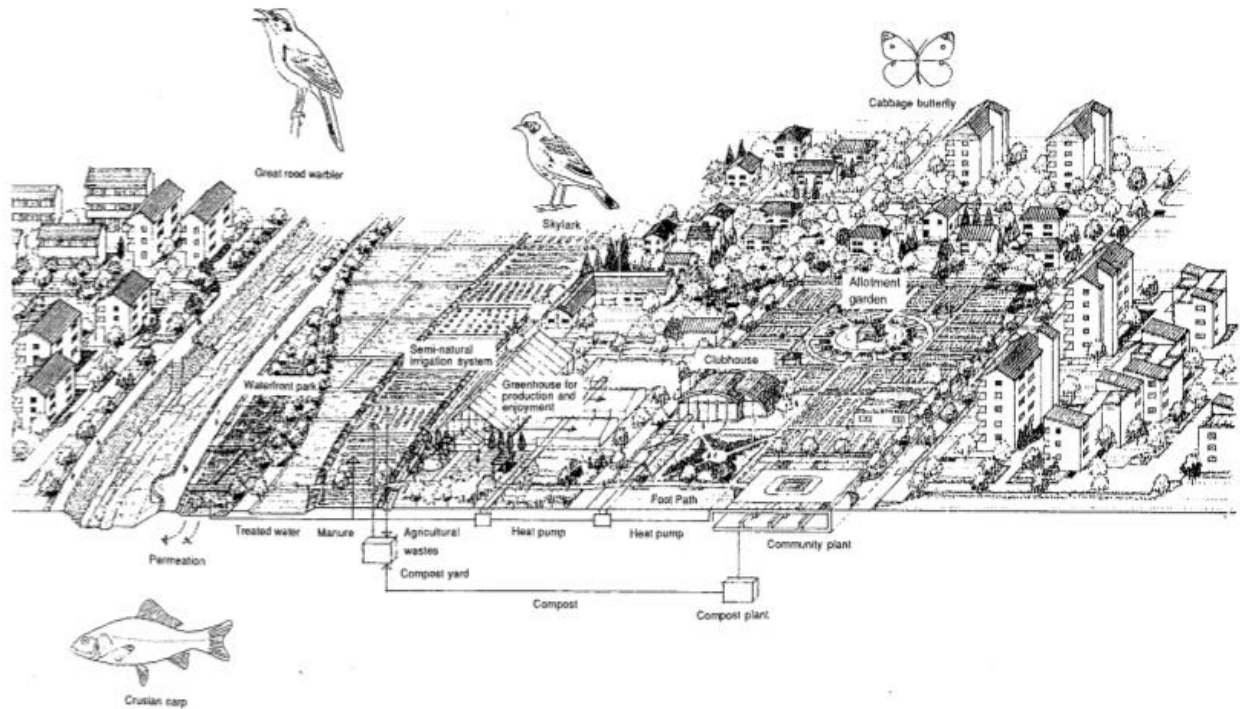


Fig.1.25. Design of the ecovillage model in the areas near the city, Takeuchi, 1998.

The following are the characteristics of the ecovillage model in agricultural areas: Villages with better agricultural conditions and a population of 1000 people were chosen in an area of 100 hectares. These 100 hectares are divided into 10 hectares for residential areas and 90 hectares for fields and agriculture. Heating and cooling systems are built using springs and underground water wells in this model. Sewage disposal devices are also used to keep agricultural and production lands clean. Another feature of this model is the promotion of forestry and the protection of the natural environment in order to improve the rural landscape.

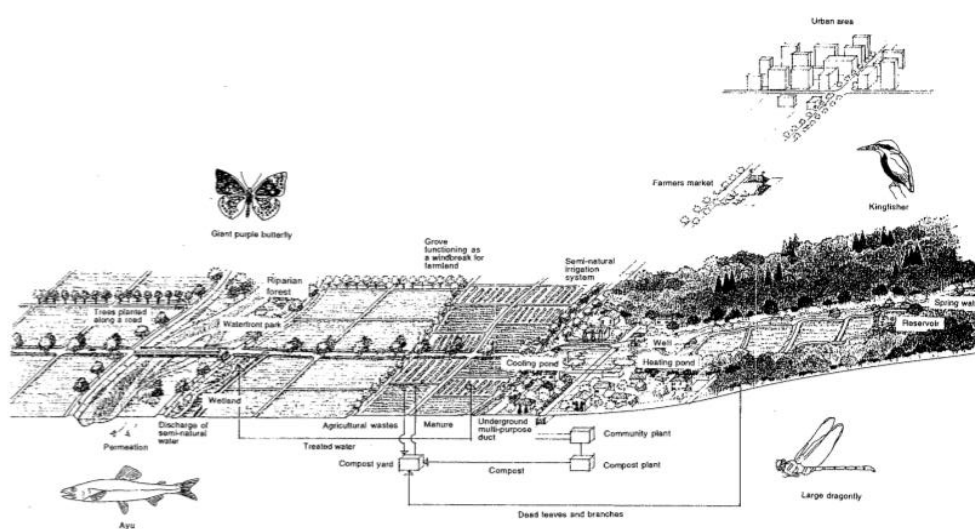


Fig.1.26. Designing the Ecovillage model in agricultural sample areas, Takeuchi, 1998.

The ecovillage model in mountainous and remote areas has the following characteristics: with 100 people (60 villagers and 40 tourists) on 100 hectares of land, only one hectare is allocated for rural housing and the rest for rice and non-rice fields. It is also used in the forestry industry. In this model, waste recycling, planting plants and trees, installing an environmentally friendly heating and cooling system, paying attention to cultural heritage and history in the village to increase a sense of belonging and staying in the village, developing environmentally friendly tourism, transforming trees Coniferous to broad-leaved trees have been emphasized to improve the rural landscape (which is also very important for biodiversity), and improving relationships have been emphasized. Not only agricultural and human waste, but also animal manure, is used in these villages to generate methane gas, which is then converted into electricity via the power plant. Trees are also used for the heating system in this model. In this model, emphasis is also placed on the construction of houses using local and durable materials that are also technologically advanced (Dregger, 2016).

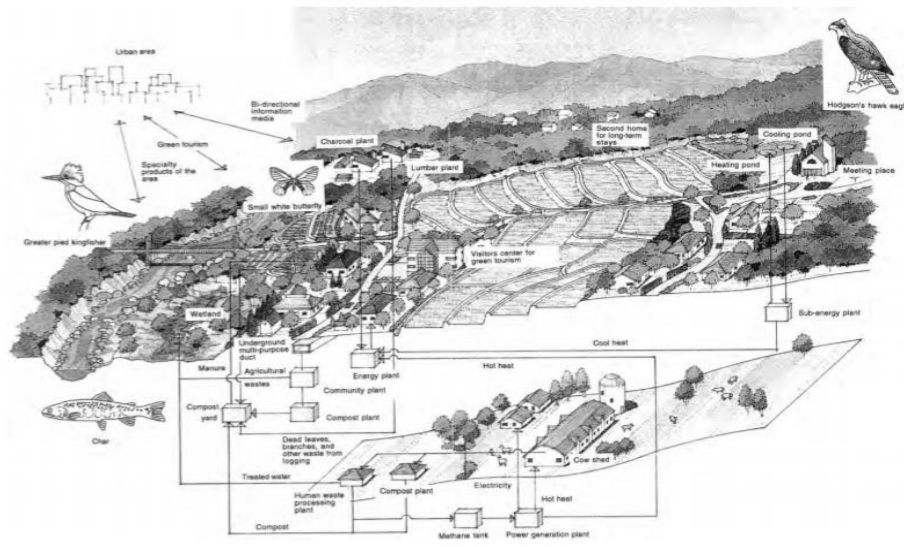


Fig.1.27. Ecovillage model design in remote mountainous areas, Takeuchi, 1998.

1.2.4.9.1. Kamikatsu Urban Ecovillage

A prosperous ecovillage Kamikatsu in Tokushima prefecture is a small town in Japan with big ambitions, located on the island of Shikoku and surrounded by lush nature. Since 2003, the city has been implementing a strict zero-waste program. Prior to this program, the city used to incinerate waste. However, they acknowledge that these waste incinerators may endanger the food supply, public health, and the environment. The incinerator has been shown to emit large amounts of greenhouse gases and toxins, which leads to the implementation and maintenance of the zero-waste program. Although it takes some time for residents to get used to the tedious task of washing, sorting, and transporting their trash to the town's sorting center, the process has now become a routine for them and can achieve an 80% recycling rate (Sidjabat & Ilmi, 2020). Therefore, Kamikatsu has become a national and international model for sustainable living. Residents use the education system to educate and institutionalize sustainable lifestyles in order to achieve sustainability. People turn food waste into compost to eliminate negative environmental effects, so the mayor gave each family a composter to turn food waste into organic fertilizer. Eventually, one of the most important goals of this urban ecovillage has been teamwork and all-around participation in order to achieve a sustainable life (Greuner, 2022).



Fig.1.28. Waste management center of the city



Fig.1.29. Co-Housing in Kamikatsu Urban Ecovillage



Fig.1.30. A view of the Kamikatsu Urban Ecovillage

1.2.4.10. Auroville

Auroville (City of Dawn) is an urban ecovillage in the Tamil Nadu district of Viluppuram. Auroville was founded in 1968 by the Mother (Mira Alfassa) in accordance with her dream of a universal township living in harmony with itself and the wider world, inspired by Sri Aurobindo's philosophy (Sarkar, 2015; GEN, 2022).

Auroville is now an endorsed ongoing experiment in human unity and consciousness transformation, also concerned with sustainable living and the future cultural, environmental, social, and spiritual needs of humankind, with support from UNESCO and the government of India (Kapur, 2021). Aurovillians currently come from 49 different countries, representing all age groups, social classes, backgrounds, and cultures. The township's population is constantly growing, but it currently stands at around 2,400 people, with approximately one-third being Indian (Walsky & Joshi, 2013). The Peace Area, located in the township's center, includes the Matrimandir and its gardens, an amphitheater with the Urn of Human Unity, which contains the soil of 121 nations and 23 Indian states, and a lake to help create an atmosphere of calm and serenity while also serving as a groundwater recharge area. This center gives rise to four

"zones" of the City Area: the "Residential Zone", the "Industrial Zone", the "Cultural (& Educational) Zone", and the "International Zone" (Kapur, 2021; Venkitaraman & Joshi, 2022).

Aurovillians are also involved in sustainable building practices and renewable energy technology and applications, land restoration, educational research, health care, community outreach, town planning, a variety of arts, music, dance, and other cultural activities, and community services (Kapur, 2021; GEN, 2022).

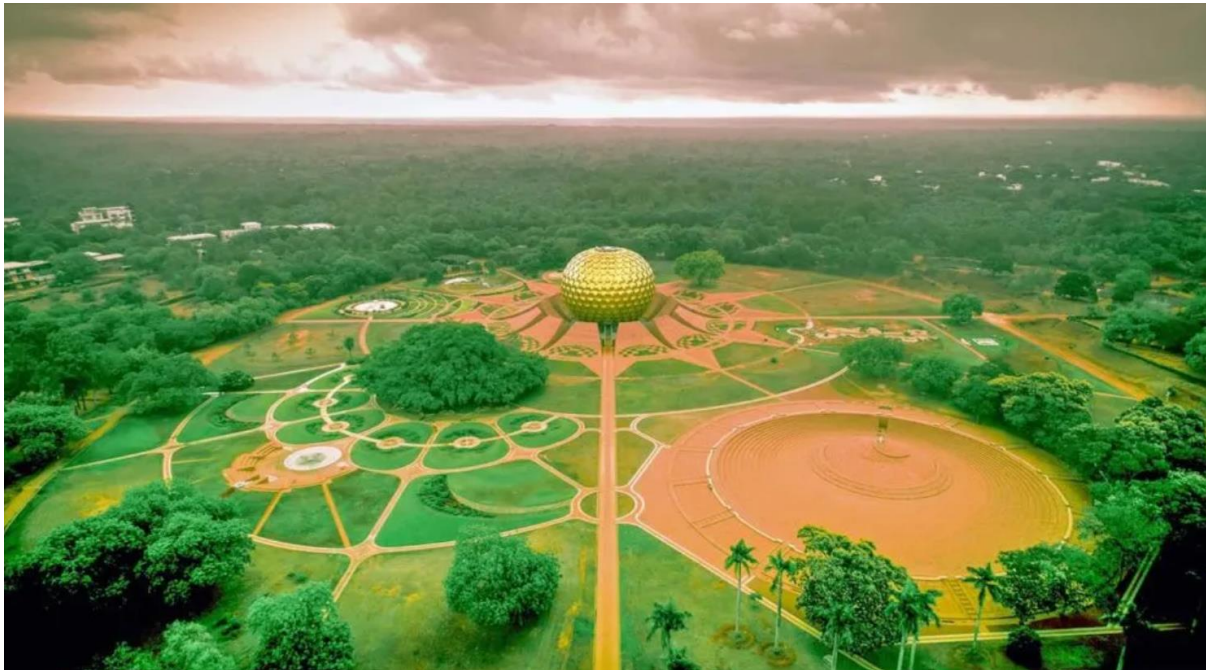


Fig.1.31. Peace Area of Auroville Urban Ecovillage in India

Auroville attracts support from many different organizations, communities, and individuals around the world as a meeting place for different cultures, as well as a demonstration site and testing ground for social, environmental, and technological experimentation. Auroville is still in the process of developing and maintaining meaningful relationships within the community, with the villages in the surrounding bioregion, with the government, and with other communities in and outside of India (Venkitaraman & Joshi, 2022).



Fig.1.32. the spiral galactic Vision of the city

1.2.4.11. Conclusion

Ecovillages, in general, can be described as being very diverse. They differ in terms of population (ranging from 20 to over 10,000 people), architecture, culture, society, and natural location. It should be noted that they are all working toward the same goal, which is to promote community solidarity and environmental protection. However, the majority of them conduct their own activities and actions. For example, in Findhorn, Scotland, on the one hand, they emphasize appropriate technologies in natural resource restoration and renewable energy production as a suitable model for local development, while on the other hand, they have made green entrepreneurship and small industrial workshops their primary goal. Other ecovillages place a higher value on the type of house architecture in an ecovillage. The variety of ecological buildings based on natural construction principles, as in Sieben Linden, Germany, is the most important factor in this ecovillage's reputation. Each of these ecovillages has considered a unique approach to achieving their objectives. In this regard, we can mention the ZEGG Ecovillage, which hosts several large festivals and workshops each year in order to attract people to the Ecovillage lifestyle and raise their awareness of environmental issues. Other ecovillages have placed a greater emphasis on alternative transportation and made it their primary goal. So, in New York, Ecovillage Ithaca built a ski slope and a bicycle track within the village to reduce the use of fossil fuel-powered transportation. Of course, in order to

preserve the population and economic development, this ecovillage also emphasizes the creation of new job opportunities and entrepreneurship.

In general, the residents' coordination and solidarity have played and will continue to play an important role in achieving these goals. For example, in the Dancing Rabbit ecovillage, everyone has agreed not to use personal vehicles and instead to use the ecovillage's transportation with everyone's participation. Of course, the role of local officials and government organizations in achieving Ecovillage goals should not be underestimated. Because they can play an important role in their growth by supporting this type of lifestyle and incorporating it into their plans and projects. China and Japan are two clear examples in this field. In China, the government has provided financial and political support for the conversion of traditional villages into ecovillages, as well as the establishment of new ecovillages, with the goal of economic development and environmental protection. As a result, the development of ecovillages in China has accelerated in the last decade. The Japanese government also promotes the ecovillage by expanding educational programs to raise public awareness, holding national and international conferences to evaluate and recognize the ecovillage around the world, drawing on the experiences of European and American countries, and fostering a culture of environmental stewardship. Ecovillages have thus been classified into border areas, normal agricultural areas, mountainous areas, and remote areas based on the population density index, distance from the city, and access to infrastructure. For countries with a diverse climate and population, this classification can be extremely useful and efficient.

Since ecovillage is a sustainable lifestyle, it is not limited to specific locations and can be found anywhere from small villages to large cities. Of course, due to cultural diversity and increased population, the formation of ecovillages in cities or urban ecovillages is much more difficult and necessitates more policies, planning, management, and government support. Some of the world's urban ecovillages have already been mentioned. LAEV, located in the heart of the United States' second largest city, is attempting to attract others to this type of lifestyle. Port Townsend is also an urban ecovillage with a population of 10,000 people. In Japan, another urban ecovillage known as the zero-waste city is Kamikatsu. Meanwhile, some ecovillages have been established with various goals in the first stage, and later, taking into account the world's problems and environmental issues, they have turned to a sustainable lifestyle and harmony with nature, which later earned the name ecovillage. Among these ecovillages is Auroville, whose primary goal was to foster human unity among people from various countries in an international settlement in India with the goal of combating racism.

Therefore, ecovillages, as well as their goals and structures, can differ, demonstrating their adaptability and compatibility with any demographic, cultural, or country diversity. A successful ecovillage, however, is not possible without coordination and solidarity among people in society, increasing awareness, the presence of motivation, emphasizing environmental issues and sustainable living, and, finally, the support of officials and government organizations. Now, one of the most important issues and goals in achieving this sustainable lifestyle is technology, particularly ICT. On the one hand, by making communication easier and better, increases residents' solidarity and harmony, as well as their awareness. On the other hand, politicians and governments can establish the foundation for a sustainable lifestyle by providing technological infrastructure. The importance of ICT is discussed further below.

1.3. ICT

ICT has significantly changed how information is shared and accessed on technological platforms in recent years. Which is most frequently used to describe a group of manufacturing and service sectors that use electronic data and information storage, transmission, and display. According to this definition, ICT is a group of hardware, software, and networking innovations that make it possible to study and use data and its processing in the areas of storage, manipulation, management, transfer, exchange, control, and automatic data preparation (Agarwal & Alam, 2018; Kendall & Dearden, 2020; González-Zamar et al., 2020). Following that, the relationship between ICT and sustainable development will be discussed, as well as the role of ICT in a smart and sustainable future.

1.3.1. ICT and Sustainable Development

ICT tools and their advancement have provided diverse and expanded channels for information dissemination via the Internet, telephones, and even other media. Increased ICT diffusion has a variety of economic consequences, including increased economic growth, financial development, educational outcomes, and even environmental sustainability. Simultaneously, while the effects vary by sector, the impact on sustainability has gained research attention in recent years. Therefore, with the advent of globalization, the increased diffusion of ICT across many remote countries around the world represents opportunities for the achievement of many inclusive and sustainable development outcomes. Nonetheless, such sustainable development outcomes must be tailored in such a way those three major aspects of sustainable development, namely the economic, social, and environmental dimensions, are taken into account in a balanced manner. Furthermore, policymakers must be concerned about the environmental

dimension and tailor relevant policies so that environmentally-friendly technologies are prioritized in order to reduce the environmental impacts of economic activities (Jayaprakash & Pillai, 2021).

In terms of the environmental dimension, ICT can have both positive and negative effects on the environment. On the one hand, ICT has the potential to reduce transaction and travel costs associated with CO₂ emissions in households and businesses. In fact, ICT reduces the information asymmetry associated with environmental sustainability by lowering the information rents associated with CO₂ emissions (Avom et al., 2020; Nchofoung & Asongu, 2022). Furthermore, ICT is expected to reduce CO₂ emissions through the development of smarter cities, transportation systems, electrical grids, industrial processes, and energy-saving gains that emit less CO₂ than alternative systems (Higón et al., 2017). On the other hand, ICT adoption increases energy consumption by individuals and businesses, resulting in increased CO₂ emissions. Furthermore, ICT enhances the financial system and information flow, resulting in greater financial integration and an increase in economic activity. Increases in economic activity increase CO₂ emissions (Avom et al., 2020). Depending on the circumstances, ICT can have either a negative or a positive impact on environmental sustainability. Many academics have proposed an inverted U-curve relationship between the two concepts because of this (Khan et al., 2020; Chien et al., 2021). Aside from the environmental impact, ICT has a variety of effects on social development. Through innovative applications and services, ICT via mobile telephony has transformed lives. It is not surprising, then, that recent research has focused on the impact of ICT on economic and human well-being (Asongu, 2020). In this regard, ICT could promote inclusive human development by reducing globalization and CO₂ emissions (Asongu & Odhiambo, 2020). Similarly, education can supplement ICT via mobile technology to promote inclusive human development (Asongu and Nwachukwu, 2018). However, the positive impact of ICT on inclusive human development varies across the dimensions of human development specified, as well as ICT dynamics, natural resource abundance, and even openness to the sea (Nchofoung et al., 2021). Another body of literature investigates social development in terms of population health. Several scholars have examined the impact of ICT on the former in this light. ICT has aided in the decentralization of health systems by removing geographical barriers and bringing healthcare providers and beneficiaries closer together (Dutta et al., 2019). According to Majeed and Khan (2019), health policies should prioritize digital inclusion. To improve the quality of life through ICT,

however, ICT usage should be geared toward promoting human rights, privacy, and online security (Adam and Alhassan, 2021).

The literature on the relationship between ICT and sustainable development is primarily concerned with the impact of ICT on the individual SDGs identified by the UN in 2015. In this regard, the literature that follows will be based on three major strands, namely the environment, social, and economic perspectives on the goals. The environmental strand is concerned with the impact of ICT on greenhouse gas emissions; the social strand is concerned with the impact of ICT on education, health, inequality, and even human development; and the economic strand is concerned with the impact of ICT on economic development through growth and poverty reduction.

Several authors in the first strand of the literature argue for a positive relationship between ICT and CO₂ emissions (Avom et al., 2020; Su et al., 2021; Liu et al., 2021; Chen, 2021). ICT will boost economic activity by increasing trade and foreign direct investment. It will boost industrialization and scale economies. A surge in economic activity will increase CO₂ emissions due to the use of energy (e.g., fossil fuels) for electrification and mechanical system operation. Thus, Avom et al. (2020) contend that ICT primarily increases CO₂ emissions through trade, financial development, and energy consumption. However, CO₂ emissions from energy consumption vary depending on the type of energy consumed. While renewable energy reduces CO₂ emissions, nonrenewable energy increases CO₂ emissions (Dogan and Seker, 2016). Furthermore, trade openness promotes economic integration and global value chains, which have recently been identified as the primary source of CO₂ emissions (Essandoh et al., 2020).

Other authors contend that ICT has a negative impact on CO₂ emissions (Ahmed & Le, 2021; Wang & Xu, 2021; N'dri et al., 2021; Chien et al., 2021). As a result, increased ICT or ICT investments reduce the impact of CO₂ emissions. In essence, economic growth and financial development all contribute to CO₂ emissions, whereas ICT only significantly reduces the effect of CO₂ emissions at lower quantiles (Chien et al., 2021). Improvements in ICT have reduced the use of many traditional commodities due to the widespread adoption of electronic commodities (i.e. goods and services) such as online meetings, online education, e (electronic)-books, e-banking, and e-commerce. Online meetings, for example, have largely replaced traditional meetings. Furthermore, e-commerce has reduced the need for travel; traditional books have been replaced by e-books, and letters have been replaced by e-mails. This massive

shift away from traditional commodities reduces the use of resources and, by extension, the activities associated with the use of underlying resources that cause environmental degradation. Furthermore, the ICT revolution has resulted in the adoption of modern transportation systems and the installation of modern software that aids in traffic management, resulting in less energy consumption and emissions (Jorisch et al. 2018; Haseeb et al. 2019; Ahmed and Le, 2021). In this regard, ICT has resulted in the advancement of electronic trade as a replacement for other systems of trade, as well as the reduction of human contacts and transportation, as well as energy consumption, which are the primary sources of CO₂ emissions (Nchofoung & Asongu, 2022).

Aside from the linear effects mentioned above, several studies have found non-linear relationships between ICT and CO₂ emissions (Usman et al., 2021; Azam et al., 2021; Su et al., 2021). ICT could contribute to rising CO₂ levels through the production of ICT devices and machinery, energy consumption, and electronic waste recycling. Simultaneously, it is expected that ICT will help to reduce global CO₂ emissions if it is used to develop smarter transportation systems, cities, electrical grids, and industrial processes. These two effects are seen in opposite directions, resulting in an inverted-U relationship between CO₂ emissions and ICT (An Hign et al., 2017). When firms adopt ICT, it has the potential to boost productivity while also increasing emissions due to the scale effect. With ICT capital in place, the production process is optimized and energy efficiency is realized, resulting in emissions reductions via the technological effect (Nchofoung & Asongu, 2022).

Some authors have argued about the impact of ICT on social development in the second strand of literature. Several studies have approached social sustainability in terms of inclusive human development in this regard (Asongu et al., 2019; Asongu and Odhiambo, 2019). Policies aimed at accelerating ICT development will increase inclusive human development, with the degree of variation determined by income level, political stability, legal origin, oil wealth, and whether the country is landlocked. Furthermore, ICT can be used to mitigate the negative impact of CO₂ on inclusive human development. The impact of ICT on CO₂ emissions is greater in English Common Law countries, Middle-income countries, and Oil-rich countries than in French Civil Law countries, Low-income countries, and Oil-poor countries, in that order (Asongu et al., 2019). Furthermore, social development could be viewed through the lens of improved health outcomes (Dutta et al., 2019; Kouton et al., 2020). However, economic freedom is required for ICT diffusion (Kouton et al., 2020). It may also have a positive impact on some aspects of health. According to Lee and Lio (2016), the spread of the internet, mobile

phones, and fixed phones are associated with higher life expectancy and lower infant mortality (Nchofoung & Asongu, 2022).

The ability of ICT to improve education quality and reduce inequality is the next aspect of social development. In this context, Asongu and Odhiambo (2019) argue that ICT has varying effects on educational quality in countries that are above the median of poor educational quality: increasing mobile phone and internet penetration rates improves educational quality, while increasing internet penetration has a net negative effect.

Tchamyu et al. (2019) contend that ICT interacts with primary education to reduce income inequality, whereas the interaction with secondary education has a negative net effect on the Gini index and is insignificant through tertiary education. However, there are inequality thresholds that should not be exceeded in order for ICT to improve inclusive education (Asongu et al., 2019). According to Adams and Akobeng (2021), ICT reduces inequality, and this relationship is strengthened by a good governance system in place. However, the impact of ICT on income inequality depends on the type of ICT used as well as the measure of income inequality used. Furthermore, the magnitude of ICT's effect on inequality compares favorably with more traditional forms of economic infrastructure, and the relationship between inequality and ICT is dependent on other economic and political factors (Richmond and Triplett, 2018). According to this viewpoint, studies have shown that ICT increases wealth inequality by increasing the wealth of billionaires and the top wealth shares in society, and that this negative effect can be mitigated through democracy (Njangang et al., 2021; Nchofoung & Asongu, 2022).

The final body of literature investigates the impact of ICT on economic growth and poverty reduction. Indeed, recent growth theories have recognized the significance of technological progress in economic growth. The impact of ICT on growth can be improved (Cheng et al., 2021). This could be due to its positive impact on financial development (Asongu et al., 2019; Chien et al., 2020), as well as globalization (Kurniawati, 2020; Asongu and Odhiambo, 2020).

Finally, ICT can play an effective role in achieving sustainable development by creating flexible and innovative infrastructure (such as smart buildings, smart water management, smart transportation systems, and efficiency in energy and resource waste management), promoting innovation, increasing access to information and knowledge, reducing inequality (social progress), and facilitating the economy even for disadvantaged sections of society such as people with disabilities (Khan et al., 2018).

According to the research literature, ICT can have numerous effects in all three social, economic, and environmental dimensions, with far more positive effects. Furthermore, depending on the type of technology distribution and digital divide reduction, its negative effects can be turned into positive effects. Hence, ICT plays a critical role in achieving sustainable cities and villages. Because of population and urban construction, this issue is more pressing in cities. Therefore, the topic of sustainable smart cities has grown in importance in recent years. Following that, more will be said about ICT and sustainable smart cities.

1.3.2. ICT for Smart and Sustainable Future

Cities are centers of innovation and development (Villa & Mitchell, 2009), but they also have significant socioeconomic and environmental impacts and challenges. Hence, urban research has focused on striking a balance between maintaining urban innovation and socioeconomic development while avoiding negative consequences. The emergence and incorporation of sustainable development principles into urban planning and management have increased awareness of the negative effects of urbanization. The emerging concept of the smart city has been recognized as a means of achieving sustainability with ICT advancements (Bifulco, et al., 2016).

We nowadays use ICT not only to communicate with friends and family, but also to play games, shop, plan trips, pay bills, date, keep track of our bodies, and find and participate in various communities. We also use ICT to monitor and control the environment through smart metering and sensors in household appliances and vehicles. Aside from being an unavoidable component of modern life as we know it, ICT is increasingly being promoted as a potential solution to sustainability problems, such as ICT-enabled solutions to reduce greenhouse gas emissions in sectors such as power, transportation, agriculture, and land use, buildings, manufacturing, and the consumer and service sectors. ICT is framed as a way to do more with less through the concept of automation, and ICT is framed as a way to eliminate knowledge and motivation deficits that are seen as impeding the adoption of more sustainable lifestyles through the concept of persuasion (Rivera et al., 2015).

There is a growing interest in using ICT to make urban areas more sustainable in this emerging field of ICT for sustainability (ICT4S). The continued concentration of the world's population in urban areas implies that they are becoming increasingly important for overall sustainable development - including both ecological and social aspects; "there can be no global environmental sustainability without urban environmental sustainability" (Tcholtchev &

Schieferdecker, 2021). Furthermore, ICT has been shown to have the potential to improve the environmental performance of the built environment without requiring more extensive changes to the urban fabric (Höjer & Wangel, 2014).

However, the use of ICT in the operation of urban infra systems is not new. For many years, ICT-enabled systems for improving transportation and making buildings more energy efficient have been available. What is novel is the framing of these previously isolated ICT interventions as smart,' as well as the evolution of the concept of smart from being associated with household appliances to becoming a concept attachable to entire cities. While advocating the overcoming of previously compartmentalized infra systems, the discourse on smart sustainable cities does so from a technocratic standpoint, implying that both the intended users of the ICT solutions and the individuals needed to implement, install, and manage these are portrayed according to what is required for the technology to function, if addressed at all (Rivera et al., 2015).

A smart city is, broadly speaking, an urban setting that makes use of ICT and other complementary technologies to improve the effectiveness of routine city operations and the quality of services (QoS) offered to urban residents. Experts taking into account a variety of factors have formally defined smart cities. According to a common definition, a smart city connects its physical, social, business, and ICT infrastructure to increase the city's intelligence (Harrison et al., 2010; Silva et al., 2018). Another thorough definition of a smart city describes it as an advanced modern city that makes use of ICT and other technologies to enhance urban services' operational effectiveness, competitiveness, and quality of life (QoL), all while ensuring resource availability for current and future generations in terms of social, economic, and environmental factors. The primary objective of the first smart cities was to improve urban residents' quality of life by addressing the disparity between supply and demand for various functionalities (Zanella et al., 2014). In order to meet the extreme needs of urbanization, modern smart cities place a special emphasis on sustainable and efficient solutions for energy management, transportation, health care, governance, and many other areas (Ejaz, et al., 2017).

Various characteristics are combined to create a smart city. According to Saruja et al., the majority of smart city proposals include four essential elements: sustainability, quality of life (QoL), urbanization, and smartness (Mohanty, 2016). Each attribute has a few related sub attributes. The sub-attributes that fall under sustainability are infrastructure and governance, pollution and waste, energy and climate change, social issues, economics, and health. Sustainability is the capacity of a city to maintain the ecosystem's balance in all of the

aforementioned ways while providing for its citizens and carrying out its operations. Urban residents' emotional and financial health show an improvement in QoL. The urbanization attribute concentrates on the technological, economic, infrastructural, and governing aspects of the change from a rural to an urban environment. The desire to raise the social, environmental, and economic standards of a city and its residents is what is meant by the term "smart." Sustainability has been regarded as the dominant paradigm in urban development since the 1980s. In actuality, the rise of smart cities was significantly influenced by the general focus on sustainability. Sustainability sub-attributes support the idea of the triple bottom line (Barton & Manning, 2017; Ekman, 2018; Wheeler & Beatley, 2014). The triple bottom line concept considers the relationships and interdependencies among the sub-attributes depicted in the following figure. Natural resources are being used more and more in the development of cities in the modern world. Therefore, it is essential to carefully consider the effects of the dearth of non-renewable energy sources. Therefore, protecting natural resources and energy sources has emerged as a crucial requirement for keeping smart cities sustainable (De Jong et al., 2015; Silva et al., 2018).

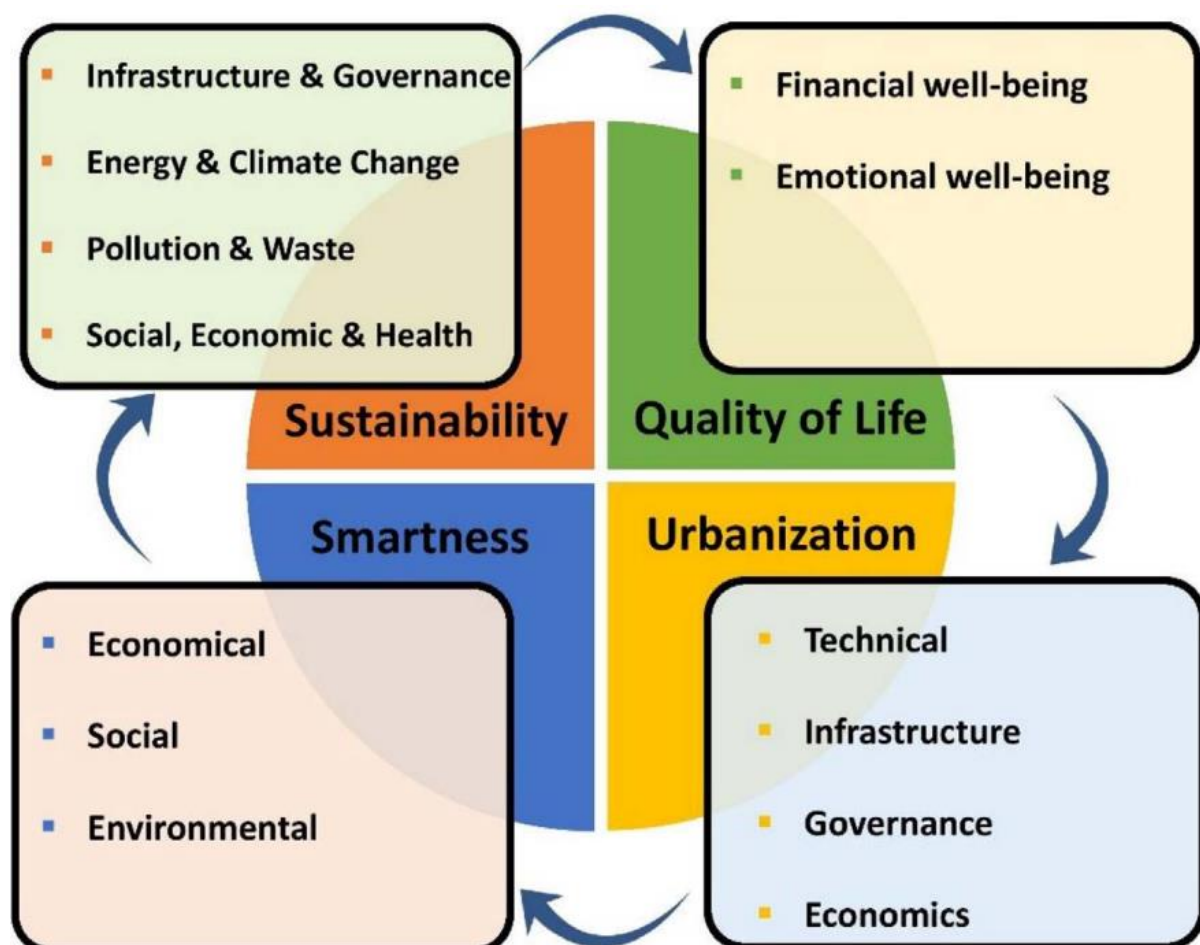


Fig.1.33. Characteristics of a Smart City, Silva, et al., 2018.

It is difficult to give a comprehensive definition of sustainable smart cities because of the various traits and definitions, as well as the variations in each city's setting and organizational structure. Despite differences in definitions, it is widely acknowledged that smart cities are those that integrate and apply ICT to a variety of city functions to help with effective and efficient urban management (Mora & Bolici, 2017; Neirotti et al., 2014).

A sustainable city is one that manages to balance economic, environmental, and socio-cultural progress through active citizen participation, according to Mega and Pedersen (1998). It is a city that makes an effort to uphold several sustainability principles (Aina, 2017). Luederitz et al. (2013) highlighted nine principles for sustainable cities, drawing on the work of Gibson (2006). Harmonized coupled human-environment systems, sustainable transportation, sustainable urban metabolism, environmentally friendly building design, livable communities, resilience, democratic governance, meeting human needs, and taking into account environmental impacts are some of the guiding principles. Utilizing the advantages that can be gained from ICT innovations and advancements is central to the idea of smart sustainable cities. Networking (including open access networks and the Internet of Things), wireless sensors, real-time data exchange, and digital infrastructure are some of these technological advancements. These technologies form the basis of smart utilities, which encourage the efficient use of water and energy (e.g. smart grid). Emerging opportunities in the geofomation science field, including increased data accessibility, multidimensional visualization techniques, distributed spatial data archiving, analysis, and management, and improved timely and accurate data collection (Li, Shan et al., 2013), have given geospatial technologies a key role in promoting smart sustainable cities. According to Morelli et al. (2013), programs for intelligent and knowledge cities "can potentially contribute to all three dimensions of sustainability" by fostering system improvement, innovation, and alterations in urban behavior.

The Focus Group on Smart Sustainable Cities (FG-SSC) (a platform that identifies frameworks for leveraging ICT for smart cities), alluding to the Brundtland Report (WCED, 1987), defined a smart sustainable city as "an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, the efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental as well as cultural aspects" (FG-SSC, 2015). The direct democracy of their participatory governance, according

to Deakin (2014), "opens up, adds value to, and constructs cities when the ICTs of future internet developments successfully embed the networks society needs for them to not only generate intellectual capital, or create wealth, but also cultivate the environmental capacity, ecology, and vitality of those spaces." Whether the mere implementation of a smart city could result in a sustainable city is up for debate (Hojer & Wangel, 2015). There are worries that the waste produced by using ICT infrastructure may have an impact on the environment, and that smart cities may simply adopt technology without taking the needs of the citizens into account (Hollands, 2008). The local sustainability and quality of life (liveability) of the cities they evaluated are improved by smart cities, according to a recent study by Anthopoulos (2017). Goals for sustainability are connected to the objectives of smart cities (Ahvenniemi et al., 2017). From a content analysis of official reports from industry participants in smart city projects, Bifulco et al. (2016) concluded that there are links between ICT, sustainability, and smart cities. ICTs have the potential to accelerate the transition to more sustainable cities (Kramers et al., 2014; Papa et al., 2015). Frameworks for smart cities should investigate these possibilities and take into account how ICT solutions will affect the environment. The various ICT applications in urban settings and the recent advances in geospatial technology demonstrate the benefits that could result from integrating ICT into the creation of sustainable smart cities (Aina, 2017).

As a result, the existence of ICT, along with sustainability dimensions, is critical for a sustainable and smart future. It should be noted that focusing exclusively on cities would not result in a sustainable future; villages must also be considered in this context. Villages can play a decisive role in achieving a sustainable future because of their direct connection with nature and the environment, as well as their important role in economic development.

The rural-urban divide is prevalent in the literature and covers a wide range of research topics, including well-being (Lagakos et al., 2018), health (Glauber, 2022), social aspects of life (Zarifa et al., 2019), economics (Lagakos, 2020), and business growth and performance (Lee & Xu, 2020). During the recent coronavirus pandemic, all of these disparities became more pronounced (Visagie & Turok, 2021). ICT and sustainable development can help bridge the gap between cities and villages. ICT can become a powerful tool for economic, social, and political empowerment if it is used appropriately and understands the different needs of urban and rural people. Therefore, rural areas and sustainable development are closely related in the field of rural development, which means that the concepts of sustainable development should also be used in rural development. Many researchers believe that focusing on rural areas is

necessary to develop a thorough understanding of these communities' needs, allowing them to absorb and promote their innovative potential while reducing the risk of poverty and social and digital exclusion. Sánchez, for example, contends that combining ICT and sustainability concepts facilitates smart destinations, thereby stimulating long-term economic growth (i.e., socio-economic, environmental and cultural). Indeed, if we are to ensure the success of the sustainable digital transition, we must emphasize a universal inclusion approach in which the benefits of digitization are extended to all people (Rundel et al., 2020; Tiwasing et al., 2022; Stojanova et al., 2022).

1.3.3. ICT in the Transformation of a sustainable lifestyle toward Ecovillage

One of the most important issues acknowledged by the researcher in this thesis is the role of ICT in the evolution towards a sustainable ecovillage lifestyle. A topic that has not been given much attention in the research is related to ecovillage and ICT.

There has been a surge of interest in the intersection of ecovillages and ICT in recent years. Some ecovillages use ICT to improve communication, collaboration, and resource sharing among community members. Ecovillages, for example, could use digital platforms to organize work parties, share knowledge and skills, and coordinate transportation. Furthermore, ICT can be used to monitor and manage renewable energy systems, track resource usage, and facilitate decision-making processes.

In general, the relationship between ecovillages and ICT is complex and multifaceted. While digital technologies can certainly offer many benefits to ecovillages, it is important to approach their use with a critical and thoughtful perspective. Finally, ICT has the potential to transform and promote sustainable lifestyles. Here are some ways that ICT can help with the transition to more sustainable lifestyles:

Education and Awareness: ICT can be used as a tool for education and awareness-raising on sustainable lifestyles. Online courses, webinars, and virtual conferences can be used to educate people about the importance of sustainability and how to adopt sustainable practices in their daily lives.

Monitoring and Tracking: ICT tools can help people monitor and track their energy and resource usage. Smart home systems can monitor energy consumption, water usage, and waste generation, providing individuals with real-time feedback on their ecological footprint and helping them to identify areas where they can reduce their environmental impact.

Collaborative Consumption: Online platforms can facilitate collaborative consumption, allowing people to share resources, such as tools, cars, and housing. This can help to reduce overall resource consumption and promote more sustainable ways of living.

Virtual Communication: ICT can reduce the need for physical travel, which can be a significant source of greenhouse gas emissions. Virtual communication tools, such as video conferencing, can be used to conduct meetings, workshops, and events, reducing the need for people to travel long distances.

Sustainable Production: ICT can also play a role in promoting sustainable production. For example, blockchain technology can be used to track the origin and sustainability of products, allowing consumers to make informed choices about the products they purchase.

In summary, ICT can contribute to the transformation towards sustainable lifestyles by promoting education and awareness, monitoring and tracking resource usage, facilitating collaborative consumption, reducing the need for physical travel, and promoting sustainable production. By harnessing the power of ICT, we can accelerate the transition towards a more sustainable future.

1.4. The Conceptual Model

In this section, I outline a conceptual framework that will guide my empirical work in the following sections. The dimensions, indicators, and research literature were used to develop the conceptual model for this study. However, due to their large volume, not all indicators are presented here. The goal of this model is to draw the theoretical generality of the thesis. In general, this model demonstrates that, in response to environmental issues and an unstable lifestyle, the researcher proposes solutions such as adopting a sustainable lifestyle through the use of the ecovillage model and ICT. Dimensions and indicators for achieving the ecovillage have also been proposed. Now, by emphasizing the dimensions of the ecovillage, it lays the groundwork for living a sustainable lifestyle and transitioning to sustainability. The following stage discussed, on the one hand, the level of ICT and, on the other hand, the role of ICT in the development of sustainability. This section demonstrates how the level of ICT, knowledge, and access to infrastructure can help to bridge the digital divide, and how the role of ICT in sustainable development can enable the structure and process of achieving a smart and sustainable future. Finally, all of this creates an environment conducive to environmental sustainability (Fig.).

Summary

Within the framework of this thesis, this chapter provides a review of sustainable development literature, ecovillage, and ICT in the direction of environmental sustainability. This section looked at the history, definitions, theories, and global experiences of successful ecovillages. The experiences of the studied regions, namely France and Iran, were also discussed. The

following section discusses the research questions and objectives, indicators and dimensions used, methodology, and the study area. Given that a quantitative method was used to collect data in urban areas and a qualitative method was used in rural areas, each is analyzed and explained separately in the methodology. The sampling method, urban and rural areas under study, and their locations will then be discussed.

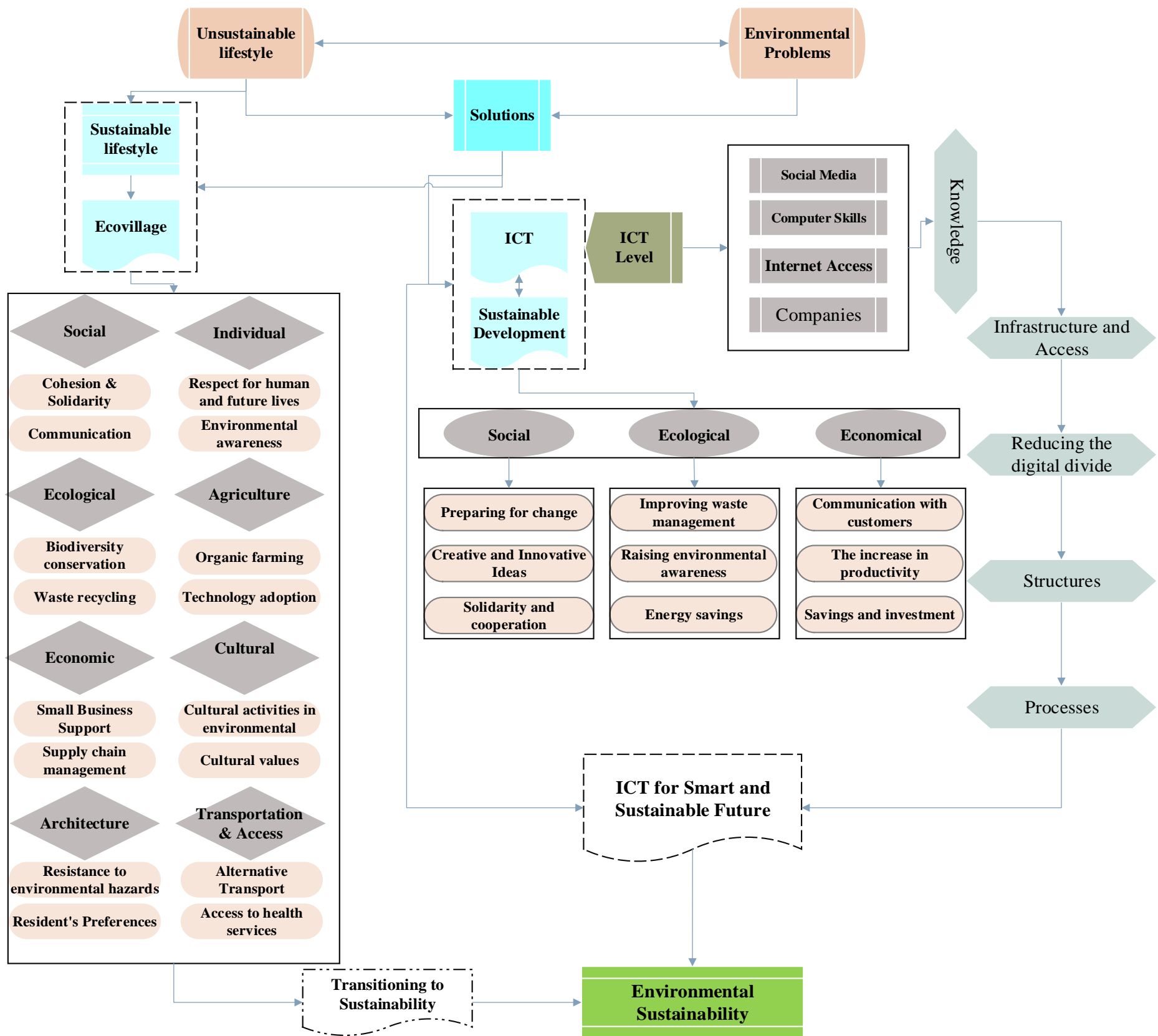


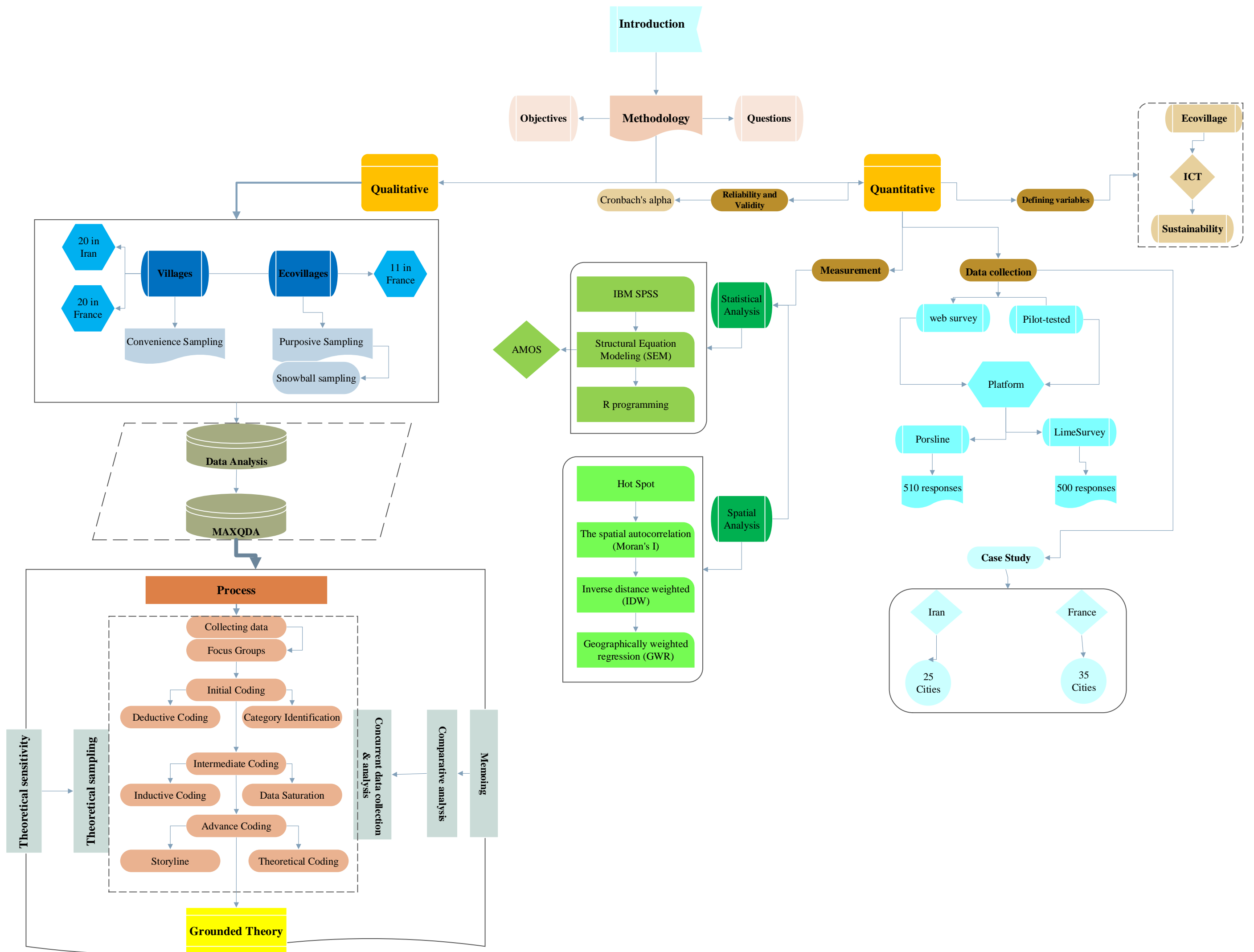
Fig.1.34. the thesis's conceptual framework

Chapter 2: Case Study and Methodology

2.1. Introduction

Given that urban citizens have played an important role in global environmental problems in recent decades, it is important and necessary to examine residents' perspectives on a sustainable lifestyle (such as Urban Ecovillage in this study) and to highlight important dimensions of urban sustainability. It is also critical to consider factors such as ICT, which can help to accelerate the process of this sustainability. Furthermore, because the villages have a direct relationship with the environment, research and investigation into the level of sustainability of their economic activities and the villages' ability to become an ecovillage became critical. For this reason, the purpose of this research is to model environmental sustainability and present an urban ecovillage pattern based on ICT in Iran and France as a comparative study. Following the description of become sustainable with Ecovillage and ICT in the previous chapter, this chapter focuses on the research methodology and Case studies. Because this study raises a variety of questions of varying nature, a mixed method was required. A mixed research method is a technique that combines quantitative and qualitative approaches in a single or multi-stage study. Therefore, after defining the main variables of the research, the methodology structure of the study has been presented in a step-by-step manner, and the method of conducting the research in each of the steps has been described. In addition, an attempt was made to briefly discuss the techniques used in the various stages of the research.

Fig.2.1.The structure of the Methodology and Case study at a glance



2.2. Case Study

Through feedback between human demand for natural resources and the carrying capacity of the environment, society and the environment co-evolve. Coupled social-ecological systems (Glasser et al., 2008) are complex, adaptive, and bounded by spatial or functional boundaries around ecosystems and natural resources where natural components (e.g., water, land, forest) are influenced by human interactions (Liu et al., 2007). These interactions are now one of the causes of environmental issues and climate change. Hence, it is critical to pay attention to global environmental concerns in the future, as well as maintain societal stability and the existence of adaptation policies in urban and rural areas. Given that these areas have been clearly different for a long time and that technological advance has expanded the gap, there is a need to pay attention to them (Bouchoud et al., 2022) .

The difference between cities and villages is more visible in rural areas due to a lack of technology and necessary cultural and social infrastructure, as well as a lack of awareness of global problems such as climate change and economic weakness, and most sustainable innovations have been adapted to the needs of urban areas (Wahba et al., 2020). These innovations either do not exist in rural areas at all (for example, the level of information and communication technology, communication with the global community, technology required for modern agriculture, and so on) or require significant effort and limitations to be usable or effective. (An example would be Internet of Things technology). Scientific research that goes beyond description is needed to clarify residents' perceptions of sustainability in urban and rural areas. The degree of acceptance of sustainable innovations and lifestyles, as well as understanding of their implications for urban and rural society, differs significantly (Zulauf & Wagner, 2021). Environmentally, as cities continue to grow, there is increased pressure on land, energy, and resources, potentially leading to more environmental threats. At the same time, its growing significance implies that environmentally sustainable urban solutions have significant potential to reduce energy and resource consumption. Overcoming these challenges is critical for developing a just society and influencing a wide range of other factors, including the environment, society, and economy, as well as health and safety. Aside from population growth in urban areas, major economic activities serve as economic drivers and sources of innovation in countries. This leads to a greater emphasis on obtaining more while ignoring the environmental consequences (Keith et al., 2022) .

Therefore, striking a balance between these three central elements is critical for the development of cities in order to achieve a sustainable society, environmental sustainability, and a fair economy. To achieve this balance, on the one hand, the necessary technology and infrastructure are required, and on the other, community solidarity toward the common goal of sustainability is required. Aside from urban areas, rural areas must be considered because they have a direct relationship with the environment, which can be effective in this case from economic activities to rural community behavior (Juraschek et al., 2018). Demographic changes, population decline, the digital divide, low income, limited access to certain services, the need to develop necessary technologies such as ICT and the Internet of Things, better job prospects, and environmental impact control can only be addressed by a comprehensive and new study. Examining the environmental sustainability of urban and rural areas in order to achieve a sustainable future is thus not only a requirement, but also an opportunity for a just transition and balanced sustainable development on a territorial scale (Moench, 2020). This increases the need for and demand for the use of dependable communication technologies such as ICT in order to have a connected society and a sustainable economy in order to ensure the integrated sustainability of policies used to address the global, national, and local environments. New knowledge and technologies, however, do not necessarily emerge everywhere and at the same time. How technology is spread at the country level is critical to how countries create and share global growth. Even though their penetration rate is rapidly increasing, there are differences in usage across countries. Disparities between developed and developing countries, as well as between large and small cities, can exist. Therefore, in this study, a comparison was made between France, a developed country, and Iran, a developing country, in order to evaluate geographical differences and similarities (Vakulchuk et al., 2022; Zhang et al., 2019). Figure 2.2 illustrates the percentage of ICT infrastructure in France and Iran during various periods, as reported on official government websites. As the figure demonstrates, France has a greater ICT infrastructure than Iran, and the percentage of ICT development increases as we approach the present. Essentially, this figure reveals the differences in ICT infrastructure development over time. Given that this study evaluates individuals' ICT proficiency, it is essential to review the infrastructure data based on official government sources.

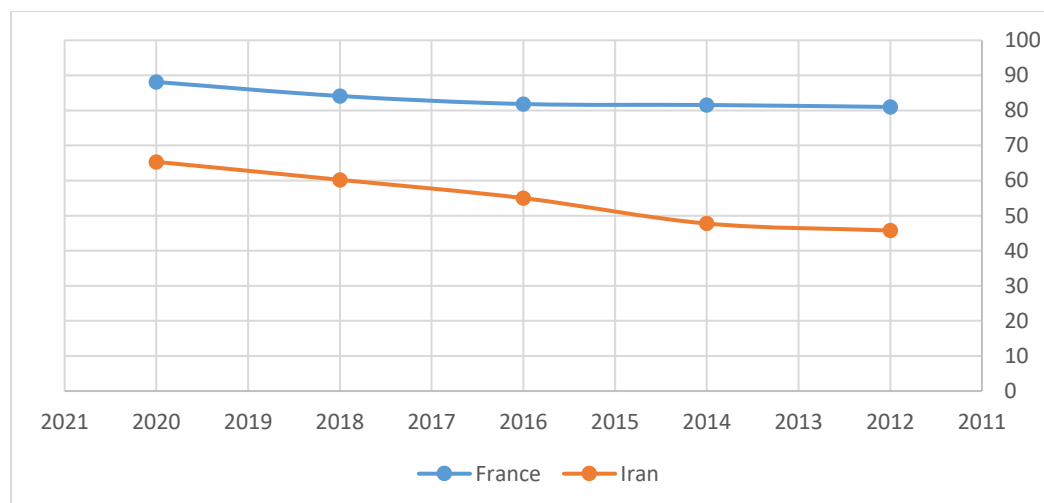


Fig.2.2.ICT percentages in Iran and France over different periods

Apart from the duality of the researcher's doctoral course in these two countries, the emphasis of this study on comparing Iran and France can be attributed to various reasons, including fewer difficulties in accessing information and collecting data, particularly in Iran, the researcher's birthplace. More understanding of Iran's urban and rural areas, France's reputation as a model of sustainable regional development in the European Union, the absence of ecovillages in Iran, and the presence of more than 19 ecovillages in France. The experiences of two countries with ecovillage will be discussed in the following.

2.2.1. Ecovillage experience in France and Iran

Given that Iran and France are the research case studies, this section discusses each country's position on ecovillage or alternative society programs.

France

The situation for ecovillages in France is more complicated than in other countries that have ecovillages. It is difficult to compile an exhaustive list of French ecovillages. On the GEN website, approximately 27 ecovillages are registered, the majority of which open and close within the time limits. Finally, the researcher discovered 19 ecovillages that were more stable than other locations. In addition, in response to the researcher's request for cooperation and an interview for this study, 11 of them cooperated (as we will discuss in the methodology). Some French ecovillages are mentioned below.

Sainte Camelle Ecovillage

Sainte Camelle is a 10-hectare village in Ariège with a population of 20 people. They place a premium on deep values like solidarity, benevolence, nonviolence, responsibility, and like-mindedness... with daily action and activity as part of sustainable lifestyles for current and future generations. Everyone in Sainte-Camelle has their own independent apartment, and they all share values of ecology and solidarity, spaces (kitchen, garden, vegetable garden, common rooms, laundry room, workshops, children's area, etc.), and occupations: 100% of each inhabitant's activity is performed within the ecovillage. They have chosen this way of life because they believe that bringing together diverse skills, experiences, and identities is a genuine solution to some of society's current problems. That is, the problem is the result of dominant individualism. This gathering also allows for the expression of collective intelligence. Residents work hard to maintain harmonious relationships among themselves because they have seen how important this is in everyday life. They share a vision for everyone to reach their full potential and be fully themselves in the service of our common goal. Furthermore, they emphasize moral values such as respect for the environment, respect for people, highlighting diversity, love in action, enjoyment of life, bonding, and helping people in need. Group visits, internships, immersion times to share their communal life experience, hospitality in ecotourism, and volunteer sharing times have been prioritized (ecovillagestecamelle.fr).



Fig.2.3. A view of the Sainte Camelle Ecovillage

The buildings, which were originally made of stone and raw earth, have been renovated using environmentally friendly and local materials such as brick, hemp, sheep's wool, straw, cardboard, and earth... Dry toilets and solar showers, rainwater recovery basins, and phyto-purification all reduce resource and energy consumption. In 2020, a portion of the buildings were outfitted with a new heating system that used a combination of solar panels and a wood-fired boiler. In the ecovillage, only organic products are consumed, and vegetarian food accounts for the majority of the inhabitants' diet. An orchard of rustic varieties and a permaculture market gardening area have also been planted for the collective's self-sufficiency. The meadows and forests, on the other hand, have never been chemically treated and have been left as natural as possible (GEN, 2022).

To avoid becoming a dormitory ecovillage, the collective has spent years experimenting with the development of a viable and local economy. Everyone has chosen to work on the site, which has become a breeding ground for collective and personal projects - courses and activities, tree houses, Shiatsu practice... The ecovillage shares its knowledge through visits, groups, courses, and immersion time (cooperative-oasis.org).



Fig.2.4. the Commonplace for weekly meetings in Sainte Camelle Ecovillage

Les 3 Sources Ecovillage

Les 3 Sources is an intercultural and inter-religious ecovillage project as well as a housing and living community with a common association. This ecovillage was founded in 2011 on 52 ha and 20 accommodations and 49 residents with the goal of promoting global and personal ecology, as well as emphasizing diversity and differences in thoughts, habits, beliefs, and cultural diversity. Les 3 Sources is located in the south of France, less than 200 kilometers from Toulouse and Montpellier, near Albi and St Affrique (South Aveyron), in the villages of PLAISANCE and COUPIAC (GEN, 2020).

The residents of this ecovillage devote the majority of their efforts to attracting tourists. Preparing attractive cottages and healing activities such as SPA, sauna, fitness area, massage, and therapy are examples of such activities (certified psychotherapist, naturopath). This ecovillage is also working on economic projects, as well as increasing social interaction and solidarity among residents. A common organization manages its common facilities such as a garden, laundry, sauna, swimming pool, and café/cafeteria/restaurant. The residents take numerous steps to further the development and improvement of the ecovillage. Teaching and organizing classes on "Living in an Ecovillage - Change Your Life Deeply," as well as organizing appropriate "Ecovillage, Living

in Adventure? To introduce tourists to this sustainable way of life (<http://www.ecovillage-3sources.eu/>).



Fig.2.5. A view of the Les 3 Sources Ecovillage

French ecovillages are distinguished from other ecovillages by their small population of 5-50 people, such as the Eotopia ecovillage, which has 8 residents. Another distinguishing feature is that most of them were not traditional villages before, but were built spontaneously and collectively by urban residents. Hence, the residents of these ecovillages were mostly city dwellers. In general, the Ecovillage concept is more recent in France. Until now, no researcher has conducted any research on them, and the researcher's knowledge of these ecovillages has come primarily from websites, GEN, and interviews with residents of these ecovillages. The government, on the other hand, has not provided any support program in this regard, and the main issue of sustainable societies has received more attention in cities. This issue has been a source of despair and weakness in ecovillages that have been built on their own without any assistance. Another issue with French ecovillages is their economic weakness, which has a negative impact on the environment, especially if it is not done with ecotourism planning and management.

Iran

According to the research, there is no specific plan for the formation and establishment of an ecovillage in Iran. Of course, scattered measures in related fields in various regions of the country have been implemented, which fall far short of Ecovillage standards. What is certain is that Ecovillage is a plan for local sustainable development, and its main core is local participation and management, and no success in this field will be achieved without local empowerment and capacity building, institutional participation, and local integration. In Iran, the implementation of local development programs, such as the conversion of traditional villages into ecovillages, necessitates a variety of public and institutional participation plans. Local people are considered the main and primary core of participation for the realization of ecovillage, and such programs will fail without their local will, acceptance, and effective participation (Rezvani, 2014).

In terms of local participation, the support of governments and local officials is crucial. Local participation is critical because the essence and nature of ecovillage as a sustainable lifestyle are dependent on individual and community motivation, adaptability, and environmental awareness. Hence, culture and the culturalization of sustainable living play a significant role in this field. On the other hand, the villagers' traditional and religious culture will make transitioning to this lifestyle much more difficult. Although a sustainable lifestyle can coexist with traditional and religious culture, one of the fundamental principles of Ecovillage is to respect people regardless of race, religion, age, or ethnicity. In other words, it refers to racial, religious, and cultural diversity. According to the researcher's interviews, there were residents of all races, ethnicities, religions, and beliefs in the French ecovillages, and most of them spoke multiple languages because of this diversity. For example, residents of the La Vie Tara Ecovillage in the southeast of France (Lalouvesc) speak English, French, German, Dutch, and Turkish (of course, this is not only for the French ecovillages, but Most ecovillages in the world are like this). Apart from that, being traditional and religious has an impact on solidarity, communication, and collective participation. Especially in this context, women in Iranian villages have a lesser role in village decisions or many village participations, which can be another issue in the transformation of traditional villages into ecovillages. As a result, in order to transform traditional villages into ecovillages or to establish independent ecovillages, culture building and participation of local people are required first, followed by government support and infrastructure.

On the other hand, because of the diversity of natural and climatic conditions in Iran, it is possible to replicate a program such as the Japanese program, which shows the ecovillage model based on the different characteristics of villages in each region. Therefore, if programs and plans to convert traditional villages into ecovillages or to establish ecovillages in Iran are developed in the future, it is preferable to present a type of ecovillage model based on the location and nature of each village, with the goal of being in line with the current situation of the target villages. Some of Iran's different villages in different climates are mentioned below:



Fig.2.6. Village of Philband in the North



Fig.2.7. Village of Masuleh in the North



Fig.2.8. Abyaneh village of Isfahan, in the Center



Fig.2.9. Qalat village of Shiraz, in the South



Fig.2.10. Makhonik of Sarbisheh, in East



Fig.2.11. Kandovan of East Azerbaijan, in North West



Fig.2.12. Uraman Takht of Kurdistan, in North West

By comparing Iran and France, it is possible to examine urban residents' perceptions toward a sustainable lifestyle, such as ecovillage, and determine what dimensions are necessary to achieve this goal in the region. Given the importance of using technology to accelerate the development of sustainability, the level of development of the two regions and the role of ICT in the development of sustainability can be analyzed by comparing the level of ICT as one of the most important dimensions of technology. It is also possible to examine the residents' viewpoints by investigating the role of ICT in sustainable development. Figure 2.13 depicts the studied cities in Iran in green and France in red. The size of the circles in this map indicates the population of the cities, while the gray circles indicate the classification of the respondents.

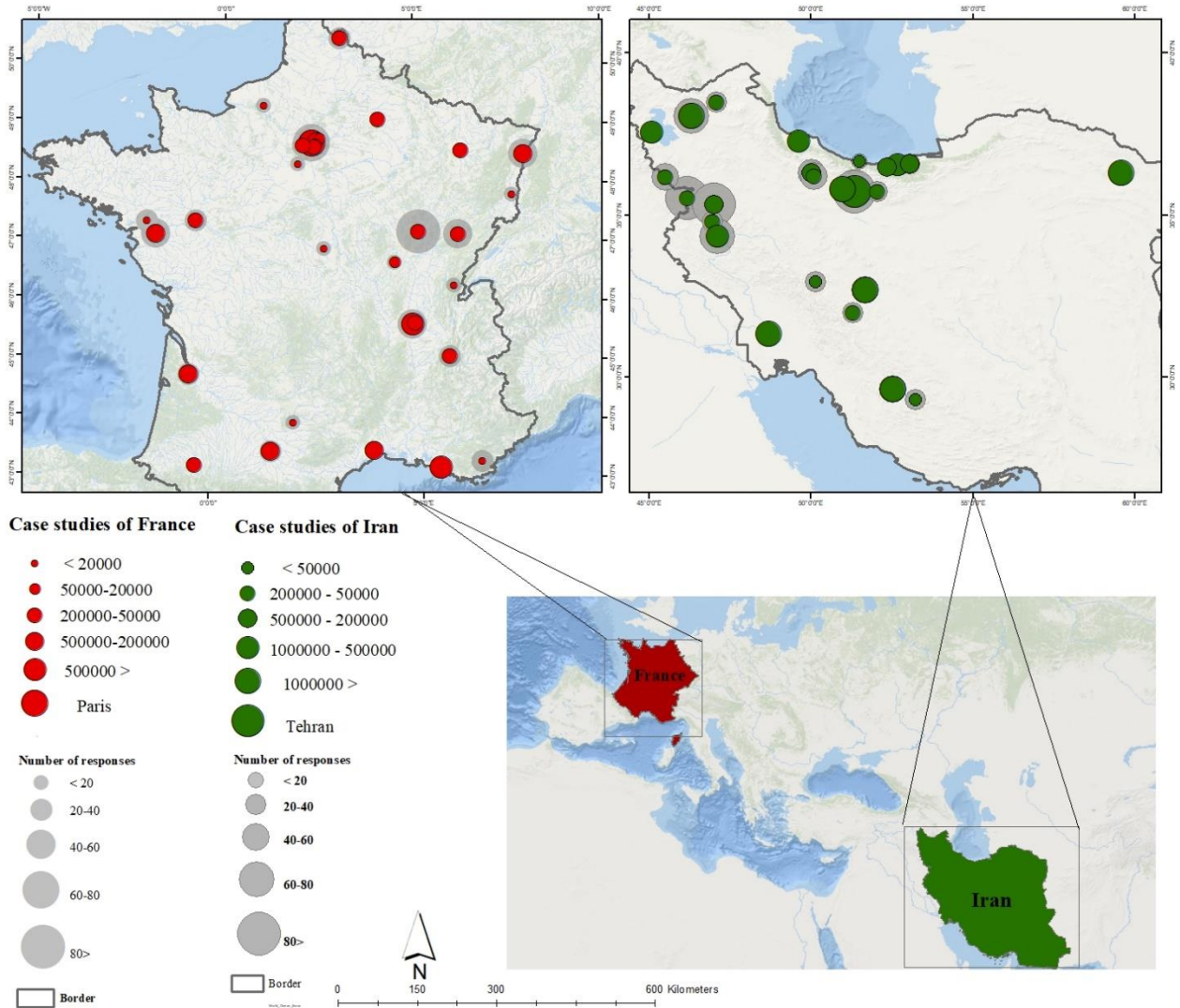


Fig. 2.13. The Case Study of the research

Given the importance of studying urban and rural areas in the issue of environmental sustainability, as mentioned previously, it was critical to emphasize rural areas alongside urban areas. Whether or not rural areas have the potential to become an ecovillage and a sustainable lifestyle, the sustainability of rural business spaces is critical. Figures 3 and 4 show the villages studied in Iran and France.

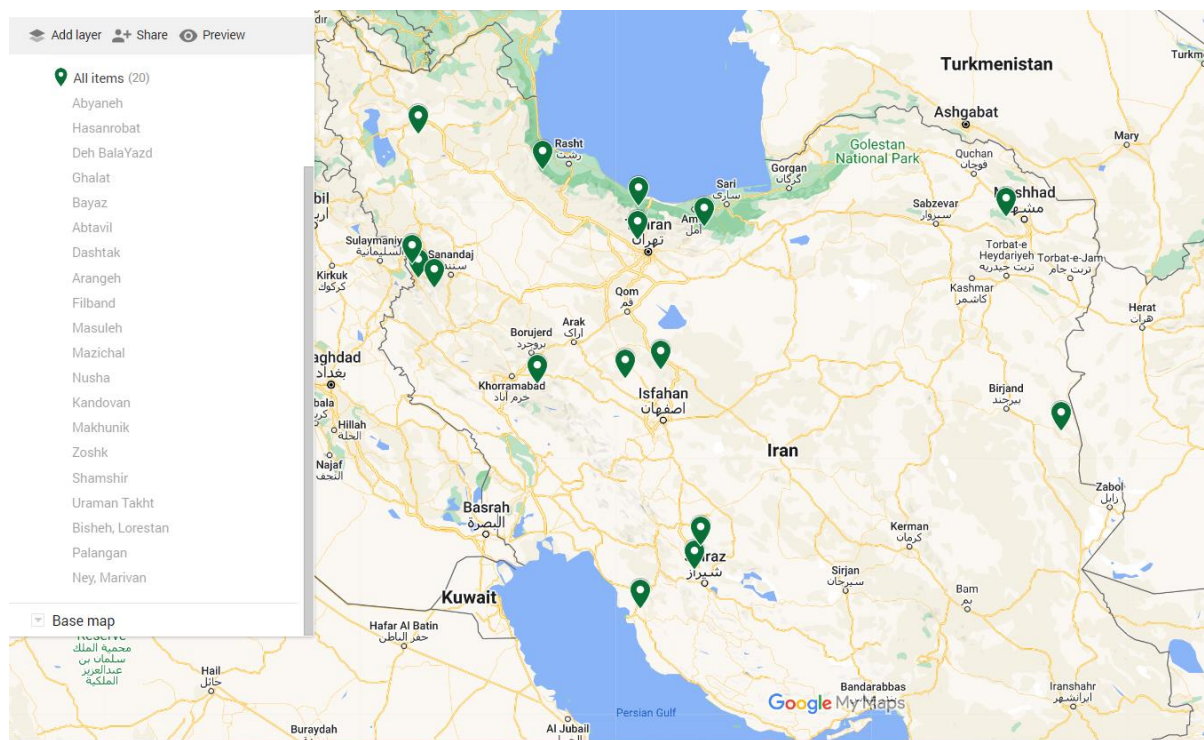


Fig. 2.14. The studied villages in Iran

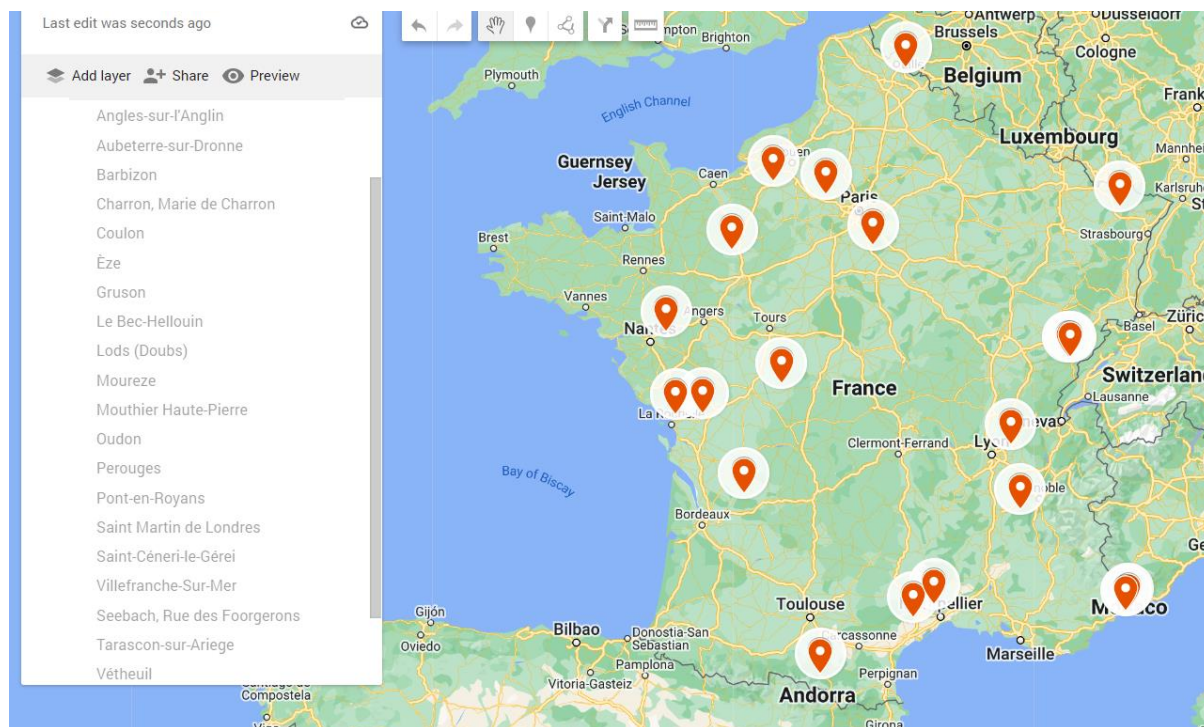


Fig. 2.15. The studied villages in France

Eventually, since this formation of ecovillage communities remains relatively new, it is essential to determine whether these communities are committed to and accountable for a sustainable lifestyle. Here, 11 ecovillages are under review and investigation (Fig. 5).

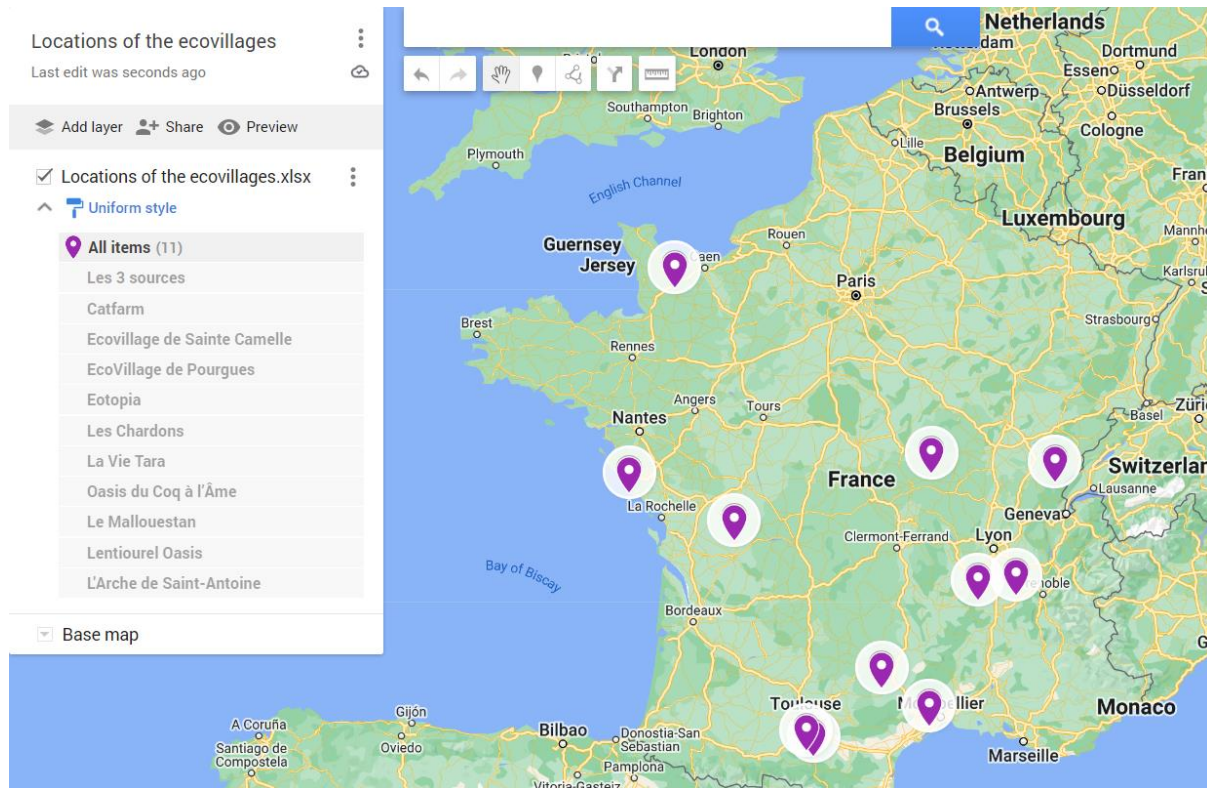


Fig.2.16. Ecovillages studied in France

Finally, the findings of this study may make it easier to implement sustainable lifestyles in Iran and France, as well as provide new strategies for introducing sustainable lifestyle promotion laws based on ecovillages and a focus on ICT. Since the goals of an ecovillage differ greatly from those of modern society, planners must be more critical of current unsustainable rural/urban development methods that are incompatible with the goals of sustainability and equity. Challenging reality is a difficult task because it involves a variety of social actors who all have competing interests in the production of social reality. To overcome these obstacles, planners must identify stakeholders who share similar values in order to achieve sustainable living goals. To achieve consensus within the alliance, discussion, communication, and consultation should be encouraged.

2.3. Methodology

The most important research objective is to investigate and analyze environmental sustainability in urban and rural communities with a focus on ecovillages and based on ICT. In light of its aim and general focus, the current research falls under the applied and developmental classifications, respectively. The goal of this research is to unearth new knowledge that can be specifically applied to a real-world procedure. Additionally, it approaches operational problems using theories, principles, and basic research tenets. In other words, although applied research has a basic component that is shared with basic research, applied research receives priority in terms of time due to its short duration, frequent decision-making, and propensity for providing quick and immediate answers to a variety of questions. Hence, this study employed a mixed-methodological approach. Mixed method research is research in which the researcher employs the qualitative research paradigm for one phase of a research study and the quantitative research paradigm for another in order to gain a more comprehensive understanding of a research problem (Creswell, 2007; Migiro & Magangi, 2011). When combined in a single study, quantitative and qualitative methods complement each other and allow for a more thorough examination of the research problem (Malina et al., 2011). The decision to use both methods in this study was based on the nature of the actual research problem and the research questions (López-Aymes et al., 2021). Hence, the mixed method used in this study increased our confidence in the research findings. For example, a researcher may conduct a quantitative experiment and then conduct an interview with participants in a qualitative study to see how they perceived the experiment and whether they agreed with the results (Tashakkori & Creswell, 2007; Johnson, 2008). Consequently, in order to achieve the desired result and idea, this method must be used in the current research.

2.3.1. Research Questions and Objectives

The research design should center on data collection and analysis and be structured in such a way that it best answers the research question (Bryman & Bell, 2015). The participants' perspectives in Iran and France were used to answer the research questions and understand how ecovillages lifestyle and ICT technologies can help to have Environmental Sustainability as well as a sustainable business environment and a better future due to environmental issues these days. To achieve this sustainability, research questions about public perceptions in this field have been addressed. In order to measure and analyze the differences and similarities between participants'

perspectives in different cities. Consequently, the study was guided by the following research questions and Objectives:

Q1. What are the most essential Dimensions of ecovillages based on residents' preferences in Cities?

O1. The Identify the most important features of ecovillages based on general resident preferences in Cities, and then compare these dimensions to Iran and France's geographical regions.

Q2. What is the state of ICT development in relation to environmental sustainability in order to build smart cities?

O2. Determining ICT development in relation to environmental sustainability in order to create smart cities.

Q3. What is the relationship between sustainable development and ICT to reach urban ecovillage communities?

O3. Analyzing the relationship between sustainable development and ICT to reach urban ecovillage communities.

Q4. How can traditional villages transform into ecovillage and adopt ecovillage lifestyles?

O4. Evaluating the possibilities for traditional villages to be transformed into ecovillage lifestyles.

Q5. What is the state of the studied villages' business spaces, and what solutions are suitable for their sustainability with the goal of becoming an ecovillage?

O5. Evaluating the studied villages' business spaces and suitable solutions for their sustainability with the goal of becoming an ecovillage.

Q6. How committed and responsible are the Current ecovillages to a sustainable lifestyle for a sustainable future?

O6. Assessment of current ecovillages' responsibility to a sustainable lifestyle.

Q7. What is the best model for achieving urban-rural sustainability based on Ecovillage and ICT?

O7. Providing an appropriate model for achieving urban-rural sustainability based on Ecovillage and ICT.

2.3.2. Quantitative Methodologies

Quantitative methodology is the dominant research framework in the social sciences. It refers to a set of strategies, techniques, and assumptions used to study psychological, social, and economic

processes through the exploration of numeric patterns. Quantitative research gathers a range of numeric data (Savela, 2018). Quantitative methodologies use statistics to analyze numerical data gathered by researchers to answer their research questions (Ögmundarson et al., 2020). In other words, Quantitative research is a systematic investigation of phenomena by gathering quantifiable data and performing statistical, mathematical, or computational techniques. Quantitative research collects information from existing and potential customers using sampling methods and sending out online surveys, online polls, and questionnaires, for example (Bauer et al., 2021; Strijker et al., 2020). This research has investigated the quantitative method process in the following sections. The definition of the research variables in the research questions and how to select them was discussed in the first stage, and the measurement tools, data collection, and study areas were discussed in the second stage.

2.3.2.1. Defining variables and research objectives concepts

The variables used for the research objectives were selected based on a comprehensive review of existing literature on each topic. They were identified as the most commonly discussed and relevant variables in the literature and categorized into their respective dimensions. Ultimately, these variables were utilized to develop the survey instrument to collect the data needed to achieve the research objectives.

The careful selection of variables and rigorous methodology employed in this study aim to provide valuable insights into the research topic. The variables used to achieve the research objectives are listed below.

❖ Ecovillage

Ecovillage is a key concept in developing sustainable human settlements and habitats throughout the world. When it comes to environmental issues, most of the solutions are global, despite the fact that they exist at all levels of society and must be addressed on a lesser level. Make this possible, incorporate, and implement (Breton, 2004). Ecovillages are rural or urban communities that strive for a supportive social environment as well as a low-impact lifestyle. To accomplish this, a number of factors are combined, including ecological design, green production, alternative energy, and many others. In other words, an Ecovillage is a society that consciously and through participation in local ownership and rights, as well as participatory processes, seeks to reclaim the

social and natural environment (Duan, 2011). Ecovillages, as defined above, are communities that strive for a socio-cultural and economic environment by reducing environmental impacts to sustainability. Finally, as an integrated model, these societies consider the sustainability of societies in ecological, economic, social, and cultural dimensions (Fig.). The indicators used by researchers in the field of the ecovillage are discussed further below (Table 1).

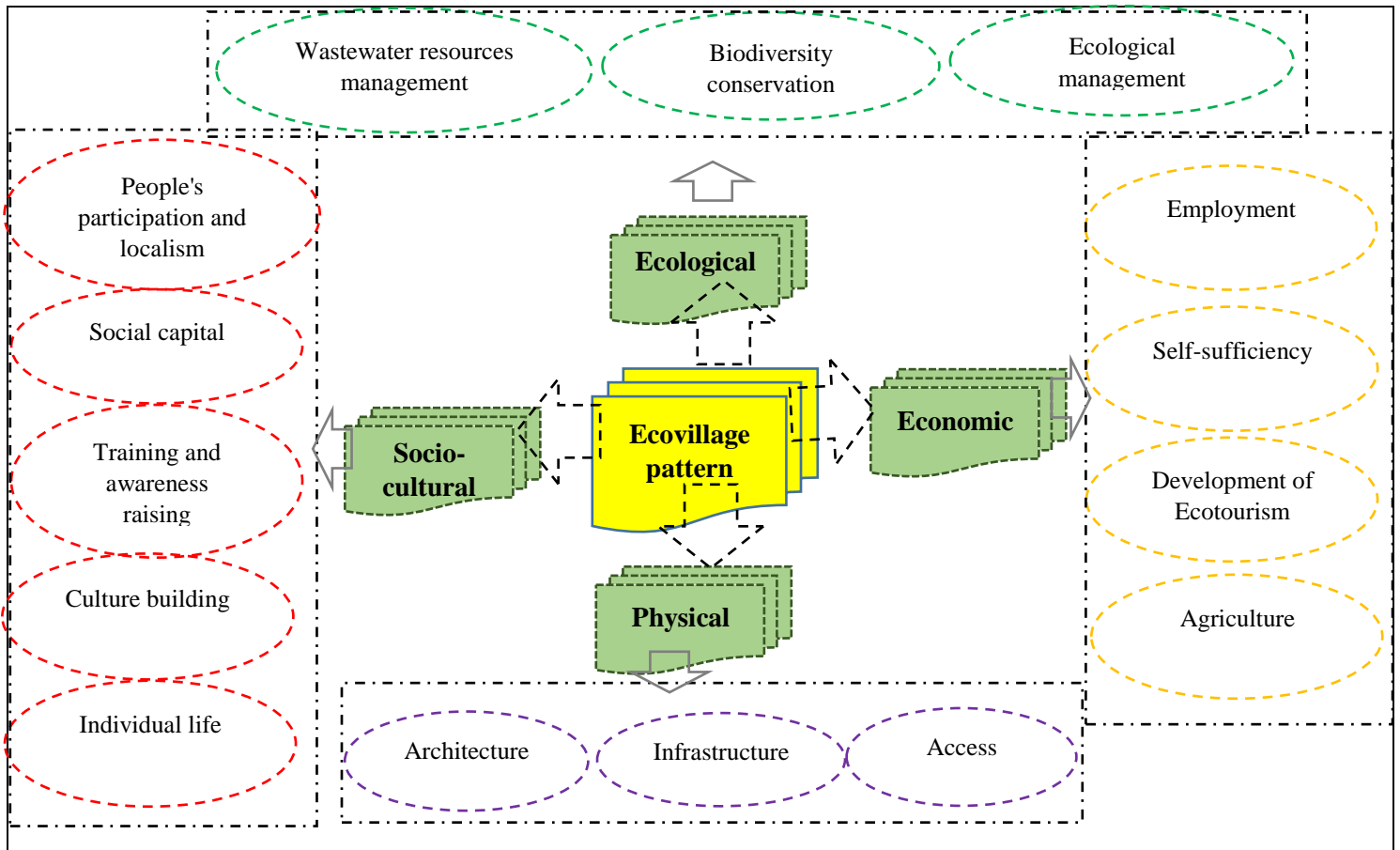


Fig. 2.17. Ecovillage pattern dimensions

Table.2.1. the variables used in the Ecovillage research

Dimensions	Variables	Gilman, 1991	Kirby, 2003	Jackson, 2004	Bang, 2005	Arzdzijskaite, 2009	Holleman, 2011	Vazin, 2012	Kunze & Avelino, 2015	Adalilar, 2015	Hall, 2015	Hong & Vicdan, 2016	Daly, 2017	Mychajluk, 2017	Loekyer, 2017	Barani & et al, 2018	Zaheri & Saadi, 2018	Royesen & Mertens, 2019	Price et al., 2020	Ulug et al., 2021	Ulug et al., 2021	Pisters et al., 2022		
Ecological	Green spaces		*						*															
	Biodiversity conservation		*					*	*						*									
	Recovery of nature		*					*	*							*				*				
	Local people's perception of the environment						*		*	*					*									
	Waste recycling in the production cycle			*		*			*	*								*						
	Waste recycling and composting infrastructure		*			*			*	*														
	Urban industrial and agricultural wastewater management																*							
	Wastewater treatment for irrigation						*											*						
	Processing and converting surplus food							*										*	*					
Cultural	Contribution of natural resources to art and local culture							*										*			*	*	*	
	Cultural values										*			*							*	*	*	
	Culture of mutual respect and solidarity										*			*							*	*	*	
	Sharing creativity art and innovation										*			*								*	*	
	Artistic and cultural activities in environmental protection							*			*			*										
Architecture	Attention to the aesthetics and architecture			*				*				*		*		*					*	*	*	
	The use of natural and local materials	*		*							*			*			*		*				*	
	The resistance to climatic and environmental hazards																*						*	
	The design and construction in harmony with nature	*										*			*	*	*							
Economic	Small Business Support								*			*				*			*	*		*	*	
	Self-employment			*					*			*			*	*			*	*		*	*	
	Supply chain management				*				*				*			*			*	*		*	*	
	Production and consumption of local and organic				*			*							*	*			*	*		*	*	
	local ownership												*			*			*	*		*	*	
	Attention to tourist attractions																							
Agriculture	Employment opportunities in the tourism		*			*								*										
	Organic farming						*														*	*	*	
	Green cultivation techniques						*								*				*	*	*	*	*	
	Recycling of agricultural products						*								*				*	*	*	*	*	
Individual	Technology adoption							*											*	*	*	*	*	
	Identifying oneself with the region						*					*					*			*	*	*	*	
	Respect for human and future lives						*				*	*		*		*				*	*	*	*	
	Acceptance of innovations						*									*				*	*	*	*	
	Political isolation				*															*	*	*	*	
Social	Environmental awareness										*									*	*	*	*	
	Participation among the inhabitants					*												*		*	*	*	*	
	local cooperation in protecting the environment		*						*									*	*	*	*	*	*	
	Cohesion solidarity and unity between people					*			*									*	*	*	*	*	*	
	Communication with neighborhood units					*		*										*	*	*	*	*	*	
	Sensitization of populations to climate change															*		*	*	*	*	*	*	
	Extension education programs			*								*				*		*	*	*	*	*	*	
	Workshops on environmentally															*		*	*	*	*	*	*	
Transportation and Access	Preserving old traditions						*					*				*		*	*	*	*	*	*	
	Increase walking trails					*			*	*		*				*		*	*	*	*	*	*	
	Reducing vehicle use					*			*	*		*				*		*	*	*	*	*	*	
	Alternative Transport					*			*	*		*				*		*	*	*	*	*	*	
	Improving the state of communication					*			*	*		*				*		*	*	*	*	*	*	
	Access to health services					*			*	*		*				*		*	*	*	*	*	*	
	Access to appropriate technology					*			*	*		*				*		*	*	*	*	*	*	
	Proximity to large cities					*			*	*		*				*		*	*	*	*	*	*	
Access to the station					*			*	*		*				*		*	*	*	*	*	*		
Easy access to airports					*			*	*		*			*		*	*	*	*	*	*	*		

❖ ICT

ICT (Information and Communication Technology) refers to the set of manufacturing and service industries that use electronic storage, transmission, and display of data and information. This definition defines ICT as a collection of hardware, software, and networking technologies that enable the study and application of data and its processing in the areas of storage, manipulation, transfer, management, transfer, exchange, control, and automatic data preparation (Mahmoudi and Mahmoudi, 2011).

Information and communication technology has a dual role in the economy. On the one hand, the input is for the user and on the other hand, it is the output for the producers of ICT industries. The technology revolution is known for its rapid improvement in equipment quality and software, as well as a sharp drop in prices. In this way, firms that aim to maximize profits respond to these changes by replacing equipment, software, and services so that they can use the rapid advancement of technology to enhance their interests (Agarwal & Alam, 2018). As a consequence, it is critical to assess respondents' use of ICT in their personal and professional lives. The indicators used by researchers in ICT development are listed in the table below (Table 2). This part of the study, by soliciting information on device ownership, internet access, computer skills, social media usage, and e-commerce utilization, the study aimed to gain an understanding of the level of information and communication technology (ICT) development and potential barriers to sustainable development practices in the cities of France and Iran. Specifically, the information gathered can inform strategies for improving access to ICT resources and promoting sustainable consumption patterns. Furthermore, the study explored the influence of pandemics on ICT usage and its impact on sustainable development practices. These findings are crucial for designing effective strategies to overcome potential challenges and capitalize on opportunities associated with the integration of ICT resources into sustainable development practices.

Table.2.2. the variables used in the ICT level research

Variables	Rahman, 2008	David, 2009	Ndeukunwa Ngolalo, 2010	Wanjiku Githinji, 2011	Tafesse Tirkaso, 2011	Grunfeld, 2011	Sarabadi et al, 2011	Mohammadi et al, 2012	Rajesh, 2013	Saifuddin Khalid, 2014	Sorani et al, 2014	Abasikashi & Soltani, 2014	Savulescu, 2015	Farhadi & Ebrahimi, 2015	Babayifini, 2015	Shirafkan et al, 2015	Heydariyesareban & Saeb, 2016	Agyakoma Mireku, 2016	Freeman & Mubichi, 2017	Sarayi et al, 2017	Moheidi et al, 2017	Aalavizadeh & Davarzni, 2017	Tunali et al., 2017	Daniyali, 2018	Halili & Sulaiman, 2018	Maski Rana et al 2018	Kamarudin et al., 2019	Alma Çalli et al., 2019	Adeleye & Eboagu, 2019	Erkhembaatar & Bataa, 2020	Fernández-Portillo et al., 2020	Erkhembaatar & Bataa, 2021	Pradhan et al., 2021					
The devices' ownership	*															*						*																
Internet Access	*																																					
Which Internet										*							*																					
Internet Access Device								*		*													*									*						
Usage Internet										*										*					*												*	
Time use internet (Daily)										*																						*						
Word processing										*														*			*											
Online research		*														*							*			*												
Data management		*											*						*																			
Multimedia		*						*															*											*				
Web design	*			*												*																					*	
Management system learning							*																															
Smartphones Applications					*																																	
Social Media																					*											*					*	
Computers in Companies	*																		*							*												
Access Internet for business			*														*																					
Access Company Internet			*																								*										*	
Access Computer for business	*											*																										
Website									*				*			*						*											*					
Website option									*																							*						
Used more computer											*	*																										
Personal knowledge of computers											*					*											*											
Used more computers In Company				*																		*			*													
Used more Internet						*																*			*													
Personal knowledge of Internet	*										*												*		*													
on computersUsed more Internet						*																													*			
Used more Social Media														*				*							*													
Personal knowledge of Social Media																		*	*														*			*		
Used more computers on Social Media																																*		*		*		

❖ ICT & Sustainability

Technological innovation is critical to improving economic development, facilitating social inclusion, and allowing for better environmental protection. ICTs are specifically considered as a means of achieving Sustainable Development Goals (SDGs), emphasizing their transformative potential across multiple domains (Chen et al., 2020; Hartono, 2020).

The advancement of information and communication technologies, as well as global interconnection, have the potential to significantly accelerate human progress, bridge the digital divide, and foster knowledge societies. This has justified the research's interest. As a result, the motivation for this section of the research is to document how ICT knowledge to promote environmental sustainability as a foundation for sustainable development has evolved (Giesenbauer & Müller-Christ, 2020; González-Zamar et al., 2021). Moreover, Building smarter cities, transportation systems, electrical grids, and industrial processes can all help to reduce emissions (Añón Higón et al., 2017). The 'ICT for green' perspective sees ICT as a potential solution to many environmental issues. There is a lot of hope that ICT will play a significant role in addressing climate change and other environmental issues (European e-Business Report, 2010; Elliot, 2011; Melville, 2010; Watson et al., 2012; Gholami et al., 2013). Therefore, The indicators used by researchers in ICT and sustainable development are listed in the table below (Table 2).

2.3.2.2. Sampling

Whenever a survey is reliable and representative of the research population, it can be extremely valuable. However, determining the appropriate sample size and survey population can be difficult. Especially for research that seeks to conduct, a humongous and general study on a large population. On the other side, using a web survey made it more difficult to draw a more representative sampling in a broader population. In this study, a comparison is made between Iran, which has a population of 86,629,544 people, and France, which has a population of 67,813,396 people. Since the research objective was to provide a comprehensive understanding of the current state of the topic in both countries, the survey was distributed throughout the entire countries. This allowed for a larger geographical area to be covered and a more comprehensive dataset to be collected, which was analyzed from a broader perspective. As a result, a more representative and diverse sample was obtained. Hence, due to the large population size of both countries, a convenience sampling approach was used to select participants for the survey. However, despite the limitations of convenience sampling, the researcher made efforts to ensure that the sample was as representative of the population as possible and that it was sufficient for the research objectives. Some of these initiatives include the following:

- ✓ To reach a diverse sample, multiple distribution channels were used, including social media and social networks, and different groups were targeted.
- ✓ The margin of error¹: A margin of error of 3-5% is commonly used in public opinion polls. In this study, the margin of error for both cases as calculated to be 4%, based on the population and sample size.
- ✓ The variability of the responses²: in this study the variability of the responses was low, meaning that there was a narrow range of preferences among residents, then this sample size was sufficient.
- ✓ Diversity of personal responses represented of a different category.

Hence, the questionnaire was distributed to adults aged 18 to 66 in Iran (45 million people) and France (40 million people), via social media and social networks to people aged 18 to 66 in France and Iran. Finally, the original survey received 500 responses from 35 French cities and

¹ The margin of error is the amount of error that researchers are willing to tolerate in the results. Represent the maximum amount by which the results may differ from the true population value.

² Variability of the responses is the extent to which responses within a population differ from each other. For example higher variability need larger sample size and lower variability need lower sample size.

510 responses from 25 Iranian cities. Given the large number of responses from various cities, the cities were divided into six groups based on population index¹ to make the data easier to analyze capitals (Paris and Tehran), very big, big, medium, small, and very small cities (Tables 4 & 5).

Table.2.4. Characteristics of case studies in France

Category	Population	The name of the cities	The number of responses
Capital	2,181,306	Paris	57
Very big	500,000>	Marseille, Lyon	65
Big	500,000-200,000	Strasbourg, Nantes, Toulouse, Bordeaux, Montpellier, Lille	93
Medium	200,000-50,000	Dijon, Besancon, Nancy, Grenoble, Versailles, Courbevoie, Vitry-sur-Seine, Villeurbanne, Bobigny, Pau, Reims, Angers	155
Small	50,000-20,000	Châtenay-Malabry, Caluire-et-Cuire, Charenton-le-Pont, Le Creusot, Livry-Gargan	30
Very small	< 20,000	Blain, Mont-Saint-Aignan, Chenôve, Baugy, Ensisheim, Dourdan, Le Luc, Ciel, Saint-Claude	100
Total		35	500

Table.2.5. Characteristics of case studies in Iran

Category	Population	The name of the cities	The number of responses
Capital	9,500,000	Tehran	69
Very big	1000,000>	Mashhad, Esfahan, Shiraz, Karaj, Tabriz, Ahvaz	111
Big	1000,000-500,000	Kermanshah, Urmia, Babol, Rasht	74
Medium	500,000-200,000	Sanandaj, Qazvin, Sari, Amol	94
Small	200,000-50,000	Alborz, Sardasht, Kamiaran, Mariwan, Ahar, Brojen, Damavand	128
Very small	< 50,000	Noshahr, Sarvestan, Fereydonshahr	34
Total		25	510

2.3.2.3. Measurement & Data collection

¹ The scale for this category varies because the populations of the two countries are different.

In this section, documentary methods - libraries and questionnaire collection tools, the dissertation social group, as well as databases including journals, reports, and books were used to address the issues based on the nature of the study.

A specially designed web survey was used to collect the quantitative data for this investigation. By utilizing a web survey, I was able to attain a wider pool of participants from both countries with ease, making it possible for a diverse range of individuals to take part in the study. This approach allowed me to reduce the financial burden that would have otherwise come with travel expenses and hiring local staff. Furthermore, the research became more cost-effective as a result. Another benefit of the web survey was that data collection occurred at a faster pace than with traditional questionnaires. Lastly, participants felt more comfortable sharing their opinions anonymously, thereby increasing the likelihood of obtaining candid and genuine responses. Hence, the survey was only open to French and Iranian citizens over the age of 18. The survey was done from October 15 to January 31, 2021, and was prepared using the LimeSurvey online survey platform for the French version and the Porsline survey platform for the Persian version. There are some constructs in each research question (items). Each construct was measured with many items to confirm the validity of all the instruments, and they were all adapted from previous research. Each item was evaluated using a different scale and depending on the item, such as which devices they use, where they use the internet, how much they are specialists in computer science, and so on. However, the majority was based on two Likert scales, one for value (Very Low, Low, High, Intermediate, Very High), and one for agreement (Totally Disagree, Disagree, Neutral, Agree, and Totally agree).

Before finishing the main survey material, the questionnaire was pilot-tested with a convenient sample, and items were amended. The main purpose of the pilot test was to improve the substance of the measuring items, thus colleagues were invited to review the questionnaire for clarity, relevance, and significance. The measurement items were enhanced and some new ones have been included thanks to comments and suggestions. In the pilot test, 42 questionnaires were completed, and the data were analyzed using an item identification analysis process that integrated descriptive statistics with the identification of extreme values and homogeneity tests to produce an acceptability index score of no more than two. The main study employed the final 115 measurement items collected from the pilot test.

It is impossible to reach the entire population with online questionnaires. When compared to those who have access, their use is limited to those who have email and internet connections

and those who do not. Because there is no proper sampling frame available, it is impossible to draw a scientific sample of the larger population for an online survey. Typically, sampling frames are only available for closed populations or specific target groups (Bordonaro, 2017; Grossardt and Bailey, 2018; Metzler et al., 2015; Poynter, 2010).

Some ways of obtaining an acceptable and representative sample for an online survey include contacting respondents by phone, distributing the link on social media, encouraging them to check in to a website, and so on (dell'Olio et al, 2018; Tanner, 2018). The web survey was distributed based on a list-based random and non-list-based random in this study. For list-based, we sent a link to survey participants via emails, such as universities and large organizations. We also send a link to social media sites such as LinkedIn, Facebook, Instagram, Telegram, and WhatsApp for non-list-based recipients.

The web survey questionnaire has four main components. The first component collects personal and work-related information from respondents. The second segment collects questions on the Ecovilages dimension. The third segment collects questions on ICT proficiency. The fourth segment collects questions on ICT and sustainability. The information received from the questionnaire was used to determine the level of ICT and to compare geographic locations in France and Iran.

2.3.2.4. Statistical Analysis

The statistical analysis for the first question was done with SPSS and the Structural Equation Modeling (SEM) was created utilizing the AMOS (Analysis of Moment Structures) software. Since concepts like "economic" and "ecology" are not directly observable and must be deduced from a series of measurable data, the SEM model with latent variables was utilized. This model can be used to look at a collection of relationships between one or more independent variables, whether they're continuous or discrete. It devises a method for breaking the correlations detected in a system of equations that explain their causal assumptions. The SEM model investigates causal linkages between directly observable data, assuming that all existing relationships are linear (Zhang & Li, 2019). As a result, SEM provides three significant advantages over traditional multivariate techniques: (1) explicit measurement error evaluation; (2) estimation of latent (unobserved) variables via observable variables; and (3) model testing, in which a structure can be imposed and data fit assessed. By not explicitly addressing measurement error, most multivariate techniques accidentally disregard it, whereas SEM

models estimate these error variance parameters for both independent and dependent variables (Novikova et al., 2013).

The Structural Equation Model provides for the measurement of a "hidden variable" using numerous observed variables, as well as the specification, estimation, evaluation, and presentation of graphics that depict hypothetical relationships between the variables. It also influences how the desired hidden variable affects the number of variables seen for a "hidden variable," as well as how the incorrect variable affects it. The hidden (or latent) variables in this model include Ecological (ECL), Cultural (CUL), Architecture (ARC), Economic (ECN), Agriculture (AGR), Individual (IND), Social (SOC), Transportation and Access (TAA). Several observable variables are related to each of these latent variables.

- ❖ ECL is related to 9 observed variables: "Green spaces", "Biodiversity conservation", "Recovery of nature", "Local people's perception of the environment", "Waste recycling in the production cycle", and "Waste recycling and composting infrastructure", "Urban industrial and agricultural wastewater management", "Wastewater treatment for irrigation", "Processing and converting surplus food".
- ❖ CUL is related to 5 observed variables: "Contribution of natural resources to art and local culture", "Cultural values", "Culture of mutual respect and solidarity", "Sharing creativity art and innovation", and "Artistic and cultural activities in environmental protection".
- ❖ ARC is related to 4 observed variables: "Attention to the aesthetics and architecture", "The use of natural and local materials", "The resistance to climatic and environmental hazards", "The design and construction in harmony with nature".
- ❖ ECN is related to 7 observed variables: "Small Business Support", "Self-employment", "Supply chain management", "Production and consumption of local and organic", "local ownership", "Attention to tourist attractions", and "Employment opportunities in the tourism".
- ❖ AGR is related to 4 observed variables: "Organic farming", "Green cultivation techniques", "Recycling of agricultural products", and "Technology adoption".
- ❖ IND is related to 5 observed variables: "Identifying oneself with the region", "Respect for human and future lives", "Acceptance of innovations", "Political isolation", "Environmental awareness".
- ❖ SOC is related to 8 observed variables: "Participation among the inhabitants", "local cooperation in protecting the environment", "Cohesion solidarity and unity between

people”, “Communication with neighborhood units”, “Sensitization of populations to climate change”, “Extension education programs”, “Workshops on environmentally”, “Preserving old traditions”.

- ❖ TAA is related to 9 observed variables: “Increase walking trails”, “Reducing vehicle use”, “Alternative Transport”, “Improving the state of communication”, “Access to health services”, “Access to appropriate technology”, “Proximity to large cities”, “Access to the station”, “Easy access to airports”.

For the second question, IBM SPSS software was used for data sorting and cleaning, and RStudio, an open-source software in the R programming language, was used for data visualization. R is a programming language that is used in statistical analysis and graphic production. R software is based on the "S" programming language created by Becker and Chambers (Dogan and Uluman 2016; Kaya et al., 2018). To assess the level of ICT in the case studies, six criteria were used: "device ownership," "Internet access," "computer skills," "social media," and "E-commerce." In R, the tidyverse, ggplot2, haven, and patchwork packages were used to analyze these items (Hůlek et al., 2013; Munir et al., 2020; Oleniacz & Gorzelnik, 2021).

Given this, ICT has emerged as one of the key management issues, and it is playing a critical role in guiding society toward sustainability. The Relationship between ICT and environmental sustainability was investigated in the next step, which is a large subject that is becoming increasingly important as more people understand the role of ICT in enabling sustainable practices only (Suryawanshi & Narkhede, 2015). Therefore, The role of ICT in the dimensions of sustainable development was analyzed using the one-sample T-test in SPSS. R programming language was then used to data visualization of the Relationship between ICT and environmental sustainability with economic, social, and environmental dimensions. Because the main dimensions of sustainable development include economic, social, and environmental dimensions, all of their indicators were analyzed separately, as explained in the definition of variables section. A boxplot was also used to examine the overall role of ICT.

2.3.2.5. Spatial analysis

Spatial statistics, according to the GIS dictionary (Wade and Sommer, 2006), is "the field of study concerning statistical methods that use space and spatial relationships (such as distance, area, volume, length, height, orientation, centrality).

Statistical tools for analyzing spatial distributions, patterns, processes, and relationships are included in the Spatial Statistics Toolbox. These tools allow you to summarize the most important features of the spatial distribution (for example, determining the mean center or overall directional trend), identify statistically significant spatial clusters (hot spots/cold spots) or spatial outliers, and assess general patterns. From clustering or scattering, features are grouped based on feature similarities, the appropriate scale of analysis is determined, and spatial relationships are discovered. Consequently, in this section, we examine the spatial statistics tools used in this study. (Chuna & Guldmann, 2014; Dutra Aguiar et al., 2007).

HotSpot: This method was investigated in the first part of the research (first question) with the aim of determining the relationship between indicators and places. In other words, the locations were classified as having high and low values for the researched dimensions (Ecovillage). The phrase 'hotspot' has been used to indicate a location or value that is higher than its surrounds across disciplines. For all features in the data, Hot Spot analysis calculates "Getis-Ord G_i^* " statistics. z-scores is the G_i^* statistic returned for each feature in the dataset. The z-scores and p-values that result indicate where characteristics with high or low values cluster spatially. This tool operates by examining each feature in the context of its surroundings. A high-value feature is intriguing, but it might not be a statistically significant hotspot. A feature must have a high value and be surrounded by additional characteristics with high values to be statistically significant. The local sum of a complication and its neighbors is small in comparison to the total number of complications. The outcome will be a score if the "Local sum" is unexpectedly larger than the expected local sum and the difference is so large that it cannot be attributed to chance. Therefore, in ArcGIS 10.3, the optimized hotspot analysis tool was used to find the most important dimension of ecovillages in the cities under study in order to locate hotspots (Wang et al., 2021; Rostaei & Alizadeh, 2020; Solari et al., 2019).

Spatial Autocorrelation (Moran's I): Based on the desired indicators, this method was used to assess the spatial autocorrelation between cities. The statistical technique of spatial autocorrelation (Moran's I) is used to calculate the degree of dispersion or concentration of features or spatial data. It's worth noting that this technique assesses the spatial feature distribution pattern by simultaneously observing the feature's position and attributes. The results of this analysis address the query, "What is the state of the spatial feature distribution (random, dispersed, or cluster)?" (Aghajani et al., 2017). "Moran's I" has well-established statistical features for describing global spatial autocorrelation, however, it fails to identify clustered spatial patterns and hotspots (Tewara et al, 2018).

Inverse distance weighted (IDW): Inverse distance weighted (IDW) interpolation was used for spatial analysis and to determine the level of ICT in each geographical location individually (second question). Indeed, cellular values can be determined using a linearly weighted combination of a collection of sample locations (the category of the cities). The weight is proportionate to the inverse distance (distance from each city). This approach presupposes that the influence of the variable being mapped decreases with distance from the sampled location (Ran et al., 2014; Luo et al., 2015; Kim et al., 2020).

The IDW method is the simplest interpolation technique available and can be applied to predicting the weights as a function of the distance between the observation point and the interpolation point at, which the prediction has to be made, with IDW it is substantially assumed that the rate of correlation and the similarities between neighbors are proportional to the distance between them, which can be defined as a distance reverse function. The closer points have more influence than the farther points (Chen et al., 2012; Setianto & Triandini, 2013; Moeletsi et al., 2016; Rasoli et al., 2019).

For the third question, the OLS and GWR spatial statistical tools were employed for exploring the spatial relationship between ICT and Sustainable dimensions. The OLS was used as a diagnostic tool and for selecting the appropriate predictors (with respect to their strength of correlation with the criterion variable) for the GWR model. It can automatically check for multicollinearity (redundancy among predictors).

The multicollinearity was assessed with the variance inflation factor (VIF) values of the OLS. If the VIF values are greater than 7.5, it, therefore, indicates the existence of multicorrelation among the predictors. In addition, autocorrelation statistic was applied to detect whether there is spatial autocorrelation or clustering of the residuals which violates the assumption of OLS. Progressively, the spatial independency of the residuals was assessed with the global spatial autocorrelation coefficient Moran's I.

Ordinary Least Squares (OLS): Among the common regression models, OLS is the simplest and most common. The intellectual underpinning of OLS is that the model coefficients assume values that the sample regression model is closest to the observations. In other words, it shows the least deviation from the above observations. In spatial modeling with OLS, it is assumed that the coefficients or parameters of the statistical model are constant relative to the location. Therefore, the value of the dependent variable that is estimated by this model is for the whole

study area and in different parts of the region, it estimates the same value, which is considered as a weakness of this method in spatial modeling (Deilami et al., 2016; Li et al., 2017).

Geographically weighted regression (GWR): This method was used in the next stage of data spatial analysis to evaluate the Relationship between ICT and sustainable development in GIS. The GWR method converts a simple regression model's framework into a weighted regression model. This is a locally linear regression model. It is based on the non-parametric locally weighted regression technique that was developed in statistics for curve fitting and smoothing applications (Fischer and Getis, 2010). It produces parameter estimates that are localized to each point or location where data is collected. Each independent variable predicts the dependent variable, and coefficient regression is affected by the location of the data. Each parameter will be estimated at each point of the geographical location so that each point of geographic location has a different parameter estimation. This will give a variation on the regression parameter values in a set geographical area. If the estimation of the parameters in each location is constant, the GWR models are called global models. This means that each location has the same model (Dwi Bekti et al., 2014). Each parameter will be estimated at each point of geographic location, resulting in a different parameter estimation at each point of geographic location. This will result in a change in the regression parameter values in a specific geographical area. If the parameter estimation in each location is constant, the GWR models are referred to as global models. This means that the model is the same in each location (Wang et al., 2021; Chun et al., 2017; Leniewska-Napieraa et al., 2020; Shabrina et al., 2020).

2.3.2.6. Reliability and Validity

Validity and reliability must be addressed within all research designs (Cohen et al., 2007; Creswell, 2012; Mertler, 2016). The explanatory sequential mixed-methods design brings the quantitative and qualitative elements into alignment in a step-by-step process and is well-suited to address the presented research questions (Bowen et al., 2017; Creswell, 2012; Creswell & Guetterman, 2019; Keifer, et al., 2015; Kleden, 2015; Leithwood & Azah, 2017; Onwuegbuzie & Collins, 2007). The study design required the development of both quantitative and qualitative data collection tools (Bowen et al., 2017; Creamer, 2018), a web survey for residents in Cities, and a semi-structured focus group for villages and ecovillages. The study variables were evaluated through an expert survey process (Koller et al., 2017; Shi et al., 2012). A piloting process served to test each variable (or questions in the survey) prior to use in the study and ensured the validity of scoring and needed content collection for each individual research tool (Creswell & Guetterman, 2019). Since the questionnaire emphasized the relationship and

impact of the dependent variable on the independent variables, the data's reliability and validity are critical. To ensure the questionnaire's reliability and validity, the factor analysis method for Composite Reliability Scores (CR) and Average Variance Extracted (AVE), and Cronbach's alpha were used in SPSS and Excel software to analyze and check validity and reliability (Chen et al., 2015; Mo et al., 2019; Chen et al., 2015, Hair et al., 2019).

Factor Analysis is a multivariate statistical technique used to examine a single set of variables to determine which variables form logical subsets that are relatively independent of one another. In other words, factor analysis is especially useful for identifying the factors underlying the variables by grouping related variables together in the same factor (Tabachnick & Fidell, 2013; Verma & Abdel-Salam, 2019). Factor analysis is based on the assumption that all variables have some degree of correlation. The variables should be measured at the ordinal level or higher. The sample size for factor analysis should be larger, but a ten-to-one ratio is more acceptable. Factor analysis is divided into two approaches: exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Exploratory factor analysis is commonly used in the early stages of research to gather information about the interrelationships between a set of variables. Confirmatory factor analysis, on the other hand, is a more complex and sophisticated set of techniques used in the research process to test specific hypotheses or theories about the structure underlying a set of variables (Ho, 2006; Hair et al., 1998; Pituch & Stevens, 2016; Hair et al., 2006; Pallant, 2010).

The average variance extracted and the composite reliability coefficients are related to the quality of a measure. AVE is a measure of the amount of variance that is taken by a construct in relation to the amount of variance due to measurement error. To be specific, AVE is a measure to assess convergent validity. Convergent validity is used to measure the level of correlation of multiple indicators of the same construct that are in agreement. To determine convergent validity, the factor loading of the items, composite reliability, and average variance extracted must be calculated. The AVE and CR values range from 0 to 1, with a higher value indicating a higher level of reliability. The fact that AVE is greater than or equal to 0.5 confirms the convergent validity. The average variance extracted is given by dividing the sum of squared loadings by the number of items (Hair et al., 2014; Shrestha, 2020; Shrestha, 2021).

$$AVE = \frac{\sum_{i=1}^n \lambda_i^2}{n}$$

Composite reliability is a measure of scale item internal consistency. Composite reliability, according to Fornell and Larcker (1981), is an indicator of the shared variance among observed variables used as an indicator of a latent construct. The CR for each construct can be calculated by adding the squares of completely standardized factor loadings and dividing the total variance of the error term for i th indicators. CR can be calculated as follows:

$$CR = \frac{\sum_{i=1}^n \lambda_i^2}{\sum_{i=1}^n \lambda_i^2 + \sum_{i=1}^n \text{Var}(e_i)}$$

Here, n is the number of the items, λ_i the factor loading of item i , and $\text{Var}(e_i)$ the variance of the error of the item i . The values of composite reliability between 0.6 to 0.7 are acceptable. The table shows that all of the constructions were more than the threshold value (3). The amount of variance captured by the latent variable from its measurement items vs the amount of variance attributable to measurement mistakes is calculated using AVE to assess the construct's internal consistency. According to research, AVE should be more than 0.5. As demonstrated in Table, the AVE score for all constructions is more than 0.5. (3). this suggests that the latent variables account for at least half of the measurement variation (Nasution et al., 2020; Shrestha, 2021; Wang, et al, 2022).

Table.2.6. Construct reliability and validity scores

Parts	Dimensions	CR	AVE
	Ecological	0.87	0.64
	Economic	0.70	0.560
	Culture	0.74	0.55
	Agriculture	0.83	0.67
	Architecture	0.81	0.63
	Individual	0.70	0.560
	Social	0.84	0.61
	Transportation-Access	0.77	0.570
	device ownership	0.87	0.64
	Internet access	0.79	0.61
	computer skills	0.85	0.69
	social media	0.73	0.54
	E-commerce	0.89	0.60

Parts	Dimensions	CR	AVE
	The influence of the pandemic on ICT usage	0.72	0.53
The third part of the questionnaire	The Economic	0.86	0.75
	The Social	0.70	0.51
	The Environmental	0.87	0.76

Cronbach's alpha was calculated to confirm the internal reliability of the survey and assess the questionnaire's reliability (Cortina, 1993; Joseph & Macgowan, 2019). The overall Cronbach for the survey indicated strong internal reliability. Included subscales within the pilot data were disaggregated and examined to confirm internal reliability. Each scale presented a set of prompts targeted to provide data for each individual research question. SPSS was used to analyze the individual data sets. According to the literature, Cronbach's alpha should be greater than 0.7. It provides a simple way to measure whether or not a score is reliable and is a measure of internal consistency. It is also considered to be a measure of scale reliability and can be expressed as

$$\alpha = \frac{n\bar{r}}{1 + \bar{r}(n - 1)}$$

In this study, the reliability of the questionnaire was examined separately using Ecovillage variables as the first part of the questionnaire, ICT variables as the second part of the questionnaire, and ICT variables in sustainable development as the last part of the questionnaire. The entire questionnaire was then calculated. Finally (Table 7), the Competency Scale results had a calculated alpha of .862 ($\alpha = .862$).

Table 2.7. The result of Cronbach's Alpha

Scale	Cronbach's Alpha
Part one: Ecovillage	.774
Part two: ICT	.702
Part Three: ICT in sustainable Development	.702
All survey	.882

2.3.3. Qualitative Methodology

Qualitative research methodology was used to clarify the purpose of the study with grounded theory. Since the aim of qualitative studies is to provide an accurate description of a real situation, such studies attempt to directly present the opinions of individual participants and to collect data through detailed and in-depth methods (Yıldırım & Şimşek, 2008). Case study research design was employed to obtain detailed and in-depth information on several cases (Creswell, 2007).

The fieldwork of this part of the research started in July 2022 and continued until November 2022. Given that the quantitative method was used to analyze and investigate urban areas, it was necessary to use the qualitative method for rural areas in order to identify potentials and solutions for environmental sustainability, and ecovillages in order to evaluate the success of this lifestyle in communities that are ecovillages themselves. This section started with a literature review, followed by observation and then semi-structured interviews. This research was done as an inductive process and with the principles that emerged during the research, using grounded theory and MAXQDA software, which is a beginning in exploring issues that connect the two research fields of society and environment. The qualitative method of this research will be examined further below.

2.3.3.1. Grounded theory

Grounded theory, as an evolving qualitative research method, is a product of its history as well as its epistemology (Walker & Myrick, 2006). In other words, Grounded theory is a research approach in which a theory develops from the information systematically collected during the research process (Bryant & Charmaz 2007, Hall et al 2013). The researcher starts by asking an open-ended question when designing his or her research: ‘What is happening here?’ The answer to the research question then emerges through the research process itself, termed an ‘inductive’ approach (Harris, 2014).

Grounded theory was employed because the current study was an exploratory attempt to define and create a framework for the ecovillage. This iterative process included transcribed literature and interviews as well as in-text coding. The text was then used to generate a list of codes, some of which were defined within it. All codes included detailed notes that explained the

meaning of the code and its sub codes. The data sets were then coded. Finally, the codes were combined, and new notes were written to go over the newly created codes.

2.3.3.2. Data collection & Sampling

The study group consisted of 51 people (17 women and 34 men) who lived in Iranian and French villages as well as French ecovillages. 40 people were studied and interviewed from 40 different villages in Iran and France (Table 6 & 7). In addition, 11 ecovillages in France¹ were interviewed out of 19 (Table 8). For villages, the convenience sampling technique was generated for this study (Patton, 2002) due to being the subjects readily available and being fast, inexpensive, and easy (Dörnyei, 2007). Convenience sampling (also known as Haphazard Sampling or Accidental Sampling) is a type of nonprobability or nonrandom sampling in which members of the target population meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a specific time, or willingness to participate, are included in the study. It is also used to refer to population research subjects who are easily accessible to the researcher (Dörnyei, 2007; S. K., & Given Lisa, 2008; Leiner, 2014). To ensure the collection of accurate and valid data, the study sought to engage village leaders, including the headman and council members, or other individuals with an in-depth understanding of the village's history, current status, future objectives, as well as strengths and weaknesses. Therefore, the sampling process was repeated until the category was saturated, or until no new information was obtained during the interview. Finally, the sample villages were classified based on their location and natural condition based on the data collected. Which were classified as plain, mountain, coastal, and hot and dry villages. Figures 3 and 4 represent the locations of the villages studied in Iran and France.

Table. 2.8. Participant Description in France

Participant	Gender	Age	Area	Location
Emma	F	24	Nouvelle-Aquitaine	Angles-sur-l'Anglin
Gabriel	M	27	Nouvelle-Aquitaine	Aubeterre-sur-Dronne
Raphaël	M	23	<u>Île-de-France</u>	Barbizon
Arthur	M	36	Nouvelle-Aquitaine	Charron
Adam	M	32	Nouvelle-Aquitaine	Coulon

¹ There is no Ecovillage in Iran

Participant	Gender	Age	Area	Location
Lina	F	35	<u>Provence-Alpes-Côte d'Azur</u>	Èze
Anna	F	39	Haut de France	Gruson
Noah	M	40	<u>Normandie</u>	Le Bec-Hellouin
Léa	F	33	<u>Bourgogne-Franche-Comté</u>	Lods (Doubs)
Paul	M	28	Occitanie	Moureze
Juliette	F	28	<u>Bourgogne-Franche-Comté</u>	Mouthier Haute-Pierre
Rose	F	27	Pay de la Loire	Oudon
Sacha	M	35	Auvergne-Rhône-Alpes	Perouges
Liam	M	29	Auvergne-Rhône-Alpes	Pont-en-Royans
Zoé	F	36	<u>Occitanie</u>	Saint Martin de Londres
Tiago	M	27	<u>Normandie</u>	Saint-Céneri-le-Gérei
Ethan	M	43	<u>Provence-Alpes-Côte d'Azur</u>	Villefranche-Sur-Mer
Mila	F	46	<u>Grand Est</u>	Seebach
Aaron	M	42	<u>Occitanie</u>	Tarascon-sur-Ariege
Julia	F	37	<u>Île-de-France</u>	Vétheuil

Table.2.9. Participant Description in Iran

Participant	Gender	Age	Area	Location
Ali	M	35	Isfahan	Abyaneh
Mehran	M	36	Isfahan	Hasanrobot
Majid Reza	M	37	Yazd	Deh Bala
Arash	M	32	Shiraz	Ghalat
Meysam	M	50	Kerman	Bayaz
Hosein	M	32	Bushehr	Abtavil
Amin	M	29	Fars	Dashtak
Mohamad	M	34	Alborz	Arangeh
Amir Ali	M	37	Mazandaran	Filband
Ebrahim	M	28	Gilan	Masuleh
Ahmad	M	36	Mazandaran	Mazichal
Amir	M	33	Nusha	Nusha

Participant	Gender	Age	Area	Location
Ahmad Reza	M	38	East Azerbaijan	Kandovan
Arya	M	27	South Khorasan	Makhunik
Ehsan	M	43	Razavi Khorasan	Zoshk
Aras	M	29	Kermanshah	Shamshir
Sara	F	36	Kurdistan	Uraman Takht
Hiva	M	35	Lorestan	Bisheh, Lorestan
Saeede	F	37	Kurdistan	Palangan
Behrooz	M	31	Kurdistan	Ney

In the next part, the Ecovillage section was sampled using a Purposive sampling technique called snowball sampling. Snowball sampling is a type of easy sampling that is used when it is difficult to access people who have the researcher's desired characteristics. Snowball sampling is one of the most popular methods of sampling in qualitative research, central to which are the characteristics of networking and referral. The researchers usually start with a small number of initial contacts (seeds), who fit the research criteria and are invited to become participants in the research, such as residents of Ecovillages in this study (Etikan, 2016; Parker et al., 2020). Agreed-upon participants were then asked to recommend other contacts who met the research criteria and might be willing participants, who in turn recommended more potential participants, and so on. Hence, they used their own social networks to make initial connections, and the sampling momentum grew from them, attracting a growing chain of participants. When the target sample size or saturation point is reached, sampling is usually terminated (Wall Emerson, 2015; Kirchherr & Charles, 2018). Consequently, 11 ecovillages were interviewed for this study, and they even invited the researcher to participate in online seminars and webinars in their ecovillages. This issue also served as the foundation for improved data collection.

Table.2.10. Participant Description in Ecovillages

Participant	Gender	Age	Area	Location	Time in Ecovillage (Year)
Anna	F	25	Toulouse	Les 3 sources	11
Camille	F	23	Montpellier	Catfarm	10
Gabriel	M	27	Toulouse	Ecovillage de Sainte Camelle	8
Julia	F	33	Toulouse	EcoVillage de Pourgues	5

Participant	Gender	Age	Area	Location	Time in Ecovillage (Year)
Lyam	M	26	Nantes	Eotopia	1
Noémie	F	26	Nantes	Les Chardons	4
Sophia	F	28	Valence	La Vie Tara	2
Théo	M	36	Poitiers	Oasis du Coq à l'Âme	6
Inès	F	34	Caen	Le Mallouestan	3
Lucas	M	36	Montpellier	Lentiourel Oasis	12
Hugo	M	32	Valence	L'Arche de Saint- Antoine	17

As a result, data was gathered through interviews, observations, and participation in seminars and meetings held by these communities. First, all interview data based on participants' responses to each question were transcribed verbatim. The researcher reviewed the transcripts for accuracy and to generate coding categories and subcategories in line with the aims of the study. In this regard, the data of the study were analyzed using MAXQDA 20.4.0, qualitative data analysis software, and descriptive analysis techniques. In the descriptive analysis, collected data are interpreted by summarizing in view of pre-defined themes (Elaldi et al., 2016). Using the code cloud feature in this software to see words that are frequently repeated was one of the simple methods. This enabled the researcher to refine the research and identify the most common and significant aspects of the interviews. Utilizing this software presents an efficient and effective approach to analyzing substantial amounts of qualitative data. This enabled the researcher to systematize, classify, and evaluate data in an orderly and structured manner. Furthermore, the software provided the capacity to visualize data in various formats.

MAXQDA has been extremely helpful in organizing the qualitative data for this study, which includes various literature review data sets, interviews and transcripts, as well as webinars and seminars. Having all of these different tools in one place, as well as the ability to easily code in-vivo, manipulate codes, merge codes, and align codes together, simplifies and functionalizes analysis as well as the creation of reports and visualizations. To be able to classify a large amount of data in one location In particular, in the first stage, the data from villages in Iran and France were examined and analyzed as a whole, and then they were examined individually to determine differences and similarities.

To ensure the rigor and quality of the data in this study, several measures were taken to enhance the reliability and validity of the qualitative methodology. Triangulation was employed by using multiple sources of data, including interviews, observations, and document analysis. This helped to ensure that the findings were consistent across different sources and perspectives.

Member checking was also conducted to verify the accuracy and completeness of the data. Participants were given the opportunity to review the transcripts of their interviews and provide feedback, which helped to ensure that the data was grounded in their experiences and perspectives.

Peer debriefing was used to present the data and findings to other researchers for feedback and critique. This helped to ensure that the research was rigorous and well-supported, and helped to address any potential biases or subjectivity.

Thick description was employed to provide detailed and context-rich descriptions of the data and findings. This helped to enhance the validity of the data by providing a clear and accurate portrayal of the phenomena under study.

In order to address potential sources of bias and subjectivity in the research process, reflexivity was employed to reflect upon and document the researcher's role and biases. This involved a systematic examination and documentation of the researcher's biases, assumptions, and preconceptions, as well as an evaluation of how these factors may have impacted the research process and subsequent findings. To facilitate this process, a research diary was maintained to record the researcher's thoughts, feelings, and reflections throughout the research process.

Saturation was used to ensure that data collection was sufficient to fully capture the complexity of the phenomenon under study. This helped to enhance the credibility of the data by ensuring that all relevant data had been collected.

Transferability was considered throughout the research process, with efforts made to provide rich and detailed descriptions of the data and findings to allow readers to assess the relevance and applicability of the study to their own context.

In summary, these measures were taken to enhance the reliability and validity of the qualitative methodology and ensure the credibility and trustworthiness of the findings.

Summary

The research methodology was examined in this section. The tools used for statistical and qualitative analysis, as well as sampling, reliability, and validity of the questionnaires, were all investigated. It was also discussed how to choose indicators for quantitative research. Finally, brief explanations of the studied areas were provided. The following chapter discusses the findings and outcomes of the research conducted using the methods described above.

Chapter 3: Data Analysis, Results and Discussion

3.1. Introduction

The analysis and evaluation of the quantitative and qualitative findings of the research are discussed in this chapter. Three of the seven research questions are analyzed using quantitative methods, while three are analyzed using qualitative methods. The seventh question of the research also briefly presents the results of each question as a model and finally deals with modeling and presenting the appropriate model to achieve urban-rural sustainability based on ecovillages and accompanying ICT.

3.2. Quantitative findings

The analysis of quantitative findings and related questions, which include the Demographic characteristics and the first three research questions, are discussed in this section of the fourth chapter.

3.2.1. Demographic characteristics

In terms of demographics, the survey covers a wide range of inhabitants in the residential area, indicating that the sample was representative of all socioeconomic groups. In France, 55.9% of the respondents were men, while 43.5 percent were women, 0.5% were without the answer (Fig. 2); 33.9% were between the ages of 27 and 34, 17% were between the ages of 18 and 26, 17.2% were between the ages of 45 and 54, 16.7% were between the ages of 35 and 44, 12.4% were between the ages of 55 and 64, and 2.2 percent were over 65 (Fig. 3). About Material Status, 37.6 % were Single never married, 41.3 % were Married or domestic partner, and 10.2% were widows (Fig. 5). Higher intellectual professionals (Engineers, doctors, human resources managers, high school teachers, pharmacists, lawyers) accounted for 21% of the respondents, students for 19.9%, and Intermediate employees (sales, service) for 15.6 percent (Fig. 7). Master's degrees accounted for 40.3% of the total, PhDs for 25.3%, and bachelor's degrees for 18.3 % (Fig. 9).

Based on the results of the data collection, it was found that the sample had a high proportion of well-educated respondents and individuals with high socio-professional status. To ensure that the sample is representative of the general population and not biased, a comparison was

made with recent general population information available from the National Institute of Statistics and Economic Studies (INSEE) in France.

The general population information revealed that the male population in France is 48.9%, while the female population is 51.1%. The sample had a higher proportion of male respondents (55.9%) than the general population, indicating that the difference between the sample and population information is not significant enough to cause a major bias.

The median age of the general population in France was reported as 41.2 years, while the majority of the respondents in the survey fell within the age range of 27 to 45 years. These findings suggest that the sample is relatively representative of the general population in terms of age demographics.

In terms of marital status, the percentage of the general population aged 15 and over who were married was 41.7%, while the percentage of the sample that was married or living with a domestic partner was 41.3%. The percentage of the general population aged 15 and over who were single was 44.6%, while the percentage of the sample that was single and never married was 37.6%. These differences in marital status may not have a significant impact on the generalizability of the results.

The general population information also revealed that 19% of people in employment were managers or higher intellectual professionals in France, while 21% of the sample were higher intellectual professionals. This indicates that the sample may be slightly biased towards higher intellectual professionals.

In Iran, 55.0% of the respondents were men, while 49.0 percent were women, 1.0% without the answer (Fig. 1); 37.0 percent were between the ages of 27 and 34, 12.3% were between the ages of 18 and 26, 8.9% were between the ages of 45 and 54, 35.1% were between the ages of 35 and 44, 6.4% percent were between the ages of 55 and 64, and 0.2 percent were over 65 (Fig. 4). About Material Status, 49 % were Single never married, 45.5 % were Married or domestic partner, and 1.1% were widows (Fig. 6). In terms of Socio-Professional, 20.7% of the respondents were Intermediate employees (sales, service), 17.7% were higher intellectual professionals (Engineers, doctors, human resources managers, high school teachers, pharmacists, lawyers), and 14.8% were students (Fig. 8). Regarding education, 38.6% have a Bachelor's degree, 33.2% master's degree, and 19.3% have a PhD (Fig. 10).

Based on recent general population information provided by the Statistical Center of Iran, the male population in Iran constitutes approximately 50.2% of the total population, while the female population constitutes approximately 49.8%. The median age of the population in 2021 was approximately 32.8 years old. The percentage of the Iranian population aged 15 and over who are married is 69.2%, while the percentage of the population aged 15 and over who are single is 27.3%.

Comparing this general population information to the results obtained from the sample used in this study, it is found that the sample is representative of the general population in terms of gender and marital status. The sample has a slightly higher proportion of women than the general population (49% vs. 49.8%), and the percentage of the sample who are single (never married) is slightly higher than that of the general population (49% vs. 27.3%).

Finally, despite efforts to assure a varied sample, there were some modest variations between the respondents' characteristics and those of the overall population. For example, the sample contains a higher proportion of educated respondents with a higher socio-professional level. This overrepresentation may introduce a bias towards more educated sectors of the population, thus restricting the findings' generalizability to larger sections of society with varied educational backgrounds.

On the other hand, it is vital to stress that the current research is exploratory in nature, with the goal of gathering preliminary findings and generating hypotheses for future investigations. While the findings give valuable insights, they must be interpreted in light of the limitations noted above. Subsequent research with more diverse populations is required to validate and extend the findings for broader generalizability.

Following the demographic questions, some questions concerning their distance from employment and whether or not they travel for work were asked in order to assess their capacity and chance to relocate. We also inquired about the pandemic scenario (such as covid-19) and its impact on their residential preferences. To see if they have worked from home during the epidemic and if the situation has influenced their decision to dwell in a small town or hamlet. Finally, we wanted to hear about their thoughts on the ecovillage concept and which weather conditions they think are best for alternative lifestyles or ecovillages.

In France, 33.9 percent of respondents worked within a 5-kilometer radius, while 28 percent worked within a 15-kilometer radius. Furthermore, 38% travel less than 5 times per week, 24.2 percent do not travel, and 23.7 percent travel 5 to 7 times per week between work. During the

pandemic, 37% of respondents said they did a lot of telecommuting. Furthermore, 31% responded that the pandemic scenario had no impact on their decision to live in a small town or village, and 28% claimed that the pandemic had caused them to relocate. 50% of respondents say that weather conditions are unimportant for alternative lifestyles or ecovillages, while 22.6 percent believe that a temperate and humid environment is preferable. In the first part of the questionnaire, we supplied the description of ecovillages along with several photographs of ecovillages to give respondents a visual representation of the ecovillage. As a result, 40 percent were aware of the ecovillage definition and agreed with it, while 38.7% were unaware of ecovillages yet agreed with the description (Fig. 11).

In Iran, 37.6% of respondents worked within a 5-kilometers radius, while 23.3% worked within between a 5-15 kilometer radius. Furthermore, 37% travel less than 5 times per week, 29.7% travel 5 to 7 times per week between work 16.8% travel more than 7 times. During the pandemic, 28% of respondents said they did a lot of telecommuting. Furthermore, 49% claimed that the pandemic had caused them to relocate, and 43.1% claimed that they thought about it. 2.5% responded that the pandemic scenario had no impact on their decision to live in a small town or village. About weather conditions, 67. % believe that a temperate and humid environment is preferable, while 26.2% believe that a cold mountainous one is preferable, and only 3% of respondents say that weather conditions are unimportant for alternative lifestyles or ecovillages. In the first part of the questionnaire, we supplied the description of ecovillages along with several photographs of ecovillages to give respondents a visual representation of the ecovillage. As a result, 75% were not aware of the ecovillage definition but agreed with it (Fig 12).

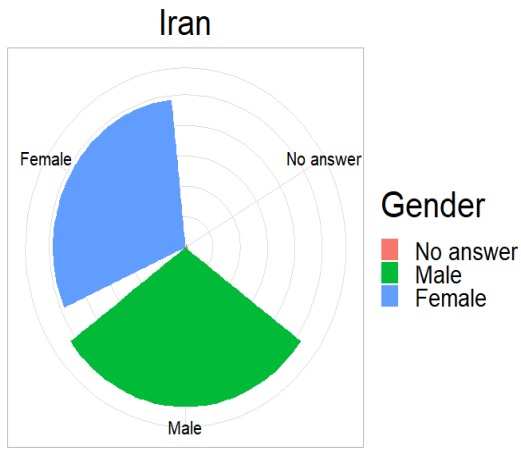


Fig. 3.1

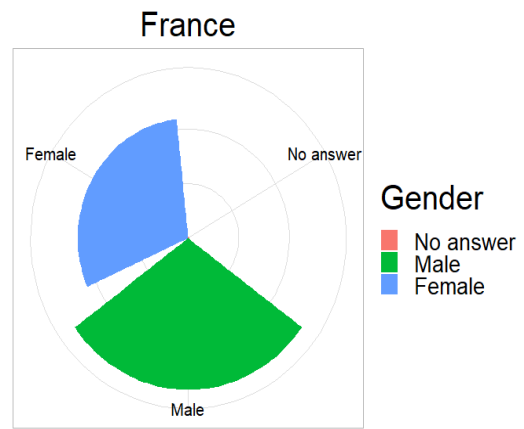


Fig. 3.2

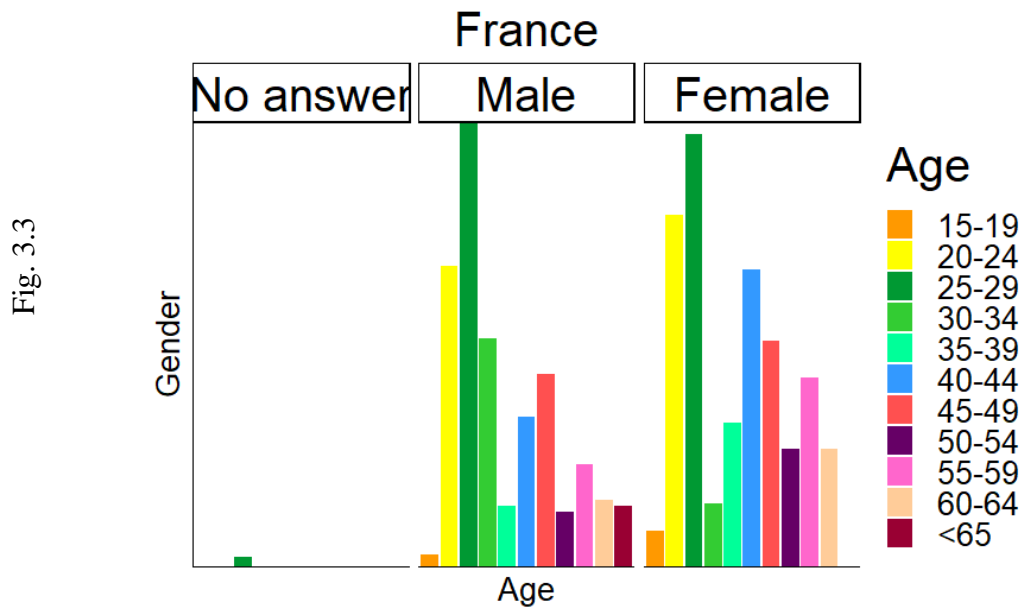


Fig. 3.3

Fig. 3.4

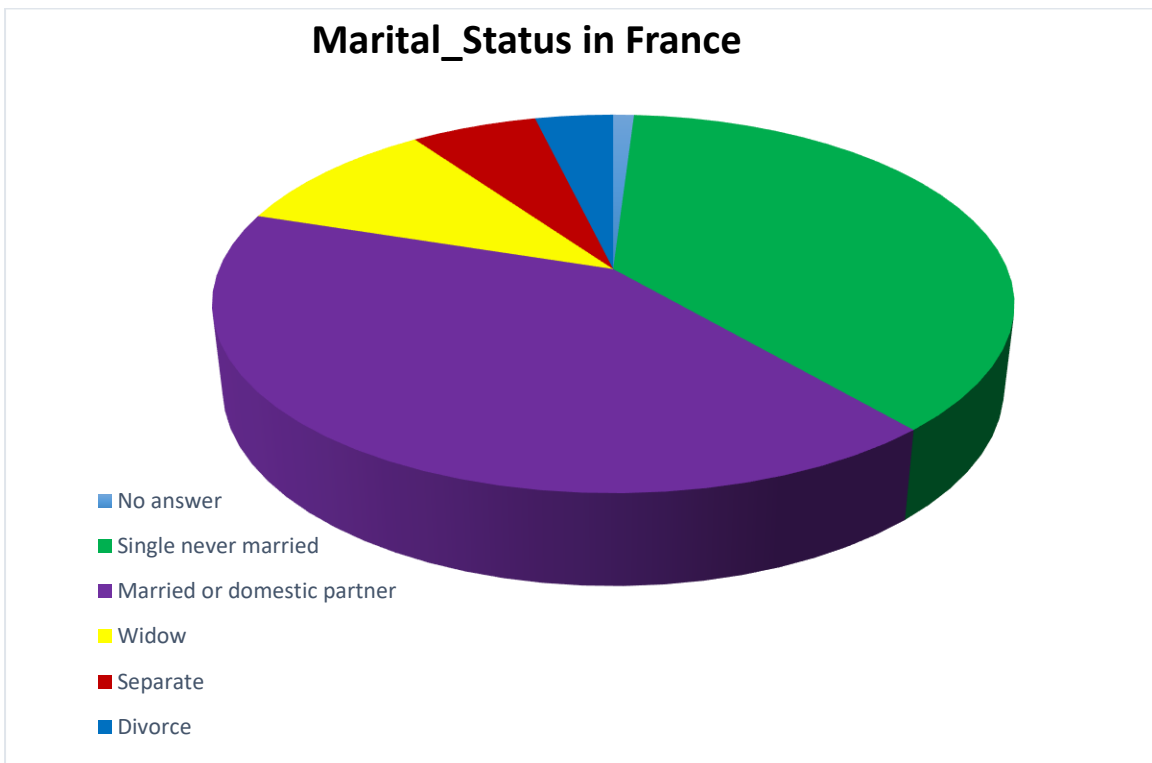
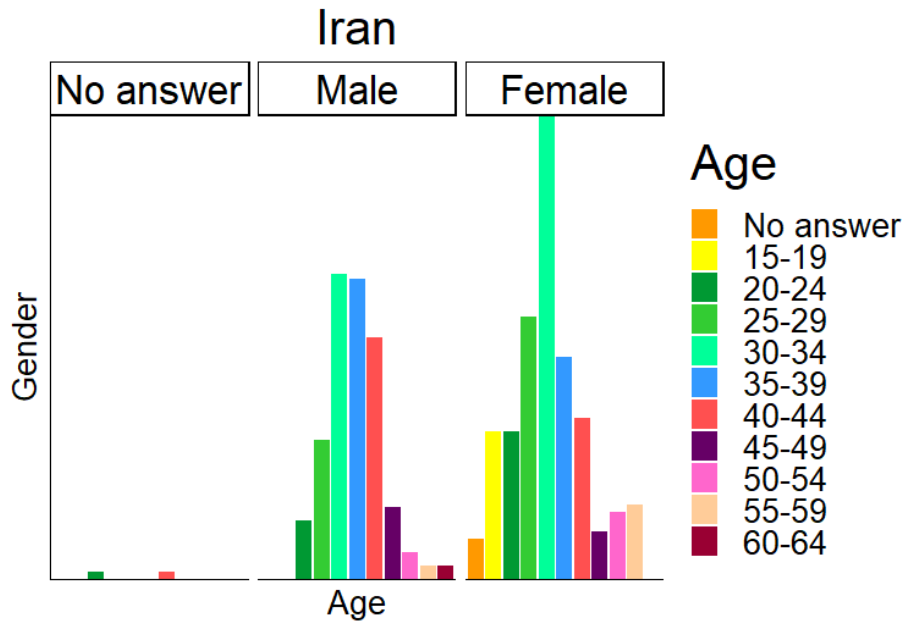


Fig. 3.5

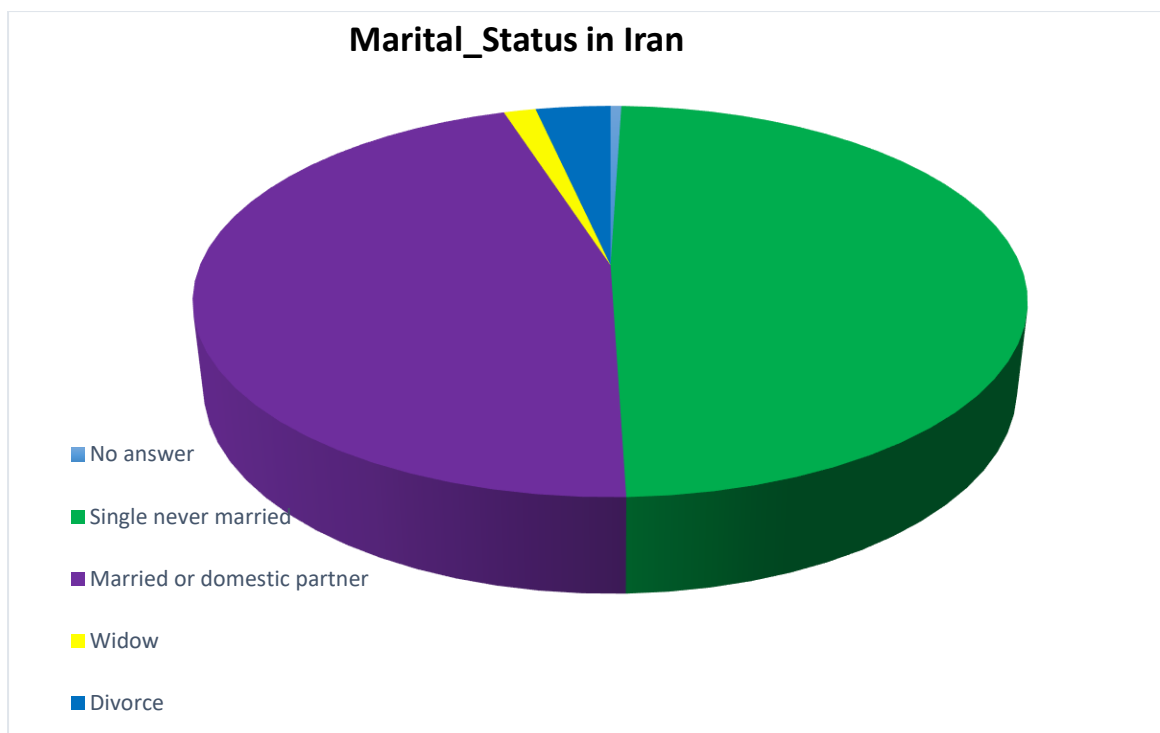


Fig. 3.6

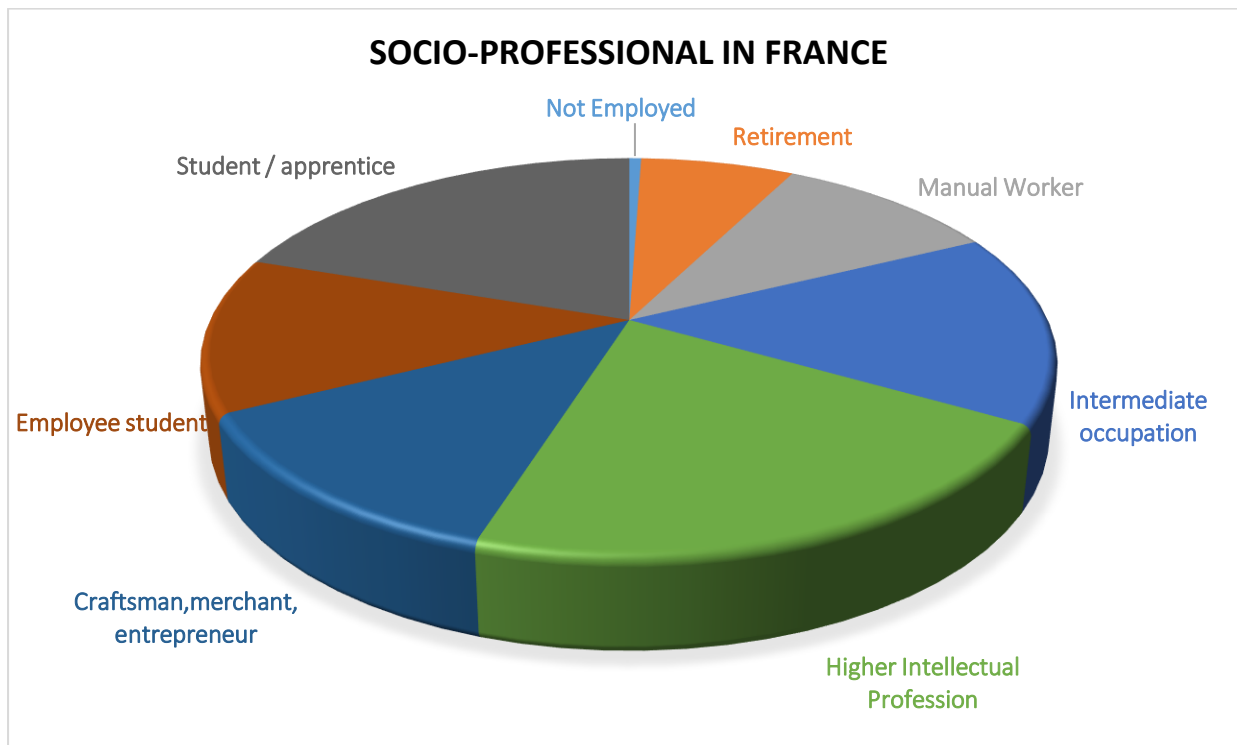


Fig. 3.7

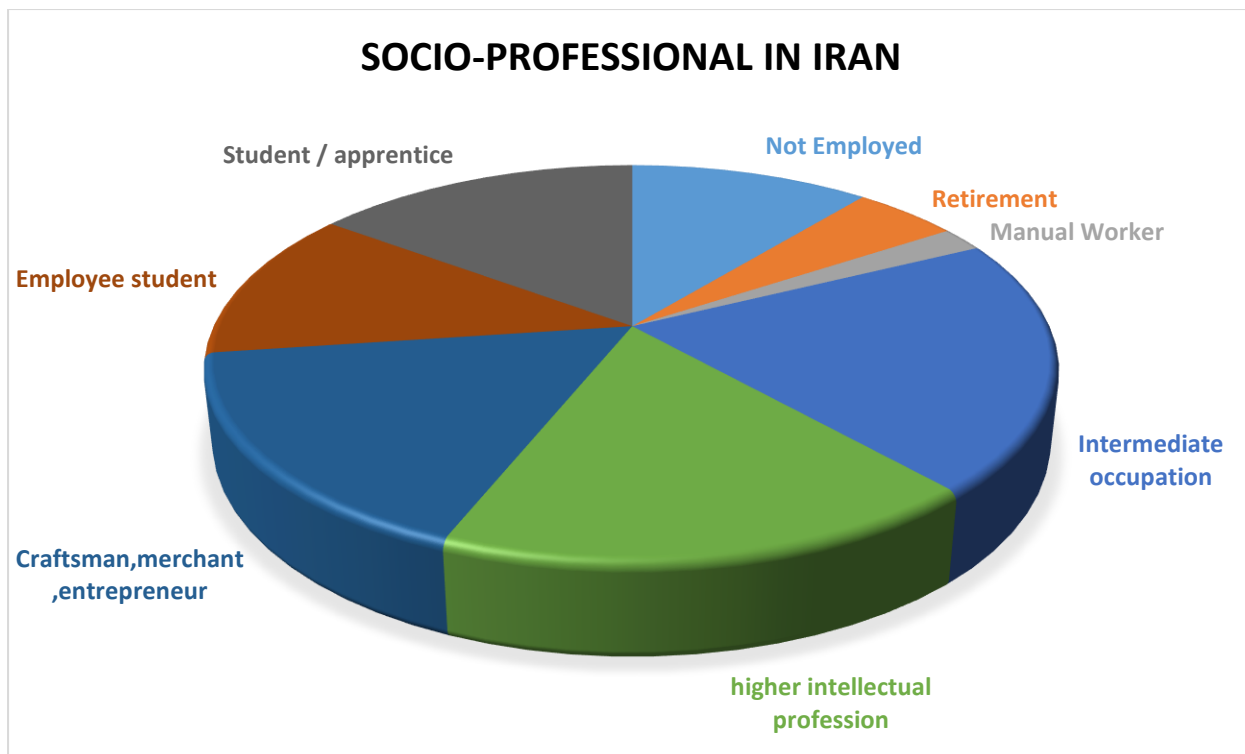


Fig. 3.8

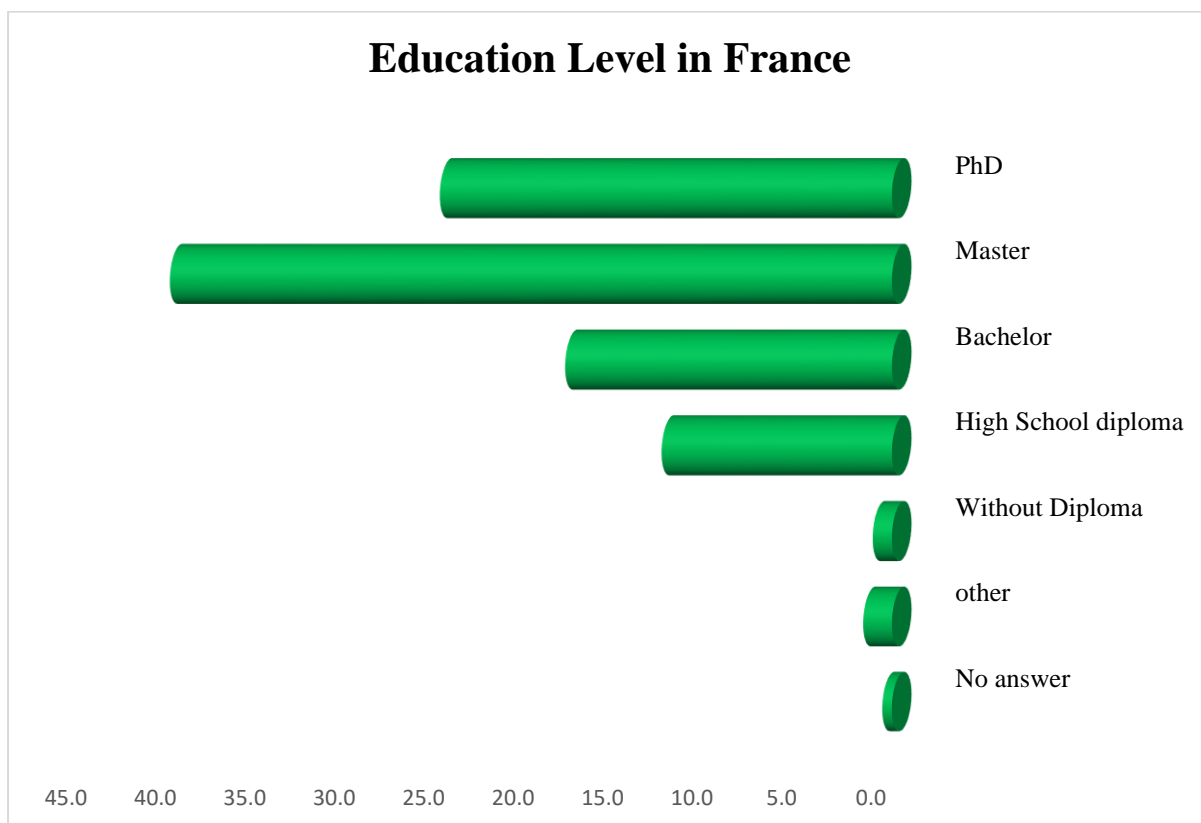


Fig. 3.9

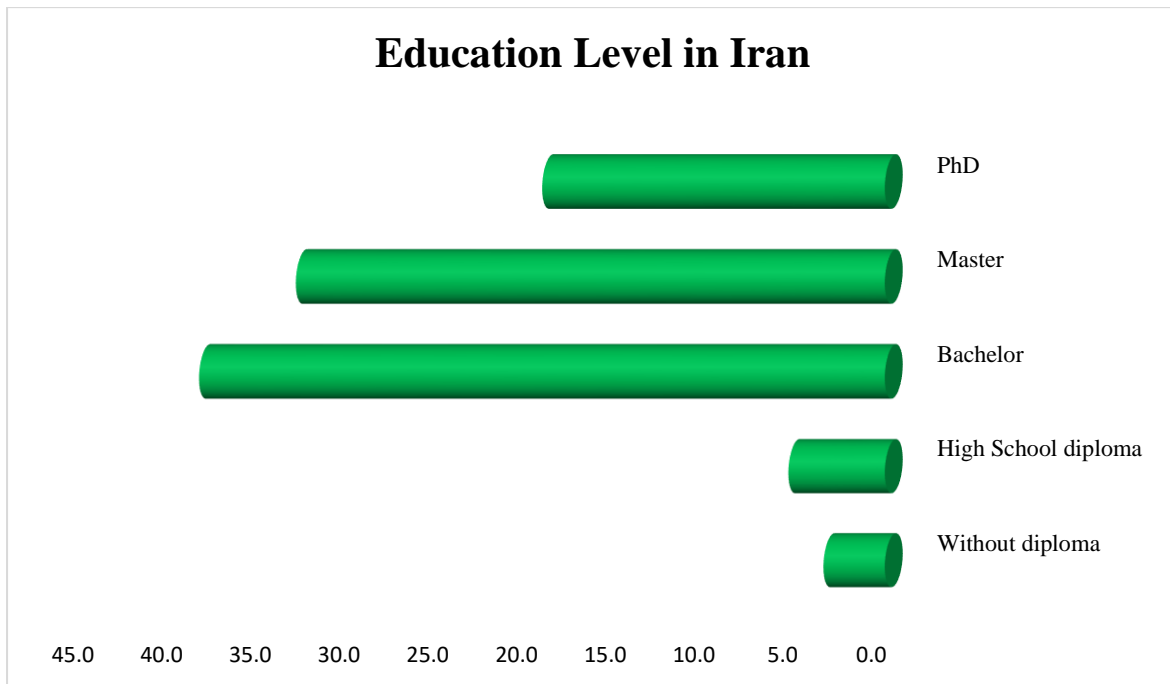


Fig. 3.10

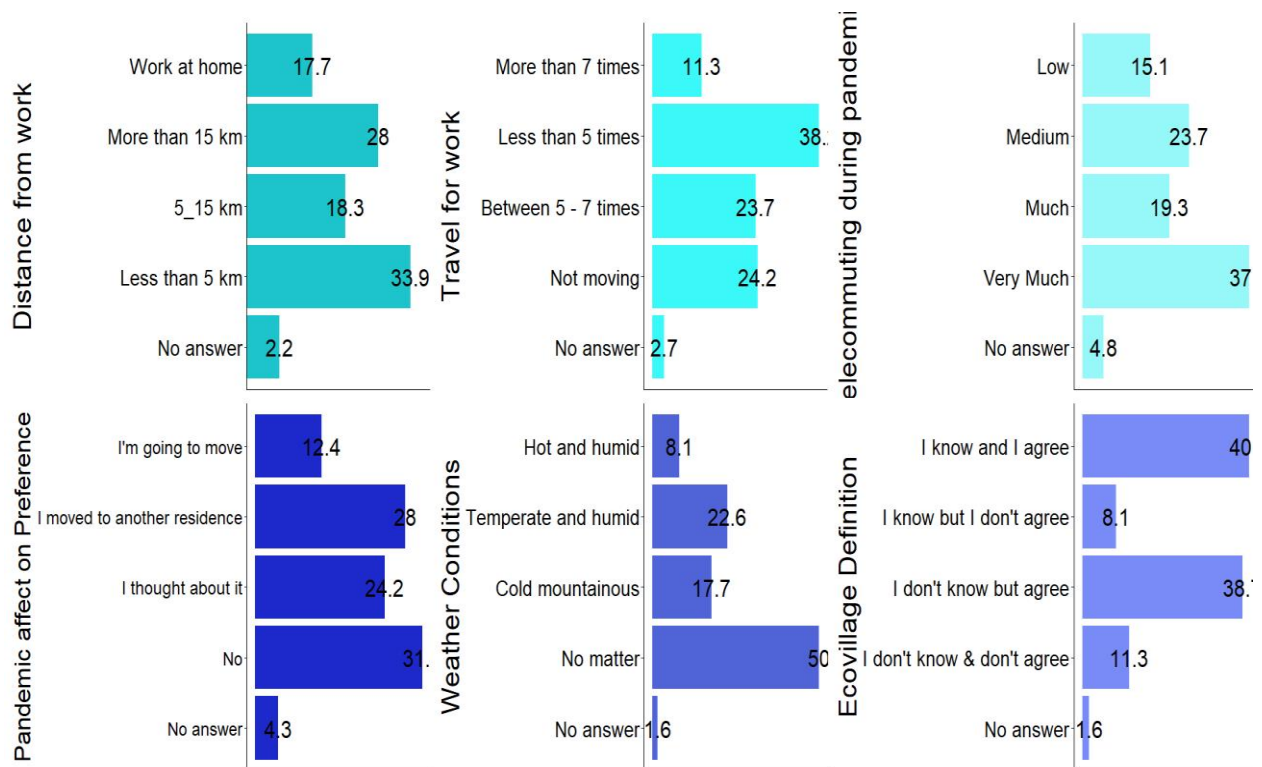


Fig.3.11. Personal Questions in France

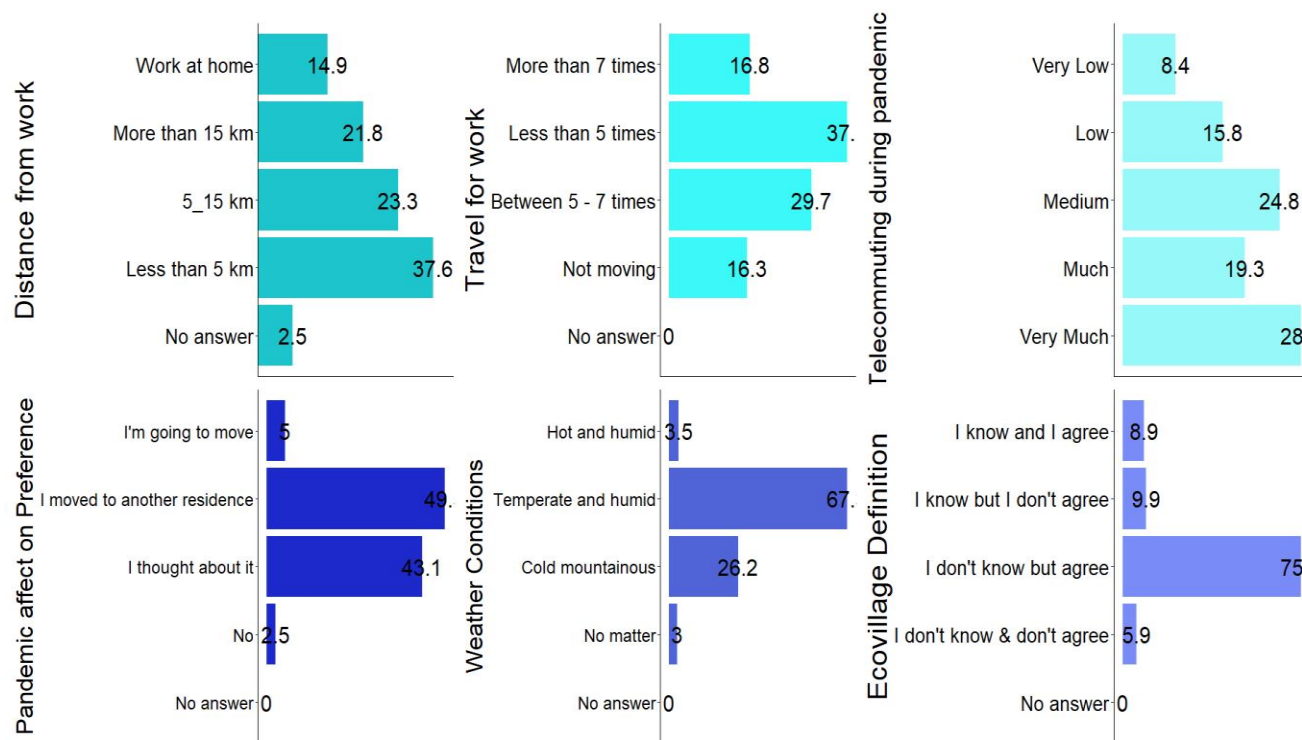


Fig.3.12. Personal Questions in Iran

3.2.1.1. Classify Demographic characteristics in relation to Ecovillage's Dimension

In France, based on the results of the questionnaire, the relationship between Demographic characteristics and the main variables can be analyzed as follows. Female respondents pay more attention to Ecological (4.15), Agriculture (4.21), architecture (4.04), Individual (3.74), and culture (3.73) dimensions. In addition, male respondents pay more attention to Economic (3.89), Social (3.82), and Transportation & Access (3.80) Dimensions of Ecovillage. The ages of 27-34, pay more attention to Ecological (4.94), Architecture (4.75), Economic (4.35), and Transportation and access (4.27). The ages of 35-44, pay more attention to Agriculture (4.75) and Culture (4.50). The ages of 35-44, pay more attention to social (4.12) and Individual (4.10). Professionals, higher intellectual professionals pay more attention to individual (4.13) and social (4.0) dimensions. Students gave higher responses to culture (4.75), architecture (4.36), and agriculture (4.19), and employees gave higher responses to ecological (4.20), transportation and access (3.88), and economic (3.87).

In Iran, based on the results of the questionnaire, the relationship between Demographic characteristics and the main variables can be analyzed as follows. Female respondents pay more attention to Ecological culture (4.15), Social (4.12), architecture (4.04), and Individual

dimensions (3.74). Moreover, male respondents pay more attention to Economic (4.45), Agriculture (3.99), and Transportation & Access (3.87) Dimensions of Ecovillage. The ages of 27-34, pay more attention to Economic (4.86), Ecological (4.70), Architecture (4.51), and Transportation and access (4.36). The ages of 35-44, pay more attention to social (4.88) and Agriculture (4.73). The ages of 35-44, pay more attention to culture (4.45) and Individual (4.30). Professionals, higher intellectual professionals pay more attention to individual (4.25), ecological (4.16), and social (3.79) dimensions. Students gave higher responses to culture (4.74), architecture (4.53), and agriculture (4.28), and employees gave higher responses to transportation and access (3.94), and economic (3.81).

In this section, the aim of the researcher was to classify demographic characteristics in relation to ecovillage dimensions and measure the level of attention or interest that respondents from different demographic groups have in different dimensions of ecovillages. By analyzing the responses to the questionnaire, the researcher was able to identify patterns and differences in the way that respondents from different groups prioritize ecovillage dimensions.

The purpose of this analysis was to provide insight into the needs and preferences of different demographic groups regarding ecovillages. By identifying which dimensions are most important to which groups, ecovillage planners, researchers, and policymakers can develop and implement ecovillage development plans and policies that better meet the needs of specific groups. For example, if we know that females in a particular region place a high priority on ecological and agricultural dimensions of ecovillages, we can tailor our development plans to prioritize those dimensions in order to attract and engage that group.

3.2.2. The most important Dimensions of ecovillage

Q1. What are the most essential Dimensions of ecovillages based on residents' preferences in Cities?

The first question will be examined in this section. The goal of this Question is to determine the most essential features of ecovillages based on residents' preferences in general, as well as to examine these dimensions in relation to Iran and France's geographical regions. Each of the aspects, for example, is related to the analysis of differences and similarities between residents' perceptions in large and small cities.

3.2.2.1. Statistical Analysis

The relationship between the urban ecovillage dimensions and their indicators in the structural equation model will be discussed in this section.

3.2.2.1.1. Model fits

Figures 13 and 14 depict the SEM model of the correlations between latent and evident variables in the urban ecovillage in Iran and France. All factor loads are positive in this diagram. In this figure, Oval shapes represent the error term (e) of each variable. In addition, the names of observed variables are displayed based on the abbreviation of hidden variables. For example, observed variables of the ecological variable are named ECO1, ECO2, ECO3, etc. As a result, all model fit indices have been evaluated at an appropriate level, indicating that the global model is completely fit. All detected factors had positive and substantial impact coefficients within their scales, according to Table (1). (Moeinaddini et al., 2020, Wang et al., 2022).

According to the statistical results of the structural model in France, the transportation and access dimension (with a factor load of 0.97), the economic dimension (with a factor load of 0.90), the social and agricultural dimensions (with factor loading 0.87), the individual dimension (with factor loading 0.86), the ecological dimension (with factor loading 0.83), the architectural dimension (with factor loading 0.81) and culture (With a factor load of 0.71) are Respectively the most important dimensions of Ecovillage.

According to the statistical results of the structural model in Iran, the Individual Dimension (with a factor load of 0.97), the transportation and access dimension and the social (with a factor load of 0.95), the economic dimension (with a factor load of 0.89), the culture dimension (with a factor load of 0.88), agricultural dimensions (with factor loading 0.85), the ecological dimension (with factor loading 0.83), and the architectural dimension (with factor loading 0.78) are Respectively the most important dimensions of Ecovillage.

Given that the selected variables are among the key variables in ecovillage studies, the objective was for residents to prioritize the importance of these variables and dimensions based on their place of residence. This is important for future efforts towards transitioning to sustainable lifestyles, such as through the development of ecovillages, as it enables a more accurate understanding of residents' priorities and needs. Consequently, the development of plans and policies that better align with the needs of residents can be achieved.

These findings suggest that the prioritization of ecovillage dimensions may vary across different cultural and geographic contexts. It is important for ecovillage planners and

policymakers to take into account these differences in order to create ecovillage development plans and policies that better meet the needs and preferences of specific communities. For example, in France, ecovillage planners may want to focus on improving transportation and access infrastructure, while in Iran, they may want to prioritize individual and social dimensions in their planning efforts.

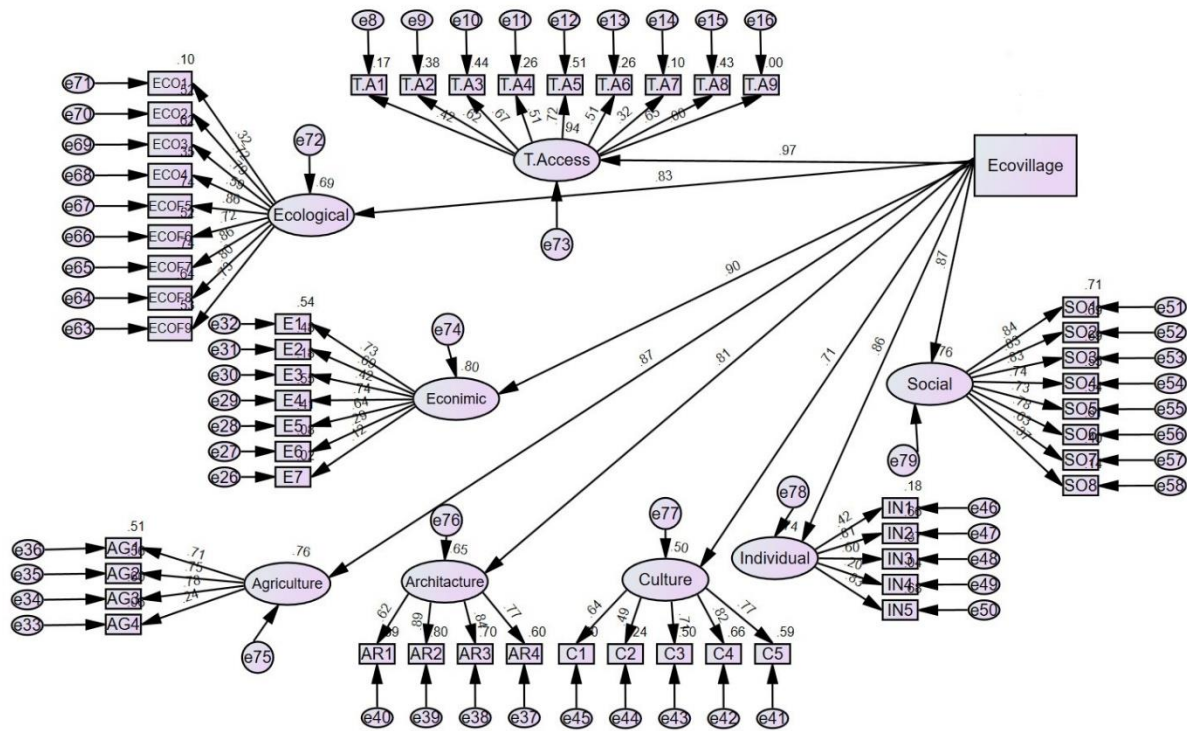


Figure.3.13. the Model of structural equations in France

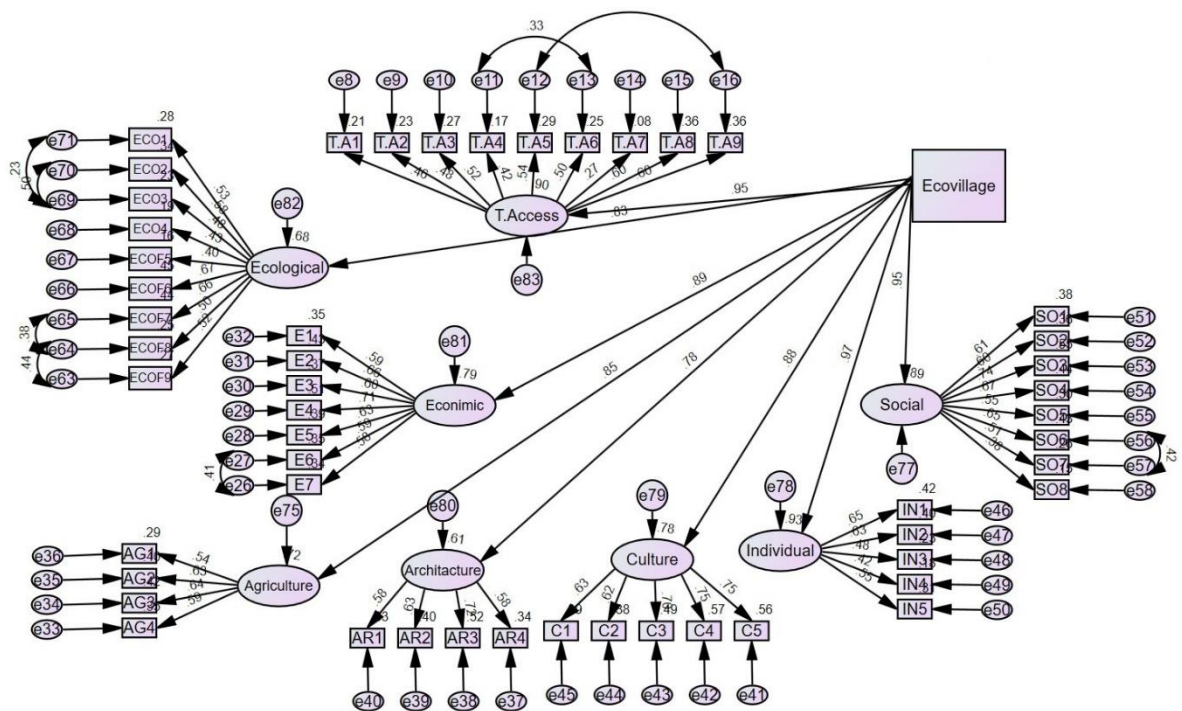


Figure.3.14. the Model of structural equations in Iran

-To be more precise about indicators from each dimension, in the Transportation and access dimension, the most relevant ones were access to health services, alternative transportation, and proximity to large cities. This is in line with Szabó et al (2021) and Sherry's (2019) findings, which include ensuring vehicle functionality at the expense of renewable or inexhaustible energy sources, natural resource utilization in vehicles and infrastructure, ensuring the necessary level of accessibility for people of this generation and future generations, and human health promotion.

-In terms of the economic dimension, the most important factors were local and organic production and consumption, small company support, and self-employment. Given that economic activities have contributed to environmental instability, becoming an ecovillage necessitates a focus on organic production and consumption, as well as sustainable business practices (Williamson, 2002; Massy, 2017; Milani Price et al., 2020). As a result, ecovillages may be considered unique sites to illuminate a broader understanding of various economies, small companies, and small-scale production, particularly food processing (Gibson-Graham, 2008; Gibson-Graham et al., 2016; Szabó et al., 2021).

-The most essential aspects of agriculture were green farming techniques and agricultural product recycling. This is in line with the findings of Adalilar et al. from 2015, who indicated that the sustainable agricultural analysis is aimed at constructing the future ecovillage model in harmony with nature. Green cultivation, solar and wind energy use, agricultural product recycling, rainfall collection and use, and accumulated water capacity are all aspects to consider when designing a sustainable agriculture plan.

-In terms of the social component, the most important factors were resident participation, local environmental cooperation, and social cohesiveness and solidarity. Reciprocity is thought to promote the development of social capital in intentional communities in ecovillages by highlighting strong social links among community members through "mutual support and communication" (Waerther, 2014). (Mulder et al., 2006). As a result, local actions, participation, and cooperation by local governments will be a critical factor in achieving its goals (Goll, 2015; Adalilar et al., 2015).

-Respect for human and future lives, as well as political isolation, were the most important in the individual dimension. Individual adaptation to nature, animals, and respect for human

future existence is one of the most essential foundations of ecovillages. As a result, one of the most common definitions of an ecovillage is "human-scale, full-featured settlements in which human activities are harmlessly incorporated into the natural world in a way that supports healthy human growth and can be effectively perpetuated indefinitely" (Blahovestova et al, 2020; Ardzijauskaite, 2009). As a result, Verma & Tiwari (2019) believes that ecovillages allow people to discover their unique relationship with the living land. Individuals enjoy working with earth, water, wind, plants, and animals on a daily basis. They meet their daily requirements — food, clothing, and a secure haven – while respecting natural cycles (Verma & Tiwari, 2019).

-In terms of the ecological dimension, the most important ones were waste recycling in the production cycle, urban industrial and agricultural wastewater management, and wastewater treatment for irrigation. The importance of settlement operations in disrupting the natural balance can be considered the reason for this. As a result, reducing human settlement pressure on nature is critical to long-term sustainability (Sherry, 2019; Xue, 2014). Reuse, recycling, trash recycling, wastewater management, and composting are all used to achieve this reduction (Blahovestov, et al., 2020).

-The use of natural and local materials, as well as resilience to climatic and environmental risks, were the most essential architectural features. The foregoing variables, as well as ecological considerations, are used to determine the layout and architecture of the houses. These concepts also underpin food production, energy production, waste management, green works, and civil processes (Mohan et al., 2016; Blahovestova et al., 2020). The ecological design also looks for alternative energy sources using local resources and frequently requires residents' active participation in the construction process (Westskog et al., 2018).

-In terms of the cultural dimension, the most essential ones were sharing creativity, innovation, and artistic and cultural activities for environmental conservation. According to some studies, the entrenched culture of sharing as a means of creating ecovillages' creativity and innovation is exemplified in particular (Litfin, 2014; Pickerill, 2016, 2017; Seyfang et al., 2014). Most ecovillages do not emphasize specific profound practices in that capacity in the Cultural dimension, but ecovillages appreciate and support – the Earth and all living creatures on it, Sharing creativity, Spiritual and aesthetic improvement, and declaration, and otherworldly assorted qualities in their own unique ways (Tiwari, 2019).

Table.3.1. Results of confirmatory factor analysis (construct validity)

Iran		France		The relationship between variables		
Sig	Standard regression weight	Sig	Standard regression weight			
***	826.	***	.833	Ecological	<input type="checkbox"/> -	Ecovillage
***	884.	***	.708	Cultural	<input type="checkbox"/> -	Ecovillage
***	782.	***	.808	Architecture	<input type="checkbox"/> -	Ecovillage
***	891.	***	.896	Economic	<input type="checkbox"/> -	Ecovillage
***	847.	***	.875	Agriculture	<input type="checkbox"/> -	Ecovillage
***	966.	***	.863	Individual	<input type="checkbox"/> -	Ecovillage
***	945.	***	.871	Social	<input type="checkbox"/> -	Ecovillage
***	948.	***	.968	Transportation-Access	<input type="checkbox"/> -	Ecovillage
***	451.	***	.278	Green spaces	<input type="checkbox"/> -	Ecological
***	514.	***	.704	Recovery of nature	<input type="checkbox"/> -	Ecological
***	396.	***	.774	Biodiversity conservation	<input type="checkbox"/> -	Ecological
***	354.	***	.573	Local people understand the environment	<input type="checkbox"/> -	Ecological
***	454.	***	.833	Waste recycling in the production cycle	<input type="checkbox"/> -	Ecological
***	729.	***	.651	Waste recycling and composting infrastructure	<input type="checkbox"/> -	Ecological
***	626.	***	.818	Urban industrial and agricultural wastewater management	<input type="checkbox"/> -	Ecological
***	139.	***	.729	Wastewater treatment for irrigation	<input type="checkbox"/> -	Ecological
***	404.	***	.696	Processing and converting surplus food	<input type="checkbox"/> -	Ecological
***	588.	***	.616	Contribution of natural resources to art and local culture	<input type="checkbox"/> -	Cultural
***	594.	***	.424	Cultural values	<input type="checkbox"/> -	Cultural
***	719.	***	.719	Culture of mutual respect and solidarity	<input type="checkbox"/> -	Cultural
***	756.	***	.816	Sharing creativity art and innovation	<input type="checkbox"/> -	Cultural
***	755.	***	.754	Artistic and cultural activities in environmental protection	<input type="checkbox"/> -	Cultural
***	566.	***	.695	Attention to the aesthetics and architecture	<input type="checkbox"/> -	Architecture
***	163.	***	.733	Use natural and local materials	<input type="checkbox"/> -	Architecture
***	726.	***	.815	Resistance to climatic and environmental risks	<input type="checkbox"/> -	Architecture
***	587.	***	.733	The design and construction in harmony with nature	<input type="checkbox"/> -	Architecture
***	156.	***	.585	Small Business Support	<input type="checkbox"/> -	Economic
***	636.	***	263.	Self-employment	<input type="checkbox"/> -	Economic
***	.547	***	137.	Supply chain management	<input type="checkbox"/> -	Economic
***	.758	***	786.	Local and organic production and consumption	<input type="checkbox"/> -	Economic
***	.622	***	565.	local ownership	<input type="checkbox"/> -	Economic
***	.632	***	146.	Attention to tourist attractions	<input type="checkbox"/> -	Economic
***	.578	***	001.	Employment opportunities in the tourism	<input type="checkbox"/> -	Economic
***	.535	***	695.	Organic farming	<input type="checkbox"/> -	Agriculture
***	.555	***	749.	Green cultivation techniques	<input type="checkbox"/> -	Agriculture
***	.598	***	741.	Recycling of agricultural products	<input type="checkbox"/> -	Agriculture
***	.594	***	165.	Technology adoption	<input type="checkbox"/> -	Agriculture
***	.651	***	354.	Identifying oneself with the region	<input type="checkbox"/> -	Individual
***	.616	***	831.	Respect for human and future lives	<input type="checkbox"/> -	Individual
***	.478	***	529.	Acceptance of innovations	<input type="checkbox"/> -	Individual
***	.352	***	119.	Political isolation	<input type="checkbox"/> -	Individual
***	.556	***	874.	Environmental awareness	<input type="checkbox"/> -	Individual
***	606.	***	81.	Participation among the inhabitants	<input type="checkbox"/> -	Social
***	603.	***	804.	local cooperation in protecting the environment	<input type="checkbox"/> -	Social
***	754.	***	831.	Cohesion solidarity and unity between people	<input type="checkbox"/> -	Social
***	671.	***	734.	Communication with neighborhood units	<input type="checkbox"/> -	Social
***	.561	***	.718	Sensitization of populations to climate change	<input type="checkbox"/> -	Social
***	.632	***	.711	Extension education programs	<input type="checkbox"/> -	Social
***	.511	***	.574	Workshops on environmentally	<input type="checkbox"/> -	Social

Iran		France		The relationship between variables	
Sig	Standard regression weight	Sig	Standard regression weight		
***	.358	***	.315	Preserving old traditions	<input type="checkbox"/> - Social
***	.362	***	.333	Increase walking trails	<input type="checkbox"/> - Transportation -Access
***	.424	***	.612	Reducing vehicle use	<input type="checkbox"/> - Transportation -Access
***	.415	***	.695	Alternative Transport	<input type="checkbox"/> - Transportation -Access
***	.381	***	.395	Improving the state of communication	<input type="checkbox"/> - Transportation -Access
***	.677	***	.725	Access to health services	<input type="checkbox"/> - Transportation -Access
***	.438	***	.455	Access to appropriate technology	<input type="checkbox"/> - Transportation -Access
***	.271	***	.317	Proximity to large cities	<input type="checkbox"/> - Transportation -Access
***	.663	***	.682	Access to the station	<input type="checkbox"/> - Transportation -Access
***	.740	***	.112	Easy access to airports	<input type="checkbox"/> - Transportation -Access

Indicators are closely related when it comes to error variables (which capture variation not incorporated in the model). The maximum likelihood estimation was used to estimate all of the variables. As a result, the collected data are deemed adequate, and the model fits well.

One of the most often used nonparametric tests to detect the disparity between an actual and predicted dataset is the chi-square (2) goodness-of-fit test. The sole goodness-of-fit test related with significance testing is this one and its limiting probability (p); the other metrics and indices are just descriptive. The result produced with the (2) is satisfactory in this regard: 2365.546 with 1185 degrees of freedom (DF). The probability level (0.000) is also quite good. This indicates that the variables differ greatly (Moeinaddini et al., 2020).

Model fit indices are shown in Table 5. The model's goodness indicators are 0.664 (France) and 0.734 (Iran), indicating that the scenario is positive. The model also has an adaptive fit of 0.771 and 0.787 (France), 0.784 and 0.801 (Iran), according to Tucker fit indices. The economic adaptive fit index is 0.607 and 0.732 (France), 0.586 and 0.738 (Iran), whereas the economic fit index is 0.607 (France), 0.586 (Iran). The Root Mean Square Error of Approximation (RMSEA) is a measure of statistical model goodness-of-fit, with the purpose of achieving an approximate or close fit with the model rather than a precise fit, which is often impractical for large populations. A good match for the model is indicated by values below 0.07. As a result, the result (RMSEA) of France is 0.070, which is acceptable, and the result of

Iran is 0.060 which is below 0.070 and acceptable. In general, the Model shows that the model is well-fitting (Adnan et al., 2019).

Table 3.2. Status of fitting indicators

The value of the index in the desired pattern		Indicator
Iran	France	
151	141	NPAR
2026.857	2365.546	CMIN
1175	1185	DF
.000	.000	P
.734	.664	GFI
1.725	1.996	CMIN/DF
.060	.070	RMSEA
.784	.771	TLI
.801	.787	CFI
.586	.607	PNFI
.738	.732	PCFI

The factor loads in the model of measuring the pattern of structural equations must be greater than 0.30; if the factor is less than 0.30, the model will be damaged, and it must be deleted. Because all factor loads are more than 0.30, the model fit indices have been evaluated to an appropriate level, indicating that the research model is completely fit. In other words, both models' measures of their independent variable have a strong correlation or covariance (Fig. 15 & 16).

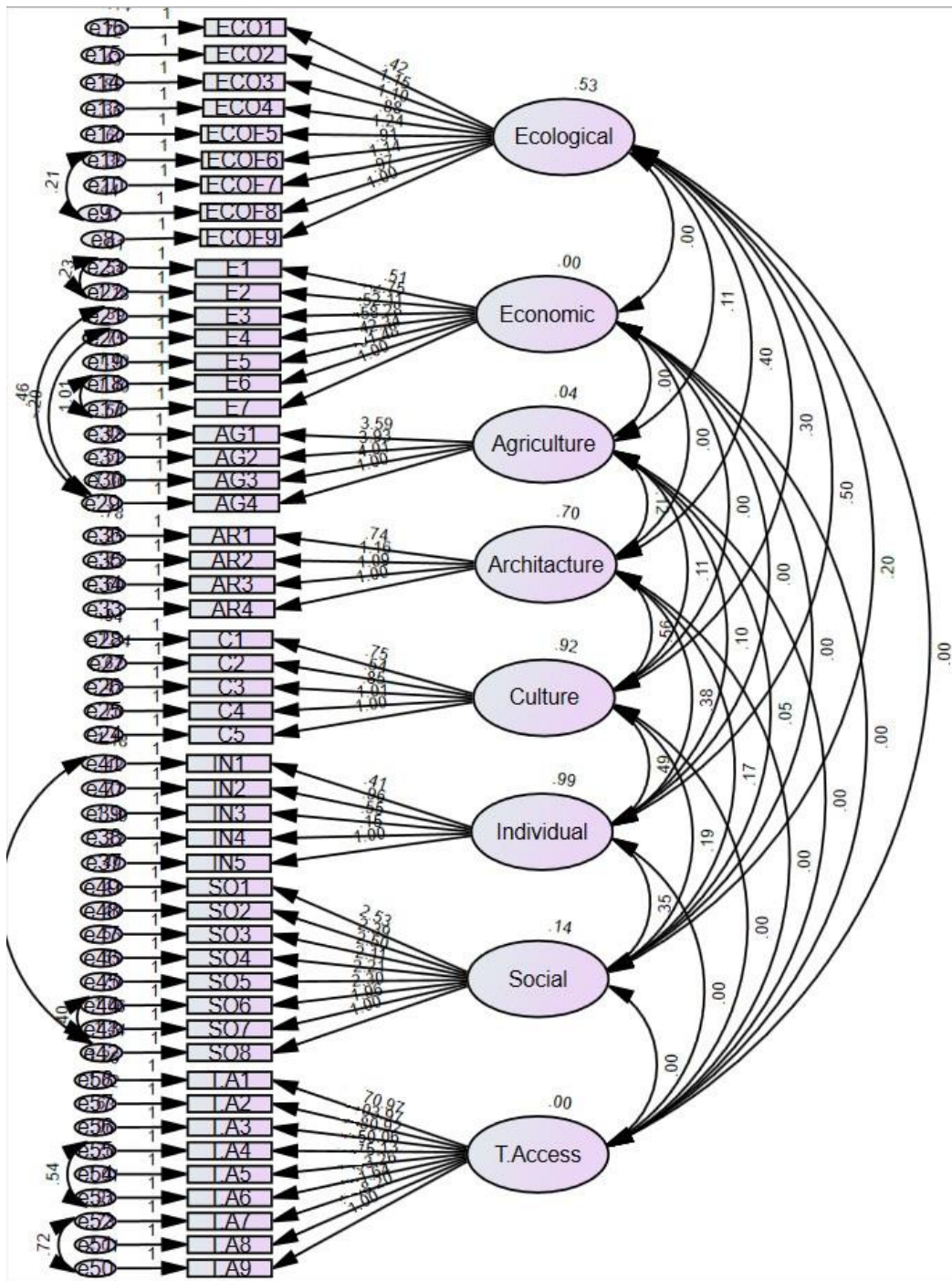


Fig.3.15. Model for measuring the pattern of structural equations of research of France

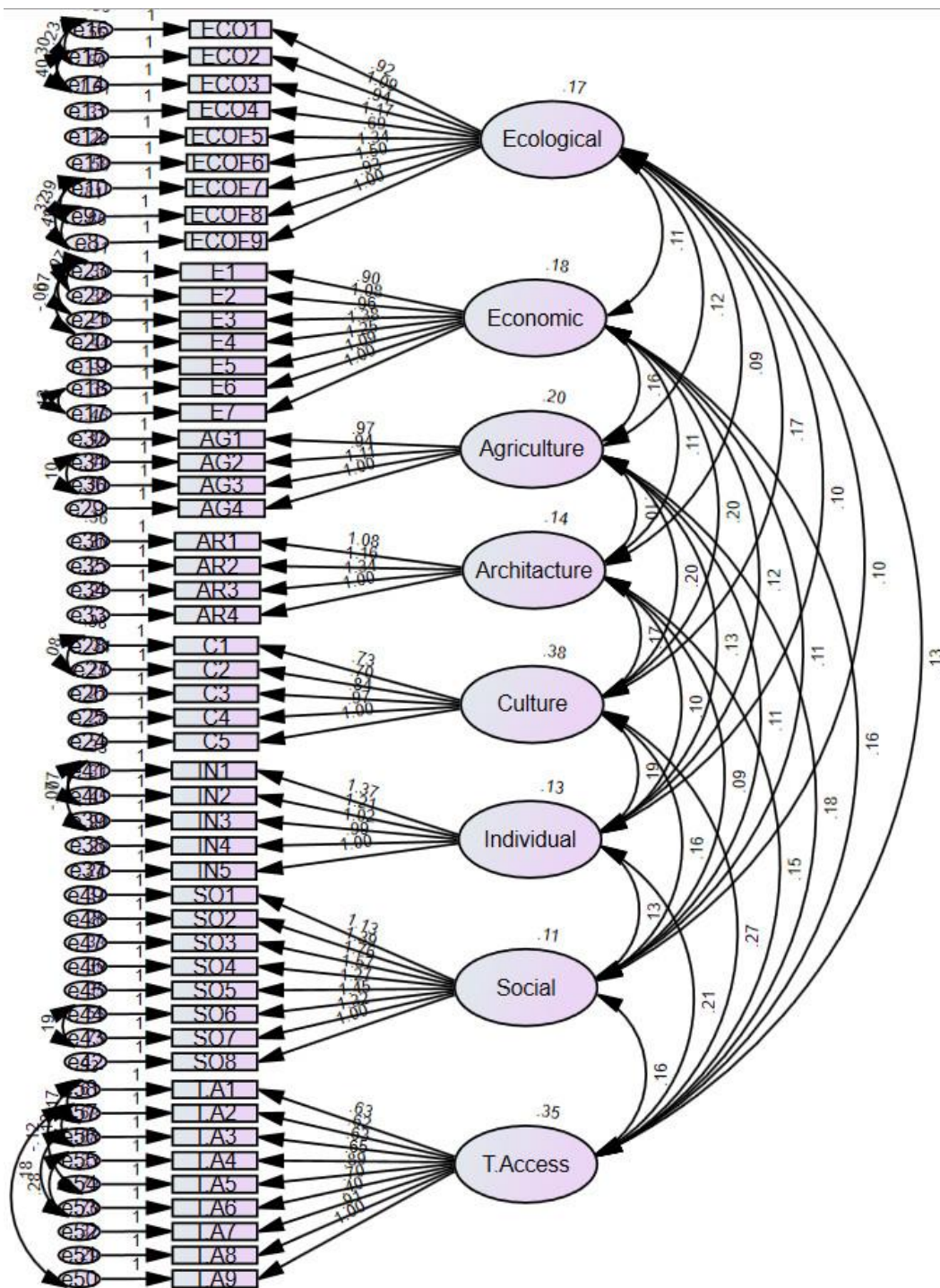


Fig.3.16. Model for measuring the pattern of structural equations of research of Iran

In general, all dimensions of the Ecovillage are very important in the case areas, but because we want to know which one is the most important, we categorized the most important ones for France and Iran in Figure (17). Furthermore, the significance of each indicator (obvious variable) has been specified.

Given that each dimension in Ecovillages has its own color, we attempted to consider each dimension based on its own color here (for example, the economic dimension is blue, the social dimension is purple, etc.).

Therefore, the differences and similarities between the two case studies are easier to see at a glance. For example, in Iran, respondents believe that "identifying one with the region" is the most important in the Individual dimension, whereas in France, respondents believe that political isolation is more important. Culture is more important in Iran, but agriculture is more important in France. In Iran, "cohesion and solidarity between people" is the most important social dimension, whereas in France, "participation among inhabitants" is more important. In terms of transportation and access, "proximity to large cities" is more important in Iran, while "access to health care" is more important in France (Fig 17).



Fig.3.17. the most important dimensions of Ecovillages in Iran and France

By prioritizing different dimensions for each category of cities, we can provide insights into the specific challenges and opportunities for sustainable living in different urban contexts. For example, in Paris and Tehran, social, individual, agricultural, ecological, and economic dimensions were prioritized over transportation and access, cultural, and architectural dimensions. This suggests that residents in these cities may be more concerned about issues related to their daily lives and the environment, rather than historical or aesthetic features of their cities. In addition, in Iran's big cities, economic, social, and individual dimensions are prioritized, which may reflect the country's difficult situation on economic development and individual prosperity. Furthermore, in small and very small cities, nearly all dimensions are given nearly equal weight, indicating a more balanced approach to sustainability. However, there are some differences between countries, with transportation and access being more important in very small cities in Iran, while architecture, social and ecological dimensions are more important in very small cities in France. This may be due to differences in urban planning and design practices, as well as cultural and historical factors.

3.2.2.2. Spatial Statistics Analysis

3.2.2.2.1. Spatial autocorrelation

The graphic output of spatial autocorrelation (Moran's I) analysis shows that the points under consideration are dispersed or grouped depending on the intended index. The analyzed sites do not contain spatial autocorrelation, according to Moran's diagram. In general, if the Moran index value is close to a positive number (+1), the data has spatial autocorrelation and a cluster pattern; if the Moran index value is close to a negative number (-1), the data is fragmented (Table 3.3). In other words, if the diagram represents a clustered pattern, it means that nearby spatial features have more similar values, if the diagram represents a random pattern, it means that nearby spatial features have more values that are randomly similar, and finally, if the diagram represents a dispersion pattern, it means that nearby spatial features have more dissimilar values (Fig. 3.18 & 3.19). In a study conducted in Tehran, Sadeghinia and Alijani (2015) iterated the utility of spatial-temporal analysis of green cover in urban environments using the spatial autocorrelation technique. Other ecological research can benefit from spatial autocorrelation and hot spot cold spot analysis. Babiker et al. (2007) looked at how borehole data was organized in space to determine groundwater quality. Another study used a spatial filtering mechanism that combined drought indices acquired from satellite pictures with spatial autocorrelation computations to provide precise spatial information about drought-prone locations (Lin and Chen, 2011). Kumari et al. (2019) investigated the spatial pattern of land surface temperature in response to land cover around a thermal power plant using Moran's I and GIS. Lopez et al. (2017) combined human and remote sensing to identify and explain urbanization hot areas and Moran's I in the south of Mexico City.

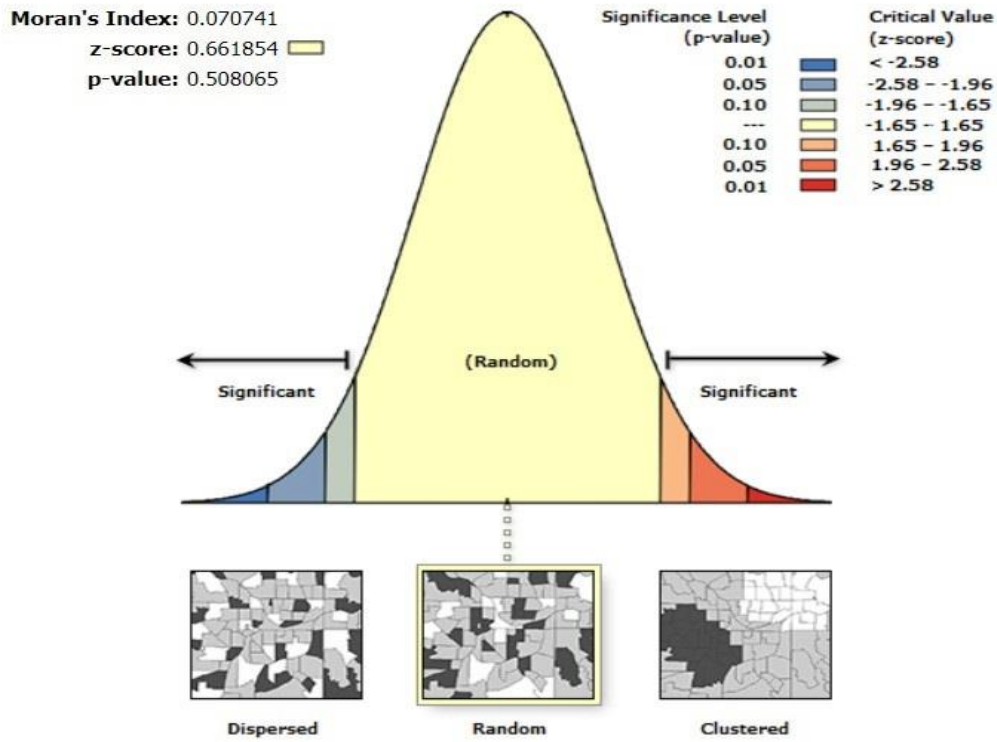


Fig.3.18. Analysis of Spatial Autocorrelation Graphic Results in France (Moran's Index)

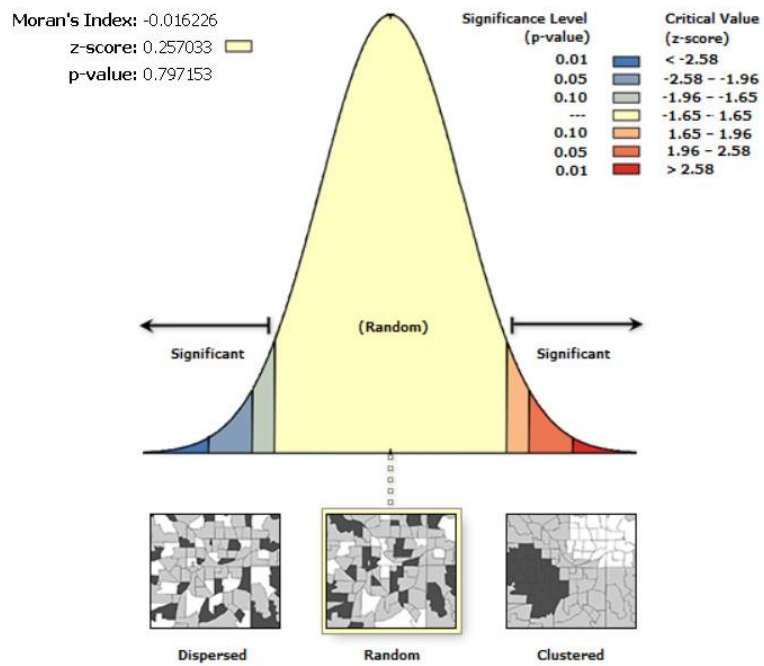


Fig.3.19. Analysis of Spatial Autocorrelation Graphic Results in Iran (Moran's Index)

Table 3.3. The numerical output of spatial autocorrelation analysis

	France	Iran
Moran's Index	0.070741	0.016226
Variance	0.022898	0.097977
z-score	0.661854	0.257033
p-value	0.508065	0.

3.2.2.2.2. Hot spots cold spots

The Hot Spot Analysis tool was then utilized to see the relationship between cities based on each dimension. For each dimension in the data, a Gi was discovered in this analysis (Ijumulana et al., 2020). The resulting z-scores and p-values, as previously stated, show where characteristics with high or low values cluster spatially (Majumder et al., 2019). In other words, the greater the z-score is for statistically significant positive z-scores, the more intense the clustering of high values (hot spot), and the smaller the z-score is for statistically significant negative z-scores, the more intense the clustering of low values (cold spot) (cold spot). As a result, the red patches on the maps below show hot locations, and these places in this study represent the most critical dimensions in Ecovillages. Furthermore, the lower and negative the value, the closer we get to the blue or frigid places on the maps. Furthermore, these places represent the Ecovillages' less important dimensions.

- ✓ The relevance of the Ecological, Transportation, and Access elements of Ecovillage in France is depicted in Fig.6, with the Ecological component being very important in Reims, Baugy, Le Creusot, Besancon, Montpellier, and Toulouse and very low in Courbevoie and Bobigny. The Transportation and Access dimension is very important in Vitry-sur-Seine, Nancy, Le Creusot, Saint-Claude, Marseille, and Le Luc, and very low in Courbevoie and Bobigny.
- ✓ The importance of the Economic and Agriculture dimensions of Ecovillage are shown in Fig.6, with the Economic dimension having a very high importance in Vitry-sur-Seine, Nancy, Saint-Claude, Caluire-et-Cuire, and Montpellier and a very low importance in Villeurbanne, Bobigny, Baugy, Chenove, and Ensisheim. Agriculture is highly important in Vitry-sur-Seine, Nancy, Caluire-et-Cuire, and Toulouse, while it is very important in Villeurbanne, Courbevoie, Bobigny, and Mont-Saint-Aignan.

- ✓ The relevance of the Culture and Architecture dimensions of Ecovillage are depicted in Fig.7, with the Culture dimension having a very high importance in Reims, Dourdan, Bordeaux, Saint-Claude, and Cordes-sur-Ciel and a very low importance in Baugy and Courbevoie. Reims, Besancon, Saint-Claude, Caluire-et-culre, Courbevoie, and Blain place a high value on architecture, while Ensisheim, Chenove, Bobigny, and Nantes place a low value on it.

- ✓ The relevance of the Social and Individual dimensions of Ecovillage are depicted in Fig.7, with the Social dimension being very important in Livry-Gargan, Dourdan, Besancon, Montpellier, and Marseille, and very low in Bobigny, Versailles, Vitry-sur-Seine, Courbevoie, Ensisheim, and Cordes-sur-Ciel. Individual dimension relevance is extremely high in Livry-Gargan, Culuire-et-Cuire, Mont-saint-Aignan, Lille, Strasbourg, Besancon, Saint-Claude, Le Creusot, Marseille, and Montpellier, and extremely low in Vitry-sur-Seine, Courbevoie, Cordes-sur-Ciel, and Ensisheim.

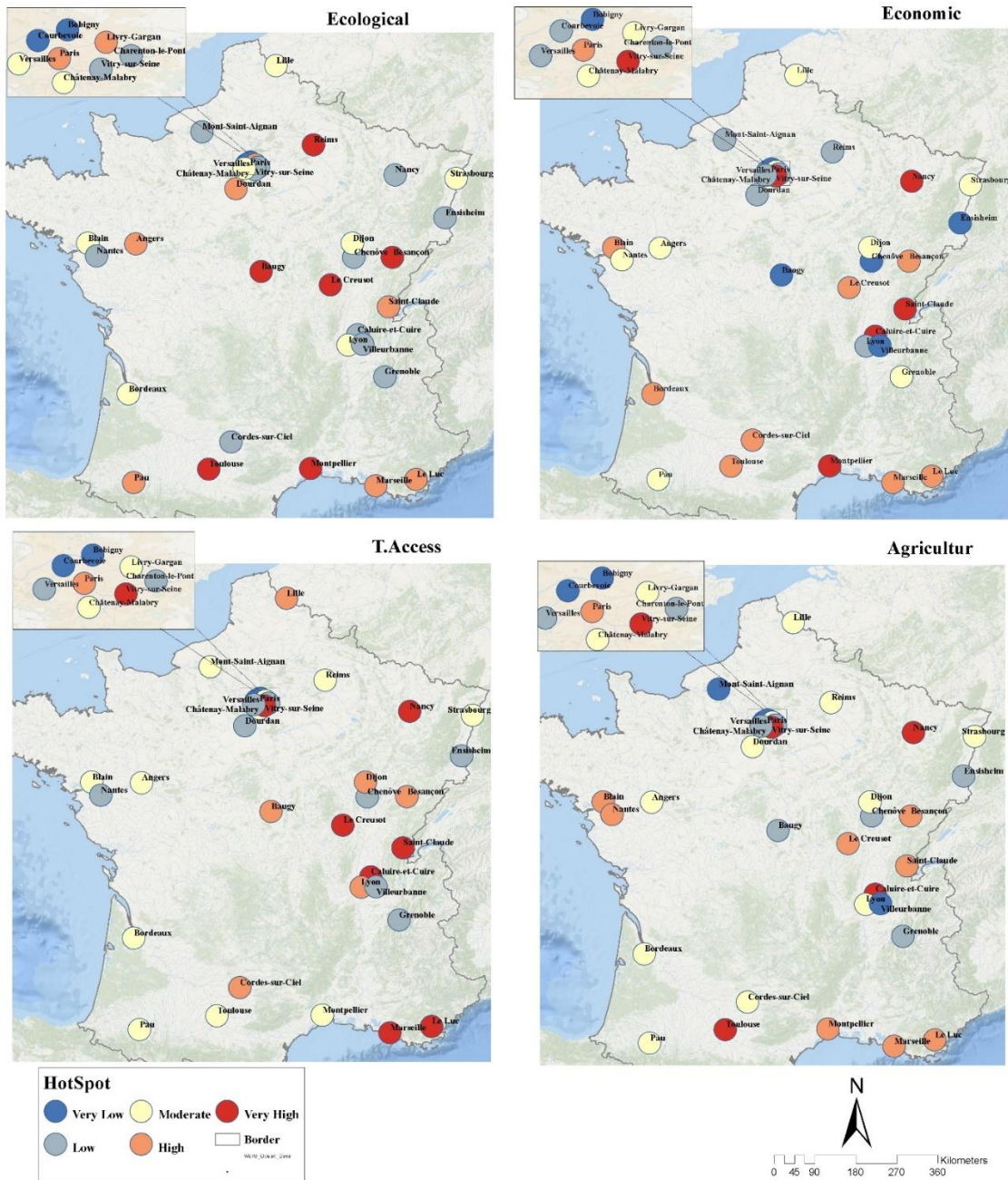


Fig.3.20. Hot spot and Cold spot of Ecological, Transportation and access, Economic and Agriculture Dimensions

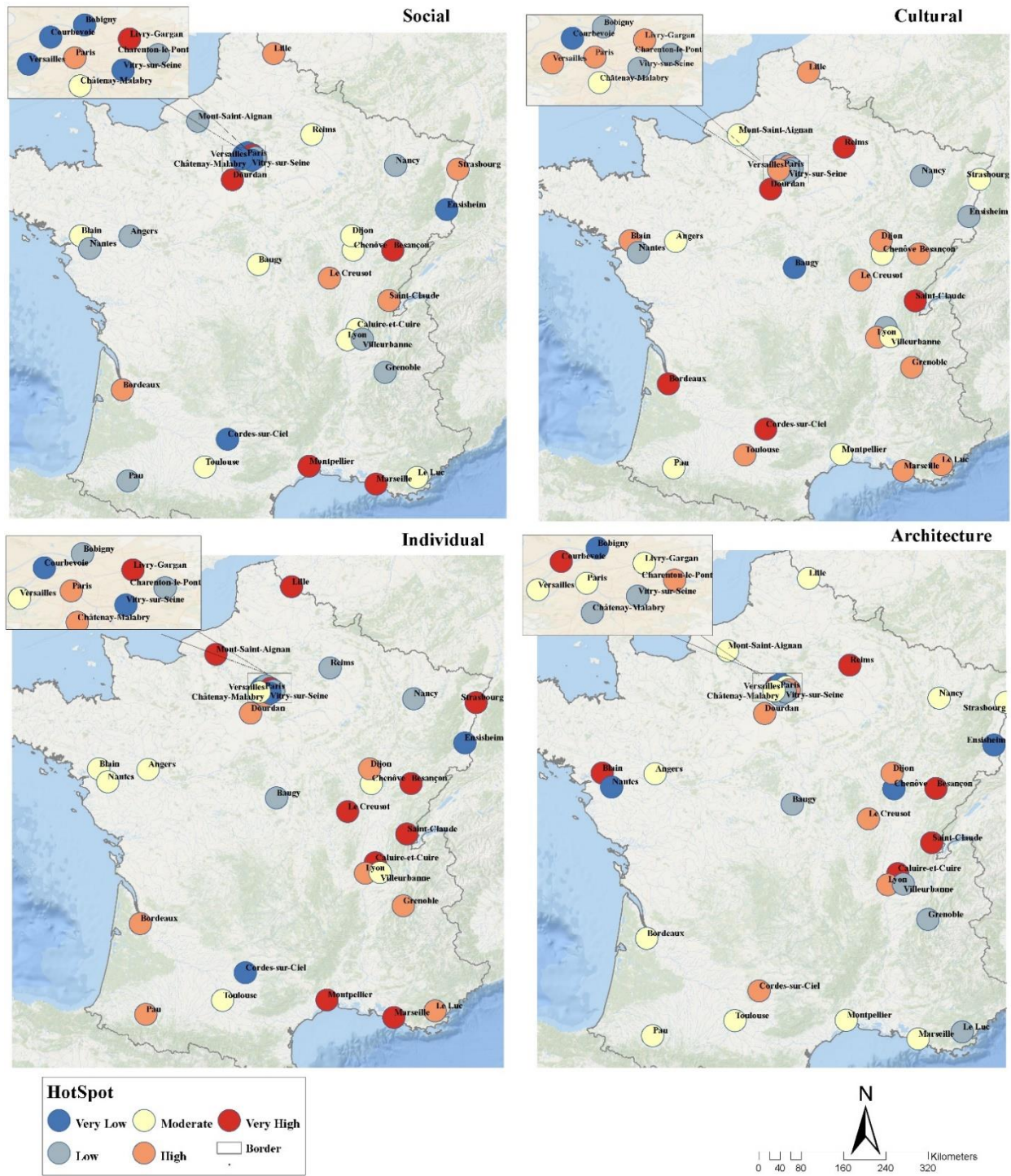


Fig.3.21. Hot Spot and Cold Spot of Culture and Architecture, Social and Individual Dimensions

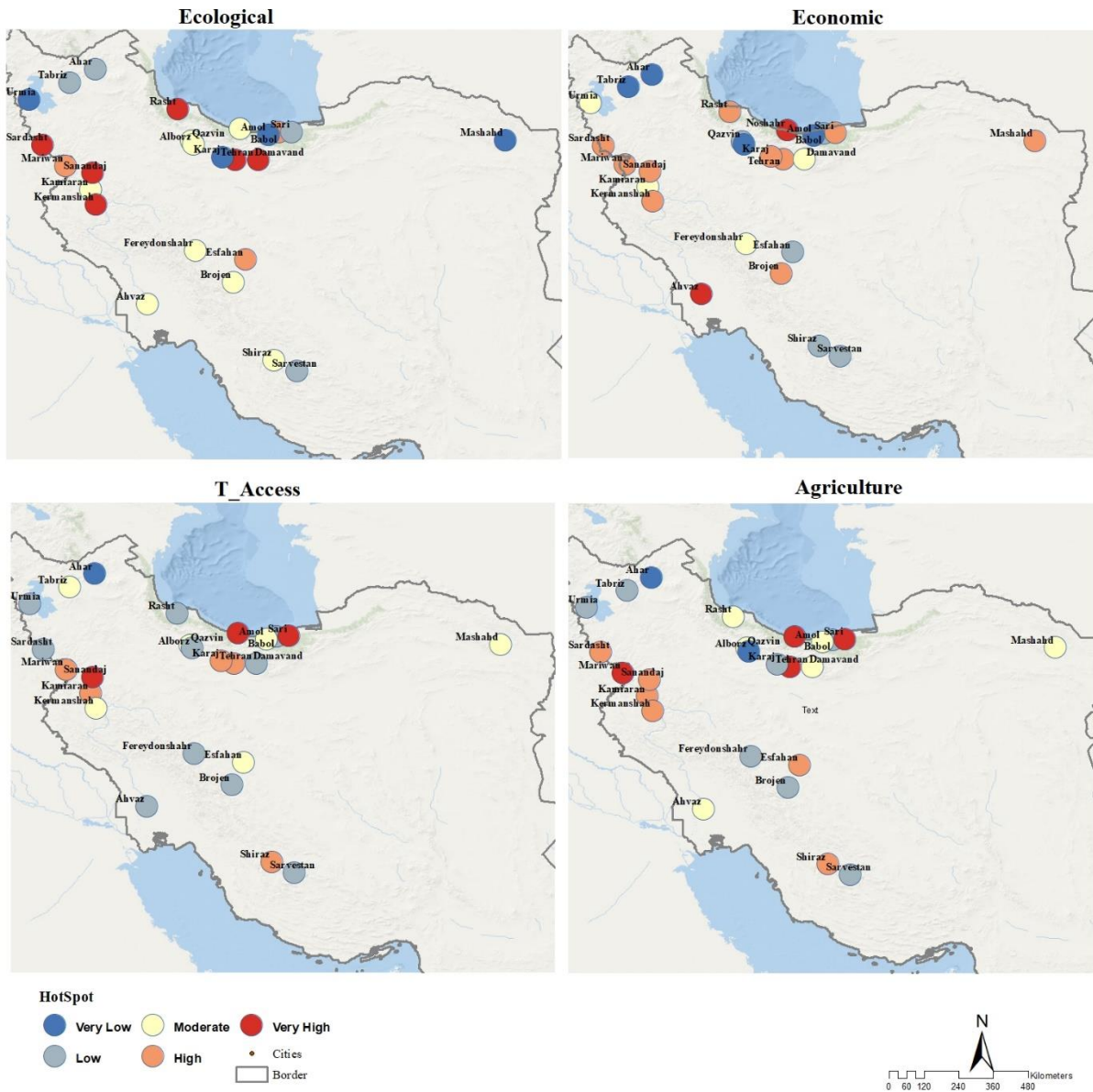


Fig.3.22. Hot spot and Cold spot of Ecological, Transportation and access, Economic and Agriculture Dimensions

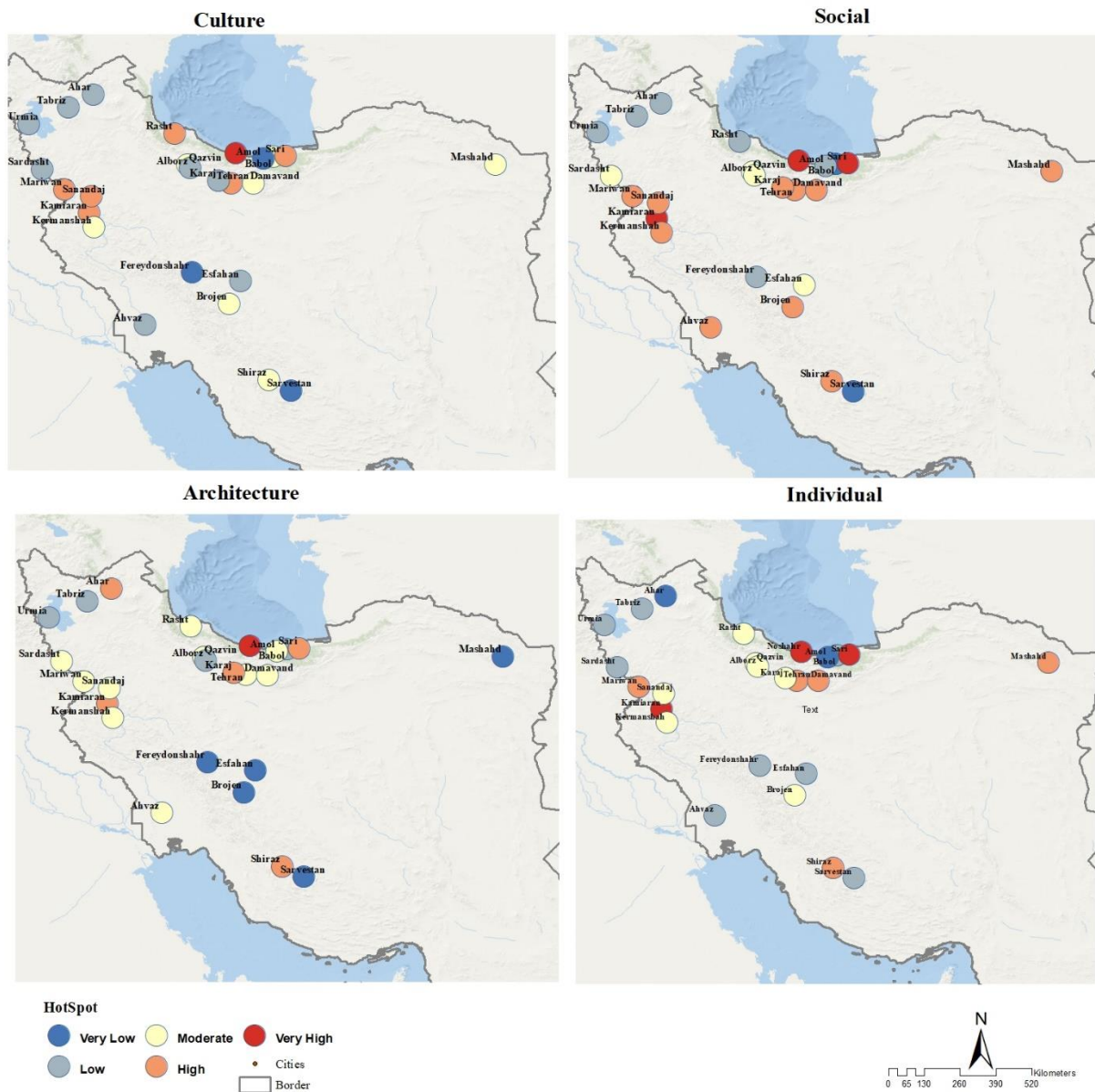


Fig.3.23. Hot Spot and Cold Spot of Culture and Architecture, Social and Individual Dimensions

It may be determined which cities are distinct in terms of which Dimensions using the hot areas and cold places in Figures 20, 21, 22, and 23. In each dimension, it is also possible to determine which cities are hot spots (extremely high in terms of the importance of the dimensions) and which cities are cold spots (very low in terms of the value of dimensions). Given the 35 cities analyzed in France and 25 cities in Iran, we grouped the cities based on population to prevent a separate analysis of each of these cities and to summarize the statistical maps. We placed the Capitals (Paris and Iran) in the top category since their population was substantially different from that of other cities, and the remaining cities were categorized as very large, large, medium, small, and very small cities, accordingly (Fig. 24 & 25). For a sustainable lifestyle in Paris and other big cities, social, individual, agricultural, ecological, and economic dimensions were

prioritized over transportation and access, cultural, and architectural dimensions. The importance of these aspects in Tehran is similar to that of Paris, with the exception that the agricultural dimension has received less attention in Tehran. Economic, social, and individual aspects were prioritized in Iran's big cities, while the ecological dimension received the least attention. In big cities in France, almost all dimensions have the same weight, but in Iran, individual and environmental dimensions were given more weight, while transport and access and social dimensions were given the least. Transportation and access have been given more weight in Medium French cities, while other dimensions have been given nearly equal weight. This analysis also applies to Iran's Medium cities. Transport and accessibility, economics, and architecture are all important factors in small French cities. Furthermore, small cities in Iran and very small cities in France have given nearly equal weight to all dimensions; in very small cities in Iran, they have paid more attention to the dimensions of transportation, access, and economy in order to achieve sustainability, and besides architectural, social, and ecological have the lowest weight.

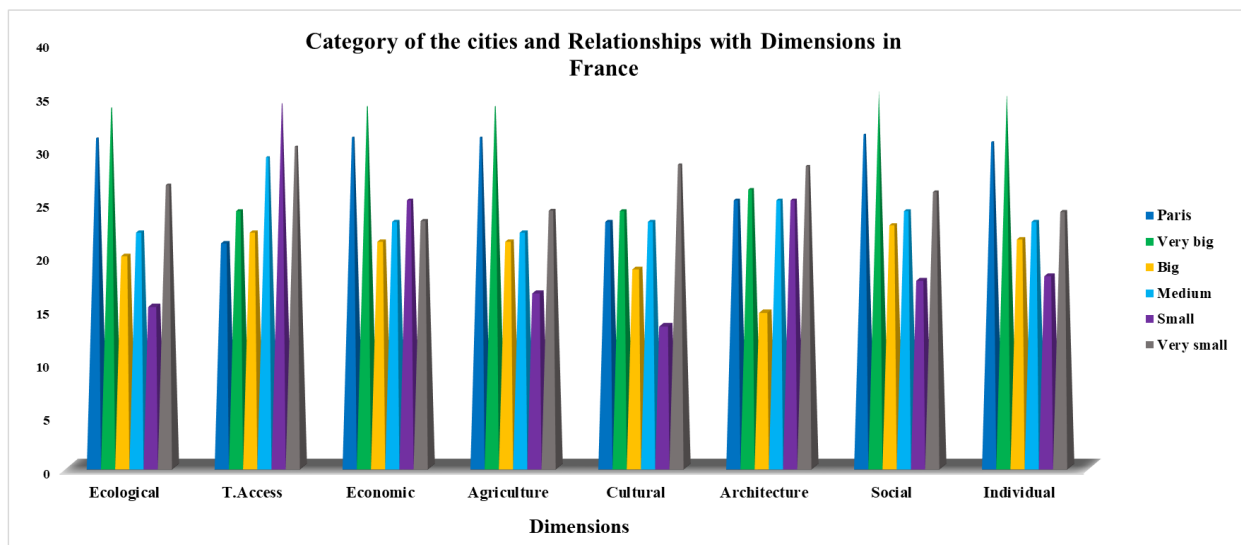


Fig.3.24. Category of the cities and their relationships with Dimensions of Ecovillage in France

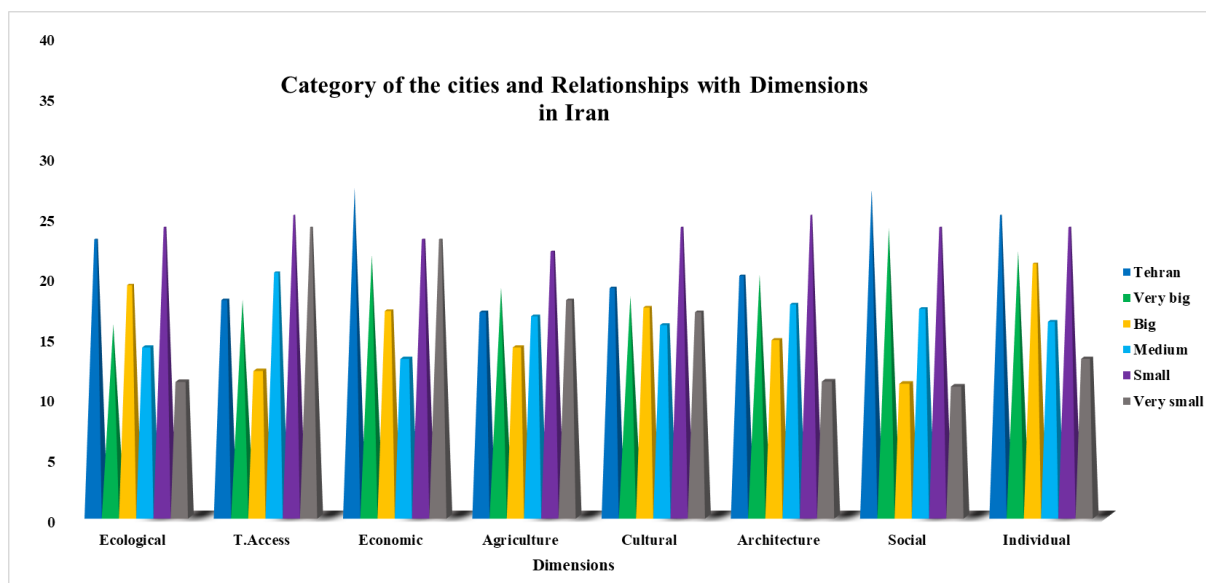


Fig.3.25. Category of the cities and their relationships with Dimensions of Ecovillage in Iran

3.2.3. ICT Level

Q2. What is the state of ICT development in relation to environmental sustainability in order to build smart cities?

The second question will be examined in this section. The goal of this Question is to determine the level of ICT and its relationship to geographic locations, sustainability, and Digital Cities in Iran and France. ICT was evaluated using the indicators "device ownership," "Internet access," "computer skills," "social media," "E-commerce," and "the influence of pandemics in ICT usage." Based on their geographical location, the case studies in both countries were categorized as very big, big, medium, small, and very small cities. Therefore, the goal is to compare Iran and France in order to define the level of ICT and determine similarities and differences in geographical places and the link between ICT, Sustainability, and geographical locations to achieve Digital Cities.

3.2.3.1. Data Visualization

Fig.26 and 27 show Internet access and device usage in each category of the cities in France and Iran (the Definition of codes is represented in table 4). In France, respondents who only have access to the internet at home use laptops. And those with internet access everywhere in very small cities have access to desktop computers, laptops, and smartphones; those with internet access everywhere in small cities have access to laptops and smartphones; those with internet access everywhere in medium, large, and very large cities have access to all devices; and those with internet access everywhere in Paris have access to the internet in home and office. In Iran, respondents in very small and small cities only have access to the internet at

home, using laptops and Smartphones. The medium, very large cities, and Tehran are the ones that have access to the internet on all devices. In general, those who have continuous internet connections own more devices. Those who only have internet access at home and the office own fewer devices. Therefore, the level of Internet access was directly related to the possession of ICT devices. The ability to access the internet is the most important key to attaining digital cities. In other words, moving toward sustainable smart cities is impossible without proper Internet access. Digital cities collect and analyze data using Internet of Things (IoT) devices such as connected sensors, lighting, and meters. Cities then use this information to improve infrastructure, public utilities, and services, among other things (Tirziu & Vrabie, 2018).

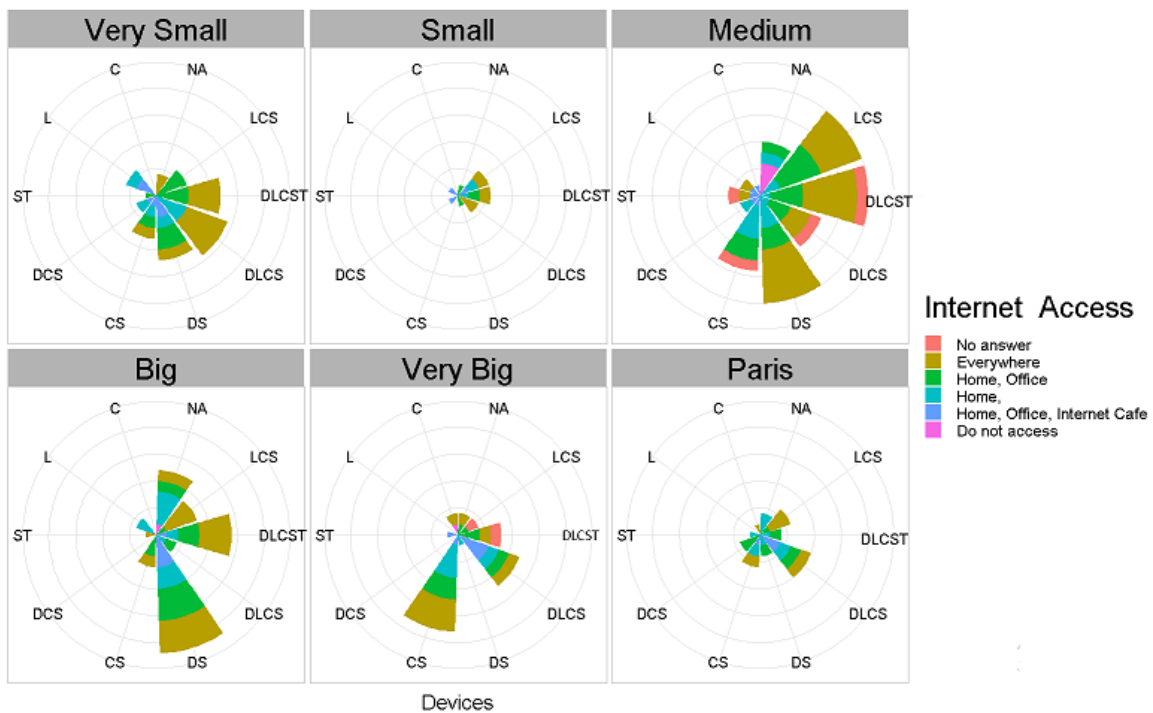


Fig.3.26. Access internet in Case studies of France

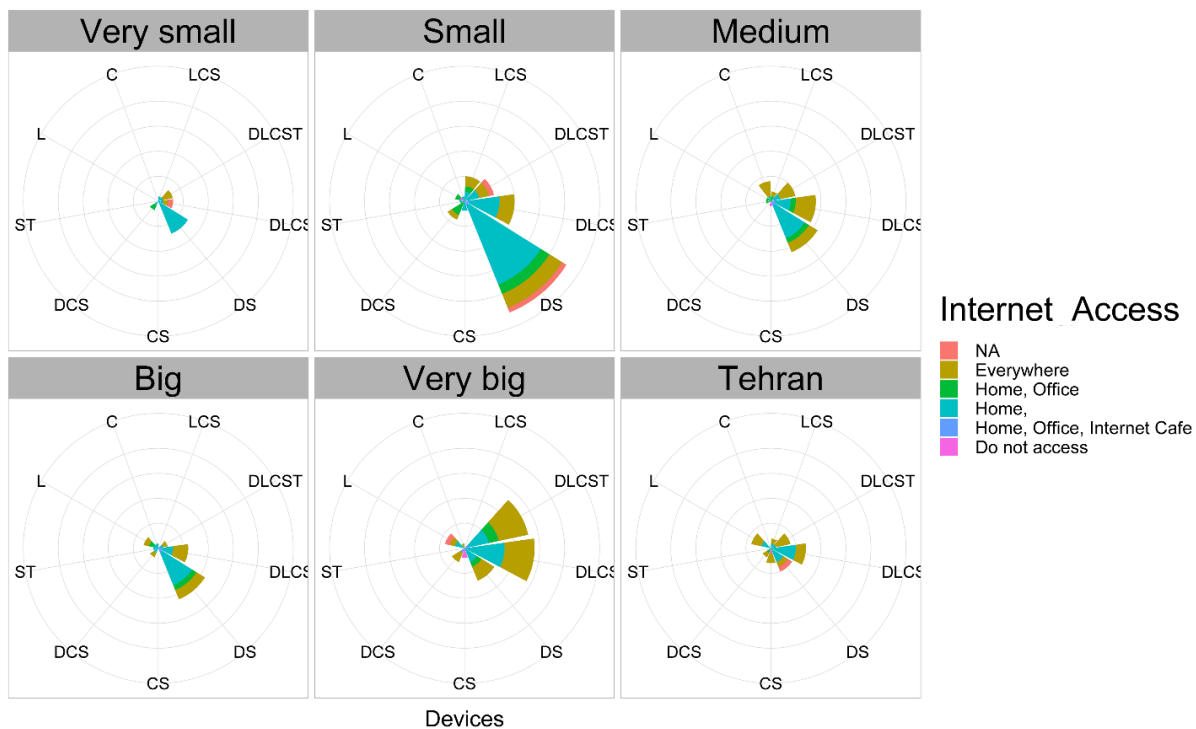


Fig.3.27. Access internet in Case studies of Iran

Table 3.4. Definition of codes for Internet access

Code	Variables
NA	No answer
LCS	Laptop, cell phone, Smartphone
DLCST	Desktop computer, Laptop, cell phone, Smartphone, Tablet
DLCS	Desktop computer, Laptop, cell phone, Smartphone
DS	Desktop computer, Smartphone
CS	cell phone, Smartphone
DCS	Desktop computer, cell phone, Smartphone
ST	Smartphone, Tablet
L	Laptop
C	Cell phone

Table 6 shows how respondents in France and Iran use the internet. In general, 61.6% of respondents in France use the internet daily, with 30% spending 3-5 hours per day and 31% spending more than 5 hours per day. In Iran, 52% of respondents use the internet on a daily

basis, with 38% spending 3-5 hours per day and 27.6% spending more than 5 hours per day. In general, more than 50% of Iranian respondents and more than 60% of French respondents use the Internet on a daily basis. Finally, respondents in France use the Internet more frequently than respondents in Iran. Increasing Internet usage is one of the fundamental pillars of becoming sustainable smart cities. The Internet, which originated as a tool for communication, has evolved into a means of social interaction, education, and commerce, as well as a means of bridging the digital divide. The provision of adequate infrastructure and the abolishment of Internet restrictions in Iran may be able to close this gap (Larrinag et al., 2021).

Table.3.5. Internet usage of Respondents

Weekly			Daily		
Variables	Iran	France	Variables	Iran	France
No Answer	1.5	9.8	No Answer	.8	3.4
Daily	52.0	61.6	<1 hour	2.9	4.6
Irregularly	14.4	12.6	3-5 hours	38.0	30.0
weekly	19.3	2.6	1-2 hours	16.3	19.2
Alternate days	12.9	13.4	Do not use daily	14.3	11.8
			<5 hours	27.6	31.0

The next step was to discuss the respondents' use of social media. Social media platforms have become an essential component of our lives and are frequently used by citizens in the context of smart cities, differing from people browsing and interacting with friends to businesses promoting their products and services. Consequently, Facebook, Instagram, Snapchat, LinkedIn, Twitter, and ResearchGate are the most popular social media platforms for responses in France (Fig. 28). In Iran, the most popular social media platforms are Instagram, LinkedIn, ResearchGate, Snapchat, and Twitter. One reason Iranians use Twitter and Facebook less is that these apps are filtered in Iran (Fig.29). It should be noted that this statistic is related to the date of the questionnaire distribution; currently, more social networks such as Instagram, Telegram, and WhatsApp are also filtered and may not be used in Iran. Given the growing population in cities, social media can be a valuable source of data. which provide a cheap and easy environment to communicate, promote products and services and create trends. This can be useful in combining smart city ideals with citizen social ideals in the construction and development of a sustainable yet modern environment in which technology is the primary tool. Hence the Iranian government must prioritize social network filtering as one of the primary pillars of smart cities (Schuler, 2002; Feeney et al., 2019; Bucur et al., 2019; Manafu, 2019; Nummi, 2019).

It is evident that knowledge of computer skills is an important indicator in ICT and digital literacy, which has daily implications in our lives, particularly in educational-research systems and rapid information transfer. These skills can help to shape, integrate, and transfer sustainable development knowledge through digital literacy practices in formal learning. Hence, it is critical to address this issue in educational institutions in order to establish the foundation for future sustainable smart cities. Some of these abilities are discussed below (Wilson et al., 2015; Khaloufi & Laabidi, 2017).

The level of word processing¹ and management system learning² was assessed in Fig.8 and Fig.9 depending on smartphone usage and city categories. The X-axis depicts word processing, while the Y-axis shows management system learning. The color reflects the level of smartphones, while the size of the circles represents the city categories. Responses with a high level of management system learning have a very high level of word processing in France. Those with a medium level of word processing knowledge have a low level of management system learning. The level of management system learning and smartphone usage was higher in Paris, the big and Very big cities than in the other cities. The relationship between management system learning and word processing levels in Iran was similar to that in France, with the exception that there were more responses in Iran with a lower level of both items. Moreover, Tehran has a higher level of management system learning than the other cities. Furthermore, Tehran, as well as the Big and Very Big cities, have higher smartphone usage than the others (Fig.30 & Fig.31). Finally, management system learning and word processing have a direct relationship; that is, the greater the knowledge of management system learning, the greater the word processing, and the opposite.

Hence, one of the most important aspects of constructing digital cities is having a high degree of computer skills, and these talents are becoming vital variables in investigating all issues concerning digital cities. Based on the results of computer skills and smartphones, it may be easier to identify a city's weaknesses and strengths and determine what can be done to emphasize the weaknesses and improve the strengths (Aubry et al., 2014; Picatoste et al., 2017).

¹ Word processing is the composition, editing, and formatting of text. Word processing programs, such as Microsoft Word, in addition to working with text also provide tools to insert pictures, edit photos, draw objects, and produce graphic organizers.

² A learning management system (LMS) is a software application or web-based technology used to plan, implement and assess a specific learning process, such as Schoology education platform.

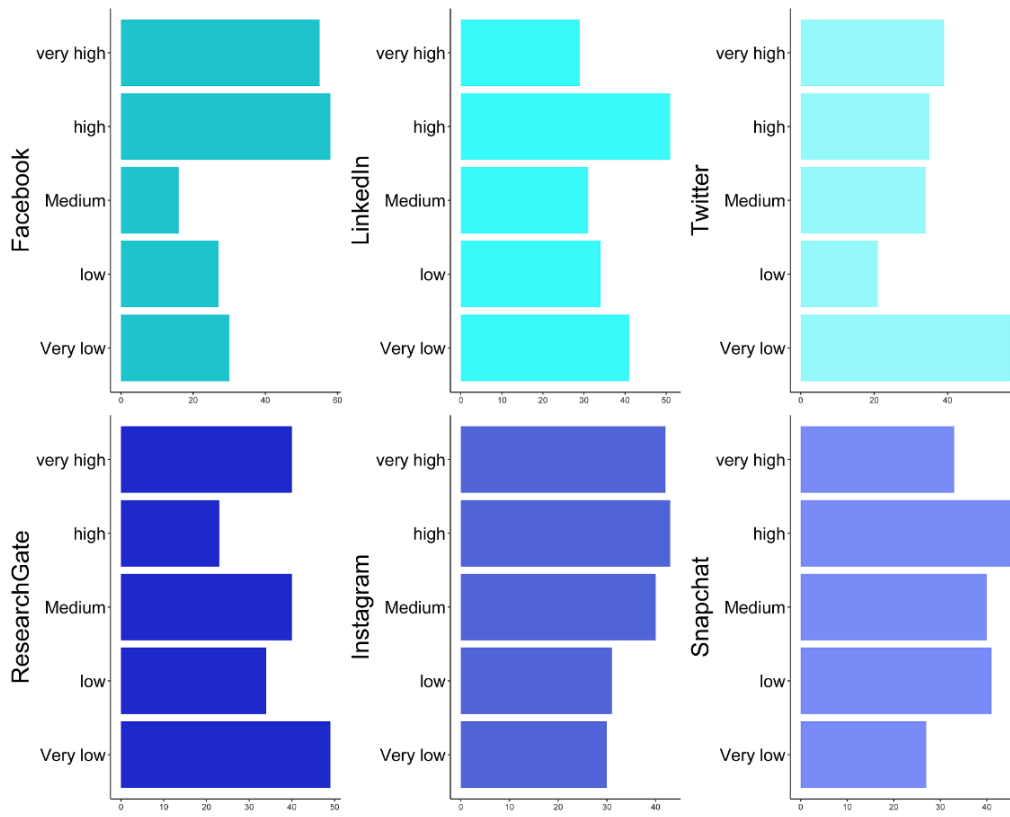


Fig.3.28. The usage of social media in France

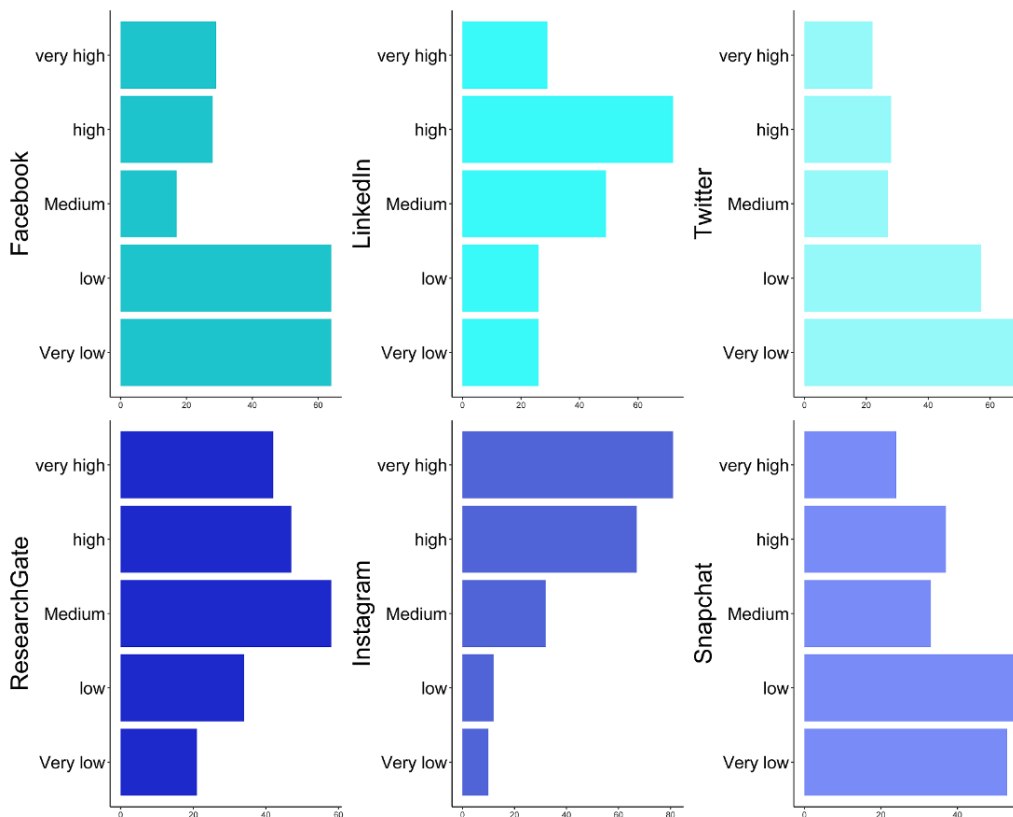


Fig.3.29. The usage of social media in Iran

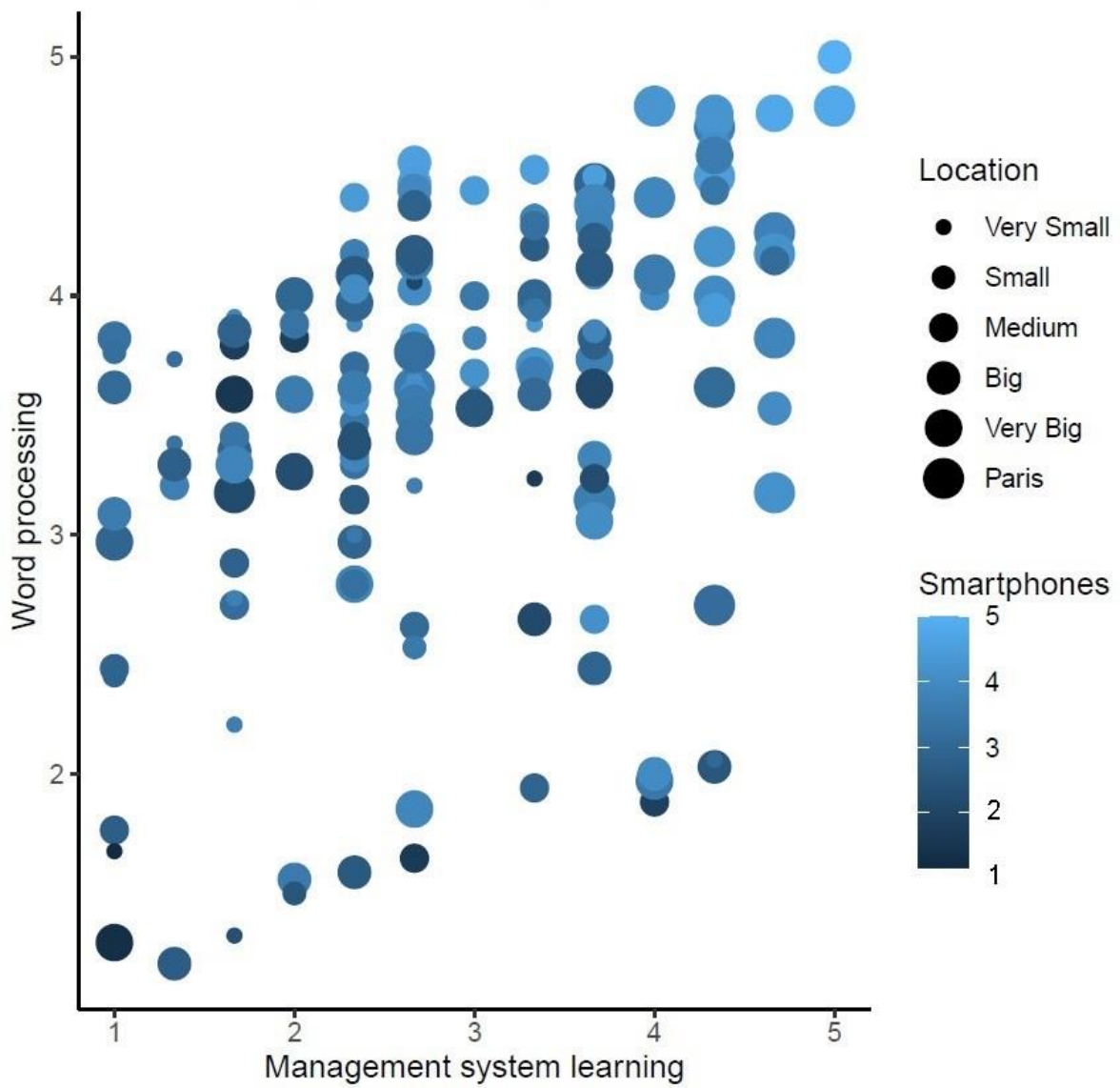


Fig.3.30. the level of word processing and management system learning in France

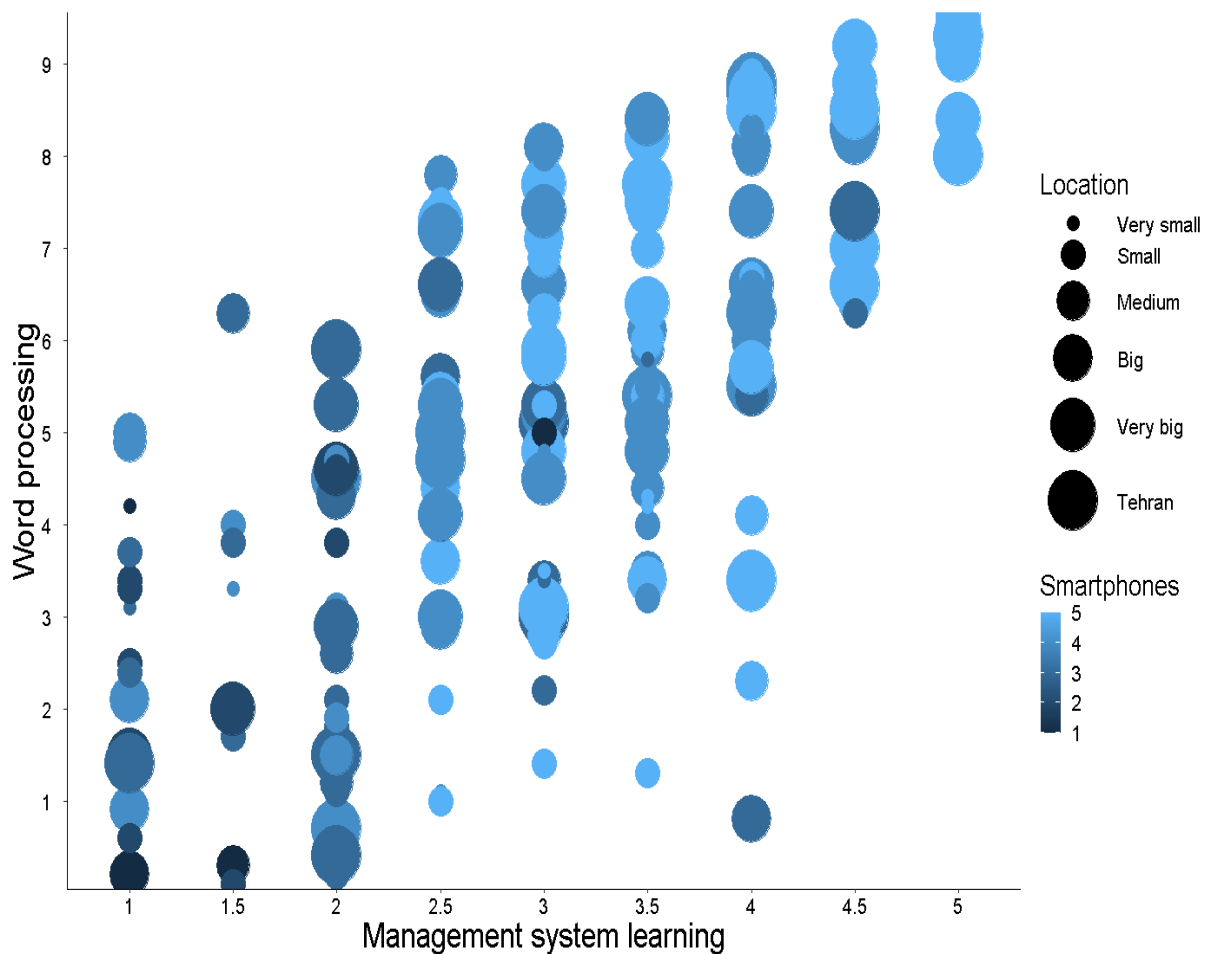


Fig.3.31. the level of word processing and management system learning in Iran

Fig. 32 and 33 depict the level of multimedia and data management based on location. In this case, Paris and Big cities have a higher level of both (Multimedia and Data management), whereas Very Big and Medium cities have an intermediate level. Small and very small cities have a lower level than the others do. Moreover, Tehran and very big cities in Iran have a higher level than others do, whereas small and very small cities have a lower level. In general, French responses were higher in Multimedia than Data management, and Iranian were higher in Data management than Multimedia.

Figs 34 and 35 illustrate the level of online research and web design, correspondingly. Paris and big cities have the highest in both, while very small cities have the lowest. In addition, medium cities have a higher level of online research than web design. In general, the French are higher at web design than online research, whereas the Iranians are better at online research than web design.

It is critical to have knowledge of computer skills (multimedia, data management, online research, web design, etc.) in order to obtain a better level of ICT in the way to construct sustainable digital cities. For example, a higher level of data management might be a solution that helps cities to digitize and connect their services (Larrinaga et al., 2021). Cities that have already been developing in a knowledge-based manner and with a high level of ICT penetration have typically developed the necessary know-how, structures, processes, and decision support tools like computer skills to select the best ICT practices they require, adapt them to their specific needs and characteristics, integrate them into their strategic plans, and successfully implement them (Ergazakis, et al., 2011; Zwhar et al., 2005).

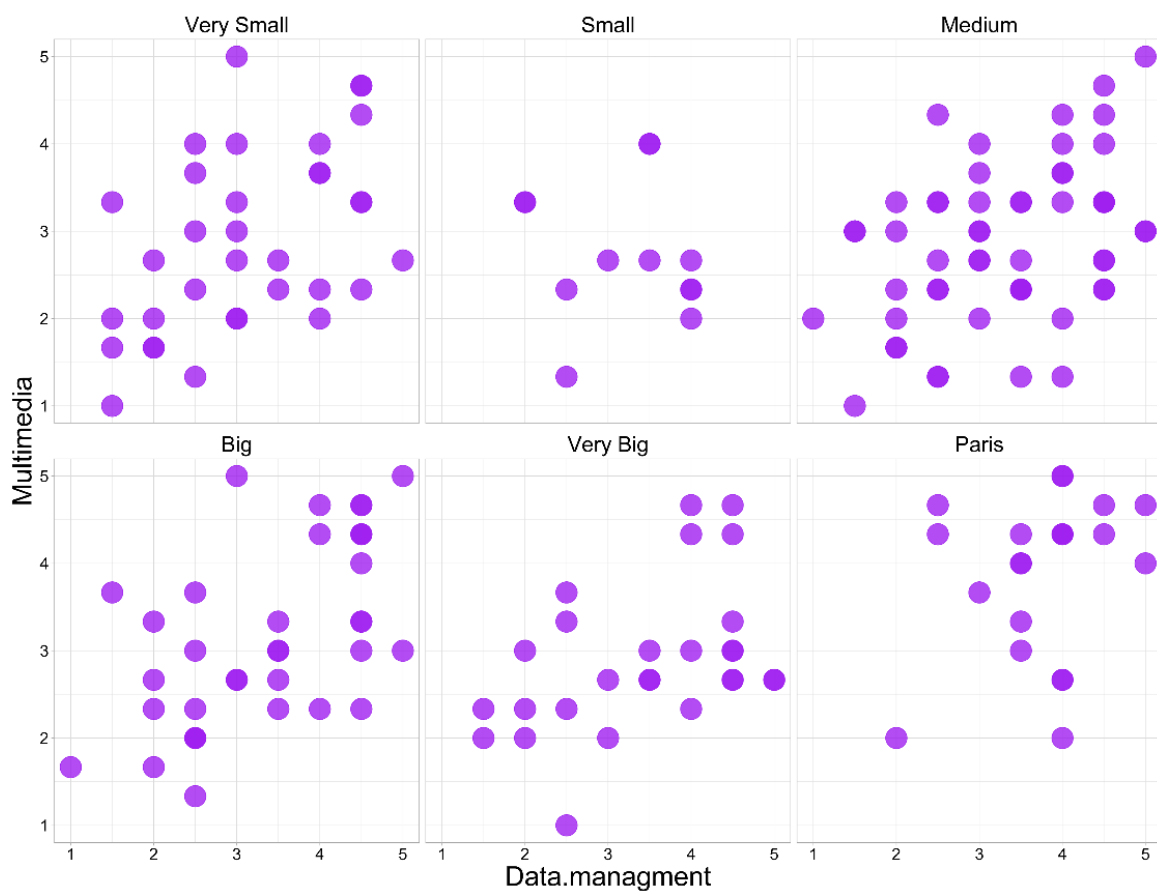


Fig.3.32. the level of Multimedia and Data management in France

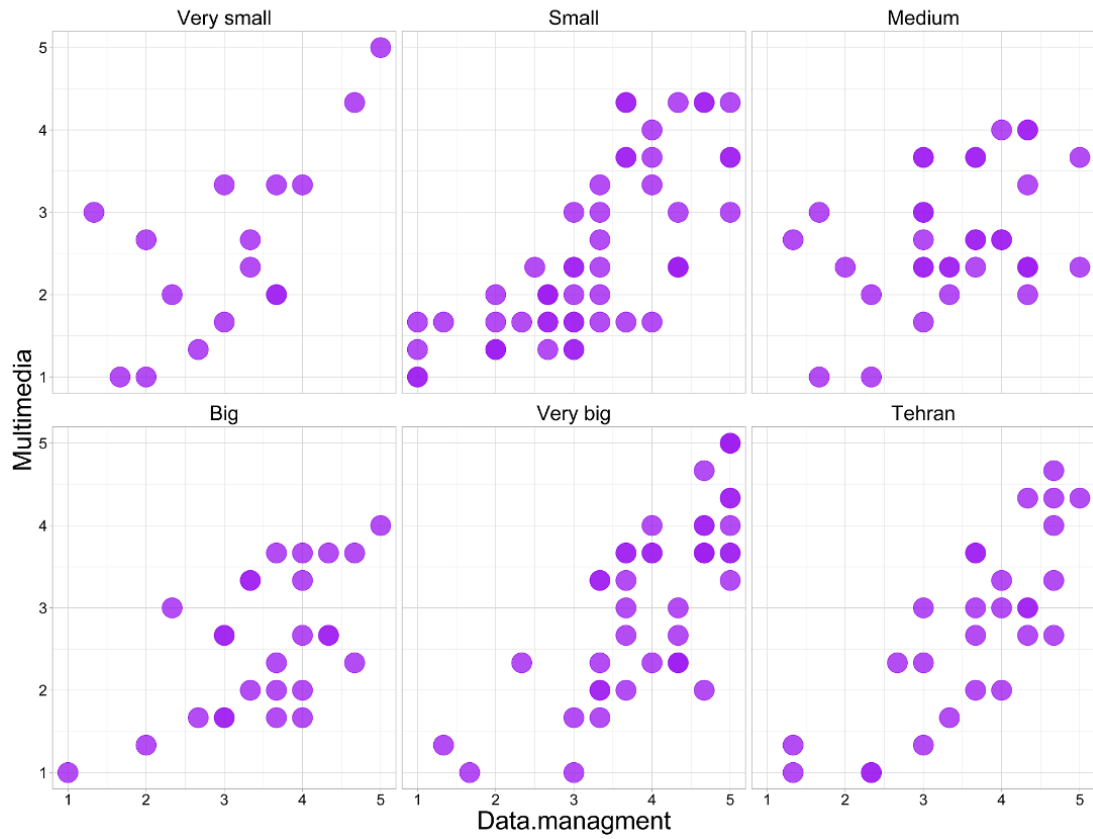


Fig.3.33. the level of Multimedia and Data management in Iran

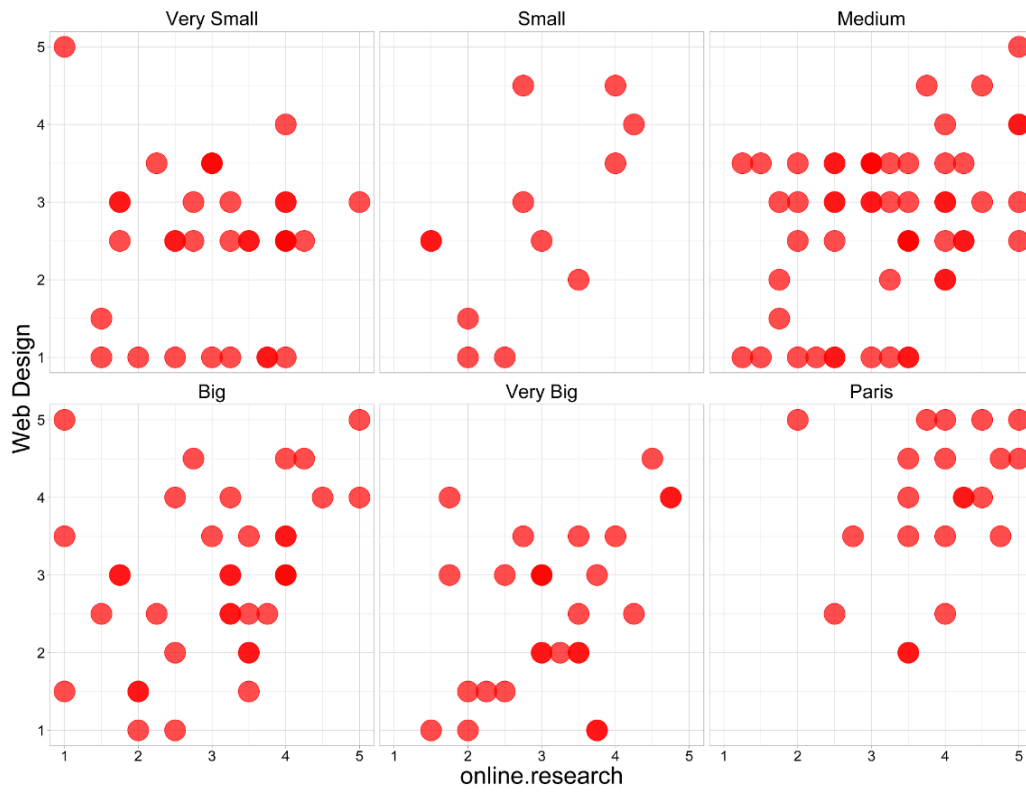


Fig.3.34. the level of Web Design and Online Research in France

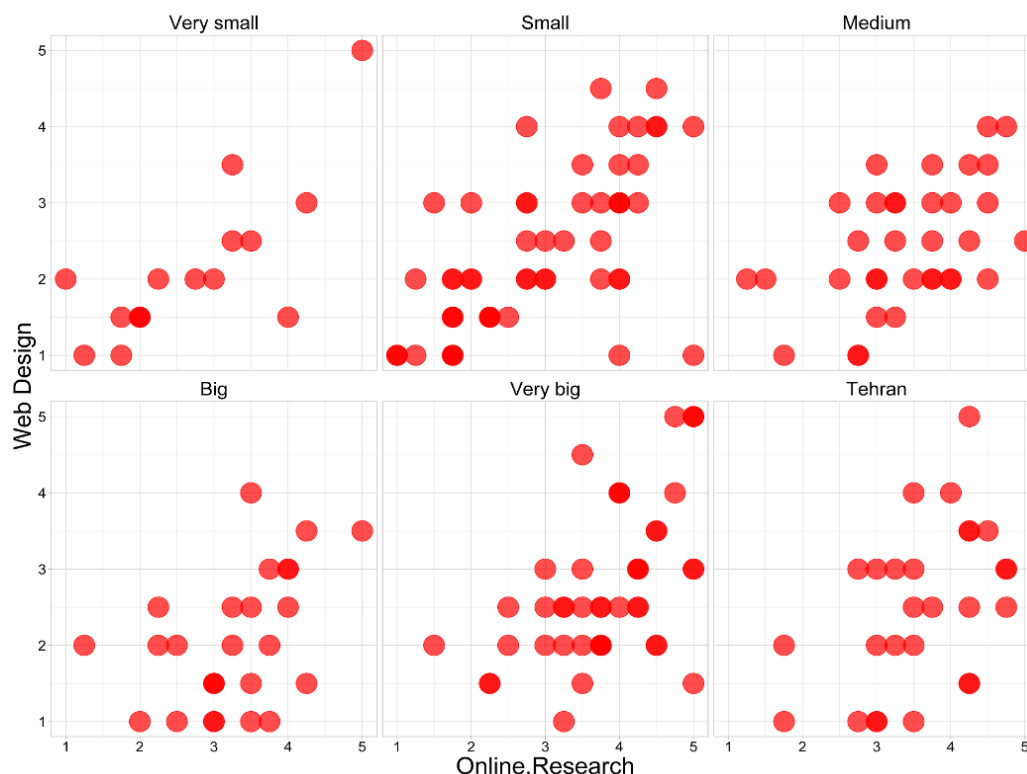


Fig.3.35. the level of Web Design and Online Research in Iran

According to the findings, there is a clear digital divide in terms of ICT level among cities, which occurs as a result of significant disparities in access to and use of ICT among cities and has also become a problem for regional development (Philip et al., 2017). Regional divergence, combined with technological disparities across regions, has resulted in a digital divide that has an ongoing impact on urbanization and leads to uneven urban development (Wang et al, 2021). In the information age, the digital divide is a barrier to healthy urbanization. Hence, expanding the positive effects of information and communication technology and closing the digital divide are critical issues that must be addressed as part of the urbanization process (Kono & Joshi, 2019; Pick & Azari, 2010). The digital divide can be narrowed if technological progress is inclusive of regional differences and cities fully utilize information and communication technologies to promote balanced development. This equilibrium can be achieved not only when the necessary ICT infrastructure exists, but also when urban residents are motivated to use this technology. This motivation can be generated by incorporating more ICT into daily life with socioeconomic goals, as well as by training in the necessary skills. Finally, both the individual and infrastructure levels, in which the government plays a role, contribute to closing the digital divide between cities.

The level of ICT in the companies where the respondents work is provided in the following step. The use of computers in companies was assessed to check if there are still some organizations that do not use a computer. So we may claim that 93.3 percent of companies in France and 85 percent of companies in Iran utilize computers (Table.7). Types of companies were examined to determine what kind of companies they are. Thus, In France, the type of companies that responded are working with, respectively are Small (31.2%), medium (29.6), and Large companies (15.6%), and in Iran, small (30.5), micro (29.2), and medium (20.2) companies (Table.8).

Table 3.6. Computer usage of Respondents in their Companies

France			Iran		
Variables	Frequency	Percent	Variables	Frequency	Percent
No Answer	16	3.8	No Answer	28	5.9
Yes	421	93.3	Yes	401	85.2
No	63	2.9	No	81	8.8
Total	500	100.0	Total	510	100.0

Table 3.7.Type of Companies that the Respondents work in

France			Iran		
Variables	Frequency	Percent	Variables	Frequency	Percent
No Answer	57	12.4	No Answer	20	3.0
Micro-C	47	11.3	Micro-C	159	29.2
Small-C	154	31.2	Small-C	154	30.5
Medium-C	168	29.6	Medium-C	98	20.0
Large-C	74	15.6	Large-C	79	17.3
Total	500	100.0	Total	510	100.0

Table 3.8. Access Internet in the Companies

France			Iran		
Variables	Frequency	Percent	Variables	Frequency	Percent
No Answer	68	14.5	No Answer	42	7.4
Yes	401	78.5	Yes	351	69.3
No	31	7.0	No	117	23.3
Total	500	100.0	Total	510	100.0

Table 3.9. Website for Companies

France			Iran		
Variables	Frequency	Percent	Variables	Frequency	Percent
No Answer	41	9.7	No Answer	36	6.9
Yes	400	79.0	Yes	327	63.4
No	59	11.3	No	147	29.7

Total	500	100.0	Total	510	100.0
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Table 3.10. Website Options

France		Iran	
Variables	Percent	Variables	Percent
No Answer	5.2	No Answer	12.9
LPO¹	15.6	LPO	17.5
All²	38.3	All	30.4
POL³	16.1	POL	10.9
DP⁴	9.1	DP	17.5
LP⁵	8.6	LP	5.4
D⁶	7.1	D	5.4

In addition, 78.5% of the companies in France and 69.3% of companies in Iran have Internet access (Table.8). In France, 79.0% have a website, whereas 63.4% in Iran have one. To see the options of the website, a question was asked to those whose companies have a website, and four items were shown to choose from (a. Description of goods or services, price lists; b. Online ordering or reservation or booking, e.g. shopping cart; c. Possibility for visitors to customize or design online goods or services; d. Links or references to the enterprise's social media profiles). All options are available on 38.3% of the websites in France and 30.4% of the websites in Iran (Table.10). According to the findings, French companies use ICT more than Iranian companies. The adoption and utilization of ICT are the basics of competitiveness and economic growth for companies who can benefit from them (Tarutè & Gatautis, 2014; Higon, 2011).

Following that, the role COVID-19 of the Covid epidemic in the use of ICT was examined. The COVID-19 epidemic prompted mobility constraints in 2020, forcing many businesses to increase or perhaps completely transition to digital technologies in order to continue operations. These extraordinary circumstances have highlighted, more than ever, the potential that digital tools hold for boosting their ICT abilities. Hence, six questions were given in order to examine

1 Links social media profiles; Possibility for visitors to design online services; online ordering or reservation.

2 Description of services; online ordering or reservation; Possibility for visitors to design online services; Links to the social media profiles.

3 Possibility for visitors to design online services; Links to social media profiles; online ordering or reservation.

4 Description of services; Possibility for visitors to design online services.

5 Links to the e social media profiles; Possibility for visitors to design online services.

6 Description of services.

the influence of the pandemic (Covid-19) in increasing ICT usage in the case studies. The following were the items: Increase the computer knowledge by using more computers. More computers in the company, more internet, more Social Media, and more personal Social Media knowledge (Fig.14 & Fig.15). According to the findings, the pandemic increased the use of ICT in both countries in the six categories indicated (Manco-Chavez et al., 2020). This point provided the first foundation for the growth and advancement of ICT awareness. The increased use of ICT following the pandemic demonstrated how important technology has become in comparison to the past. This establishes the foundation for a greater emphasis on ICT in the pursuit of a better and more sustainable future, as well as a decrease in the digital divide (Zaman et al., 2020; Manco-Chavez et al., 2020).

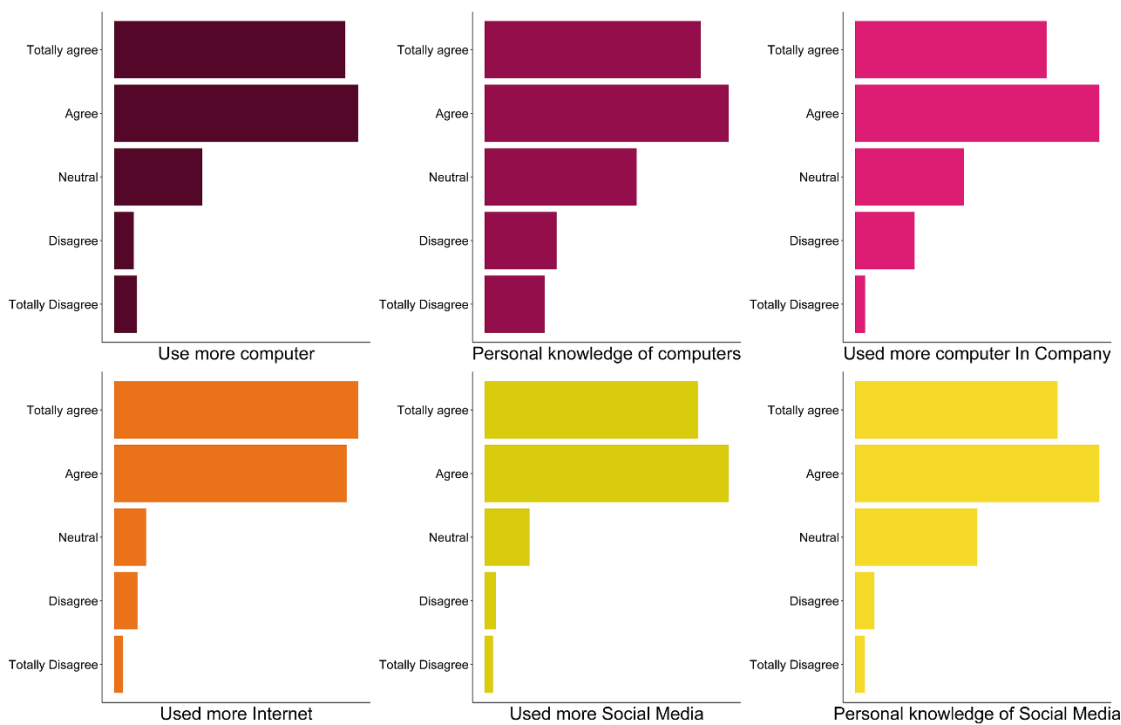


Fig.3.36. the pandemic (Covid-19 impact)'s on increasing ICT usage in France

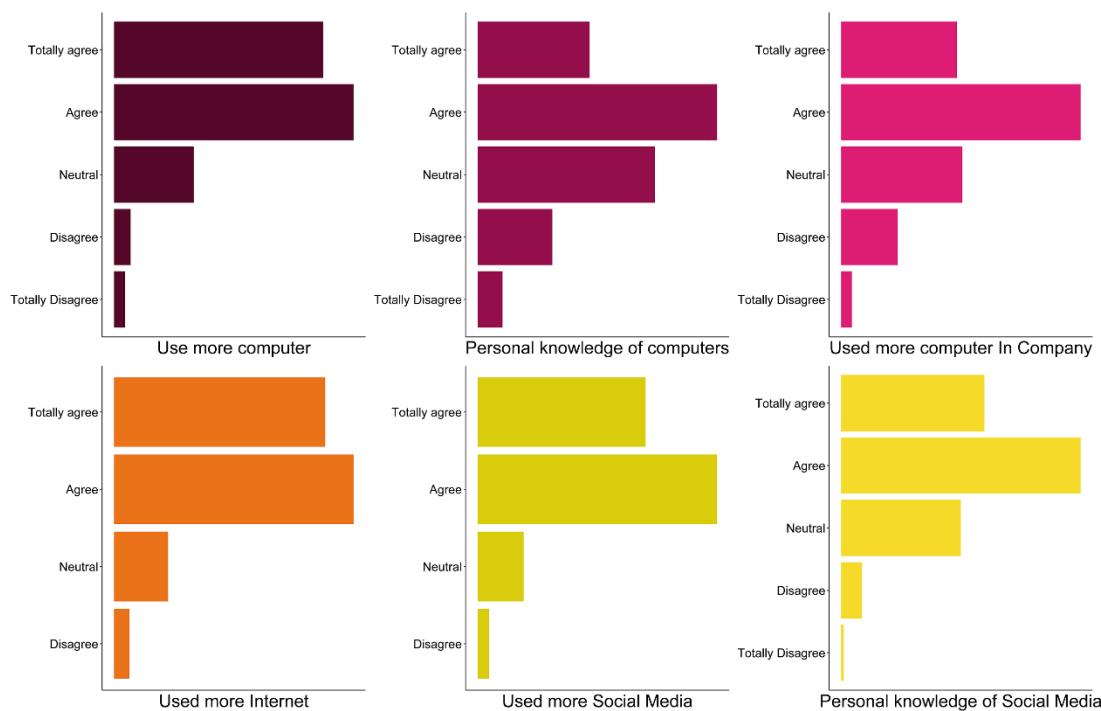


Fig.3.37. the pandemic (Covid-19impact) 's on increasing ICT usage in Iran

3.2.3.2. Spatial Statistics Analysis

Enabling spatial analysis and geospatial thinking skills is a critical component of digital city development. Hence, the spatial distribution patterns of Internet Access, Computer Skills, Social Media, E-Commerce, and Pandemic were visualized using IDW on ArcGIS 10.8. Fig. 38 and 39 demonstrate the spatial distribution of ICT levels in case studies from France and Iran (Ran et al., 2014; Yu et al., 2016; Solgi & Oshvandi, 2017). The IDW method assumes that the values of the unsampled points are more similar to the values of the closer sampled points (Haldar et al., 2020). Therefore, IDW not only performs spatial analysis on existing point data but also anticipates those that are neighboring. The areas representing the red color have a high value, the areas representing the blue color have a low value, and the other colors are the values in between these two. According to the findings (Figs. 15 and 16), the cities of Paris, Montpellier, Marseille, and Lyon, which all are in very large and large categories, ranked higher in terms of ICT than other places. Also, Tehran, Mashhad, Tabriz, and Shiraz which all are in very large and large categories as well, ranked higher in terms of ICT than other places (Yang et al., 2020; Gu et al., 2021; Wang et al., 2021).

Based on findings, not all cities profit equally from ICT. To create a balance between geographic location innovation, ICT development, and sustainability, and to move forward with digital cities, it is critical to raise the ICT level (Ania, 2017). Improved ICT infrastructure will have an influence on the environment, and digital cities may simply adopt technology

without considering citizens. As a result, knowing the degree of ICT makes it easier to adopt the technology in a city. For example, knowing how people use ICT and what their knowledge is about it gives urban planners and administrators ideas about the potential of each city (Deakin, 2014; Morelli et al., 2013; Maysoun et al., 2015; Bifulco, 2015; Ahvenniemi et al., 2017).

Accordingly, Cities are smart when future internet developments' ICTs successfully embed the networks society requires for them to not only generate intellectual capital or wealth, but also to cultivate the environmental capabilities, ecology, and vitality of the spaces in which the direct democracy of their participatory governance opens up adds value to, and constructs (Hojer & Wangel, 2015; Ania, 2017). Therefore, it can be said that there are connections between ICT, geographical locations, sustainability, and digital cities (Bifulco, 2015; Ahvenniemi et al., 2017; Ania, 2017; Maysoun et al., 2015; Bifulco, 2015; Larrinaga et al., 2021).

Based on the data visualizations, the discrepancies between small and large cities are higher in Iran than in France. ICTs have the ability to accelerate the transition to more sustainable cities and decrease technological disparities between geographic locations in Iran and France. However, the approach to digital city implementation is primarily top-down, and there is no defined mechanism for transforming traditional urban administration into new governance based on urban technology (Moser et al., 2015). A structure that incorporates both top-down and bottom-up actions may encourage successful digital city deployment (Breuer et al., 2014; Capdevila & Zarlenga, 2015).

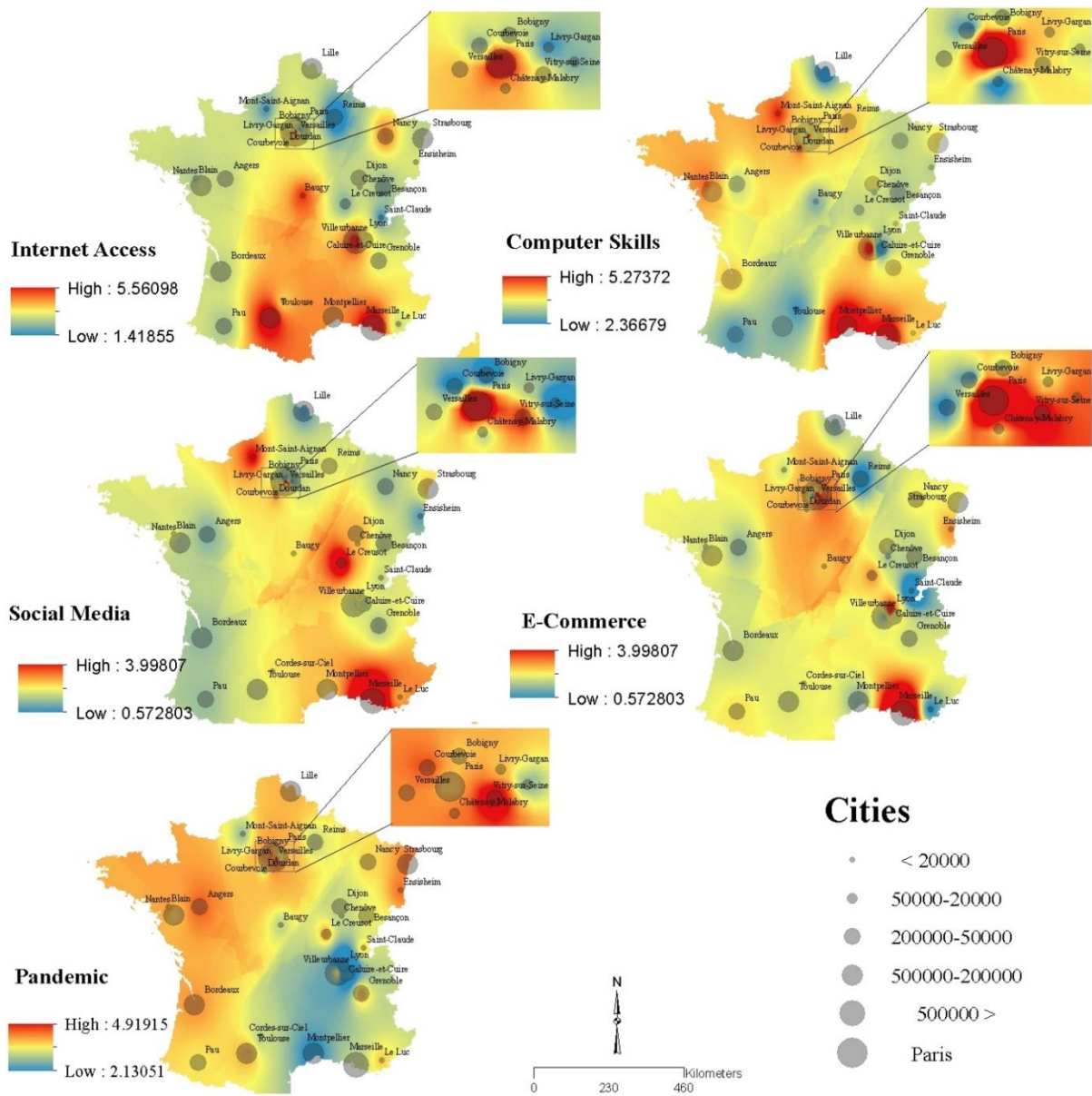


Fig.3.38. the spatial distribution patterns of ICT in France

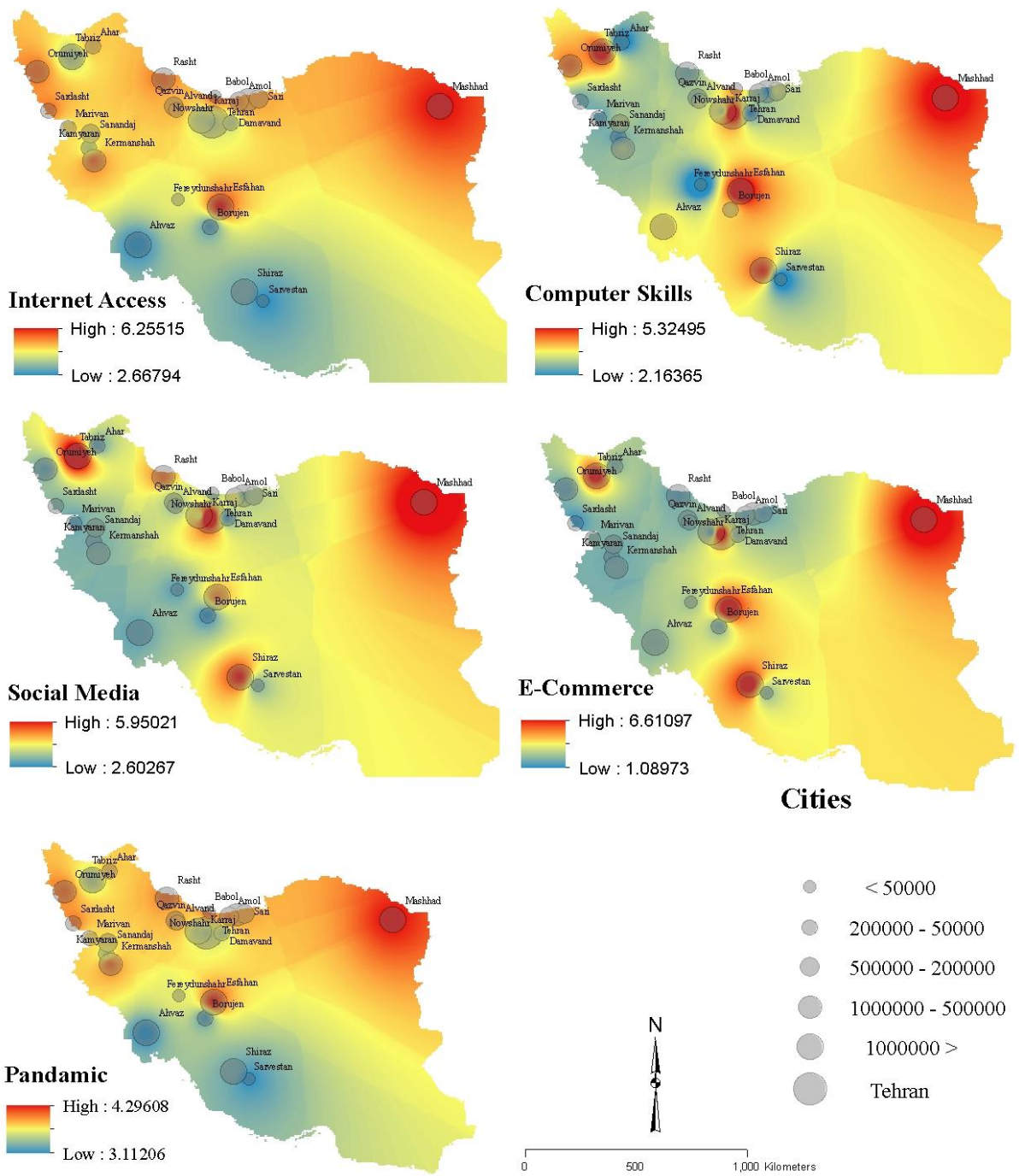


Fig.3.39. the spatial distribution patterns of ICT in France

3.2.4. ICT and Sustainable development

Q3. What is the relationship between sustainable development and ICT to reach urban ecovillage communities?

The third question will be examined in this section. The first stage of this question is to assess the role of ICT in sustainable development, followed by a spatial analysis of their relationship based on the studied areas in order to reach urban ecovillage communities.

2.3.4.1. ICT's impact on sustainable development

In this section, the impact of ICT on the studied indicators will be examined first, and then in relation to urban areas. Given that a conceptual framework for an analytical approach to the relationship between ICT and sustainable development must first analyze the normative concept of sustainable development, this is a necessary first step. The so-called three-pillar or three-dimensional approach to sustainable development, which divides the concept into environmental, social, and economic dimensions, is a common idea. Each of these dimensions will be examined in turn. The one-sample T-test was used in the first step to compare the Mean of the desired dimensions. According to the T-test results, ICT has had a positive impact on environmental sustainability. The acceptable limit of the average in this test is defined as 3.00, indicating that ICT has a significant impact on all dimensions of sustainable development in Iran and France. More specifically, residents in France and Iran believe it has played the most significant role in the environmental dimension (Table 12).

Table 3.11. The impact of ICT on environmental sustainability

The Variables	France				Iran			
	Mean	Standard deviation	Index T	Sig	Mean	Standard deviation	Index T	Sig
Economic	3.3010	.87104	7.726	.000	4.3429	.47789	63.461	.000
Social	3.6068	.84180	16.119	.000	4.3337	.56468	53.341	.000
Environmental	3.6148	1.13424	12.119	.000	4.3454	.58885	51.597	.000

If we want to evaluate and separate the studied indicators more precisely, residents in France believe that ICT has the greatest impact in "improving product quality," "communication with customers," "cultural institutionalization of technology in business," and "cost reduction." In general, ICT can improve product quality and customer communication by combining new economic methods and models with new technologies. Therefore, given the challenges of global market competition among companies in the twenty-first century, it is becoming increasingly important to use knowledge, skills, and resources obtained from partners in improving product quality and expanding customer relationships (Arsovski et al., 2016). Finally, one of the most important first steps toward achieving sustainable development is the institutionalization of ICT use in businesses, as well as its acceptance by the government and the nation as an important factor in development (Wang, 2018). This role can improve the quality of the production process and, as a consequence, customer satisfaction; it also broadens the scope of customer communication.

Residents in Iran believe that the greatest impact is on "growing business-to-business partnerships," "finding new businesses," "increasing productivity," "communicating with successful entrepreneurs," and "improving product quality" (Fig. 40 & 41). Increasing corporate collaboration with the help of ICT can consequence in both economic and sustainable development (Bilan et al., 2019). This issue becomes the foundation for international cooperation and the creation of new job opportunities, particularly with successful people and entrepreneurs in this field (Garca Alonso & Samy, 2018). In general, ICT received greater attention in the economic dimension in Iran than in France (Fig. 40 & 41).

Residents in France believe that ICT plays a greater role in "solidarity and cooperation," "technical knowledge", "learning new skills," and "cooperation with other regions" in the social dimension. ICT has had the greatest impact in Iran in terms of "raising awareness," "creative and innovative ideas," and "technical knowledge" (Fig. 42 & 43). For this reason, the role of ICT is critical in moving toward more strategic and integrated national information, communication, and educational policies. which can be used not only to increase knowledge and awareness but also to eliminate participation inequalities and the digital divide in society (Carrión-Martínez et al., 2020; Nevado-Peña et al., 2019). These findings demonstrate the importance of ICT in promoting learning, participation, and cooperation in order to achieve sustainable development (Kim, 2018).

In terms of the environment, French respondents believe that ICT plays the most important role in "saving energy," "improving waste management," and "advanced technologies to reduce pollution." While in Iran, the indicators influenced by ICT were "environmental awareness," "care more about climate change," and "commitment to the environment". On the basis of the available data, it can be inferred that the social dimension in France exhibits a comparatively higher degree of emphasis on ICT than in Iran (Fig. 44 & 45). The findings of this section show that ICT plays an important role in reducing negative environmental effects. The use of ICT can increase the construction of suitable buildings with the goal of reducing energy consumption. It raises people's awareness of the need to change their lifestyles and take appropriate environmental measures (Santarius et al., 2020; Wu et al., 2018; Rothe, 2020; Kendall & Dearden, 2020).

The broad scope of the potential of using information and communication technology to support various areas of sustainable development, such as economic empowerment, raising awareness, e-government, or environmental sustainability, demonstrates that in order to

achieve sustainable development, the role of ICT in all three social dimensions, as well as economically and environmentally, is required (Heeks, 2018; Thapa & Saeb, 2014).

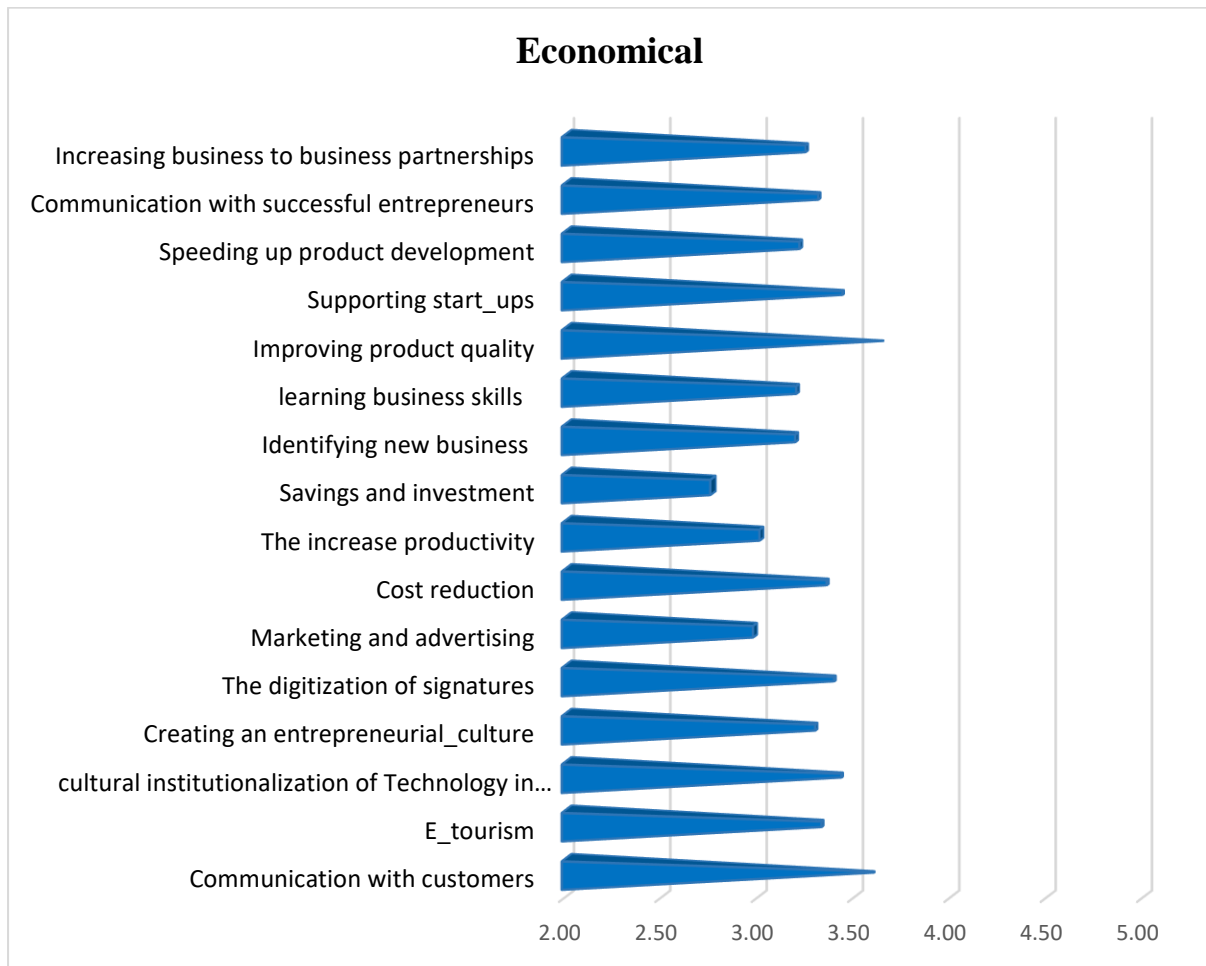


Fig.3.40. The impact of ICT in the Economic Dimension in France

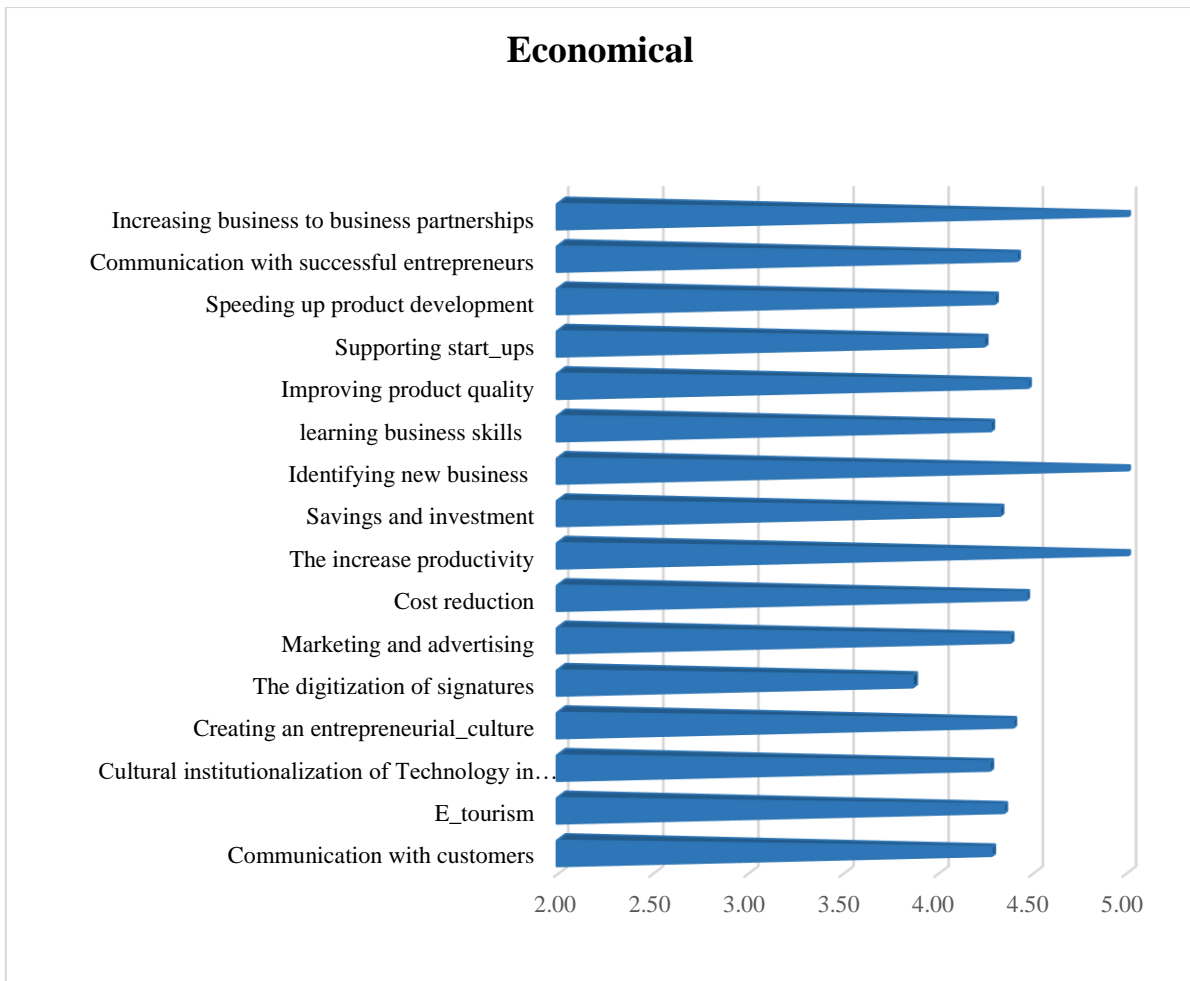


Fig.3.41. The impact of ICT in the Economic Dimension in Iran

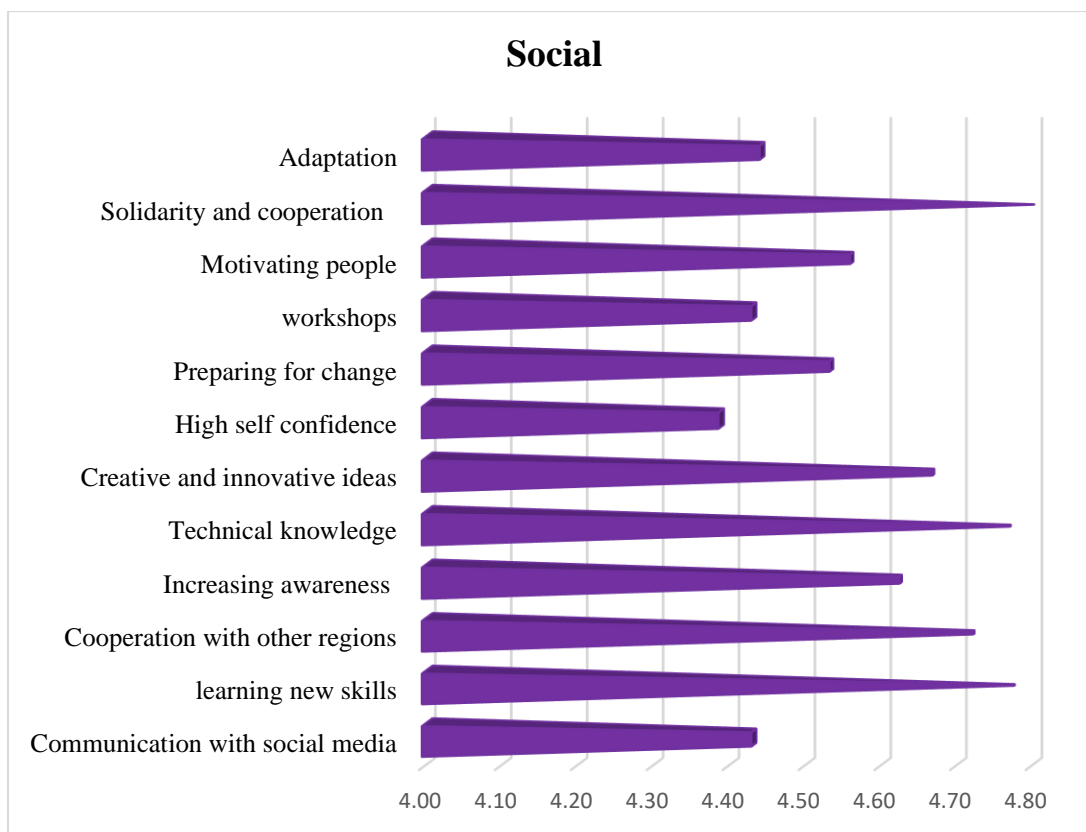


Fig.3.42. The impact of ICT in the Social Dimension in France

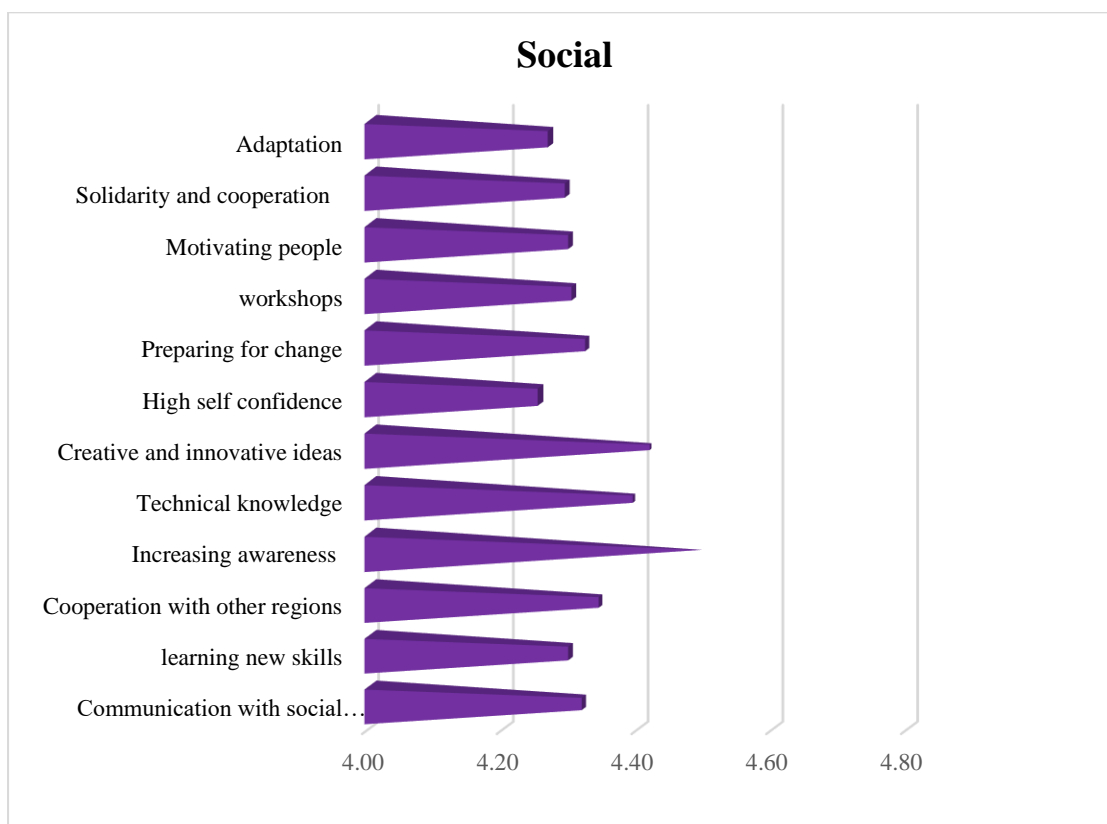


Fig.3.43. The impact of ICT in the Social Dimension in Iran

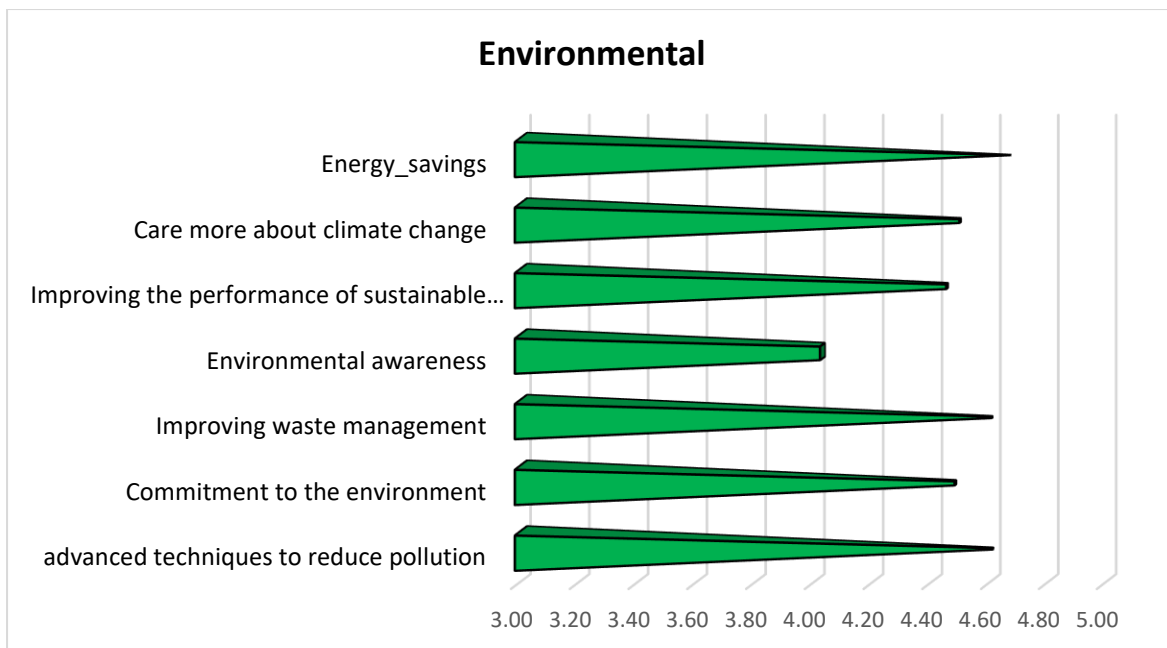


Fig.3.44. The impact of ICT in the Environmental Dimension in France

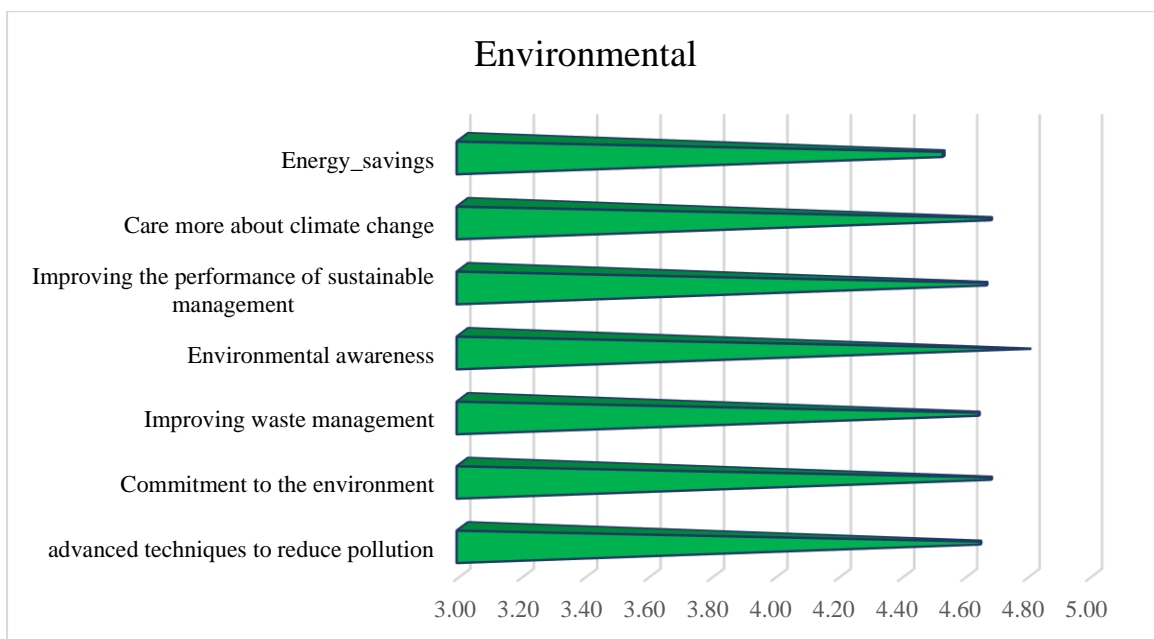


Fig.3.45. The impact of ICT in the Environmental Dimension in Iran

We can better understand the data and its distribution by using a boxplot, which allows us to see the nature of our data at a glance. For this reason, the boxplots were used to analyze the role of ICT in environmental sustainability in relation to the classification of the cities studied. All cities in Iran, classified in all three socioeconomic and environmental dimensions, place a high value on the role of ICT in environmental sustainability. More specifically, in economic, social, and environmental terms, Tehran and medium-sized cities have prioritized this role over

other cities. Similarly, in France, with the exception that the city of Paris and small towns have prioritized this role over other cities. Residents in small and large cities, as well as in France and Iran, have a positive attitude toward the role of ICT in the economic, social, and environmental dimensions of sustainable development, according to the findings. This issue demonstrates that cities of all sizes require ICT infrastructure in order to prosper (Fig, 3.46 & 3.47). Rising urbanization and awareness of sustainability issues have sparked a wave of investment in revitalizing existing cities and developing new ones (Santarius et al., 2020). However, given the magnitude of the problem, simply throwing more money at it is not the solution; instead, the world requires a new operating model that meets the needs of urban dwellers in an economically, socially inclusive, and environmentally sustainable manner (Chatti & Majeed, 2022). Businesses and governments are beginning to recognize the importance of technology in achieving these objectives. Urban investments with a significant ICT component can enable the design of smarter cities that improve the quality of life for their residents while being more sustainable and cost-effective (Barns, 2019; Anenberg & Kung, 2015). This trend benefits more than just residents. Governments can achieve their objectives more quickly and cheaply, while ICT players are on the verge of entering a completely new market. To play and win in this uncharted territory, these stakeholders must adopt a new operating paradigm (Tranos & M. Ioannides, 2020).

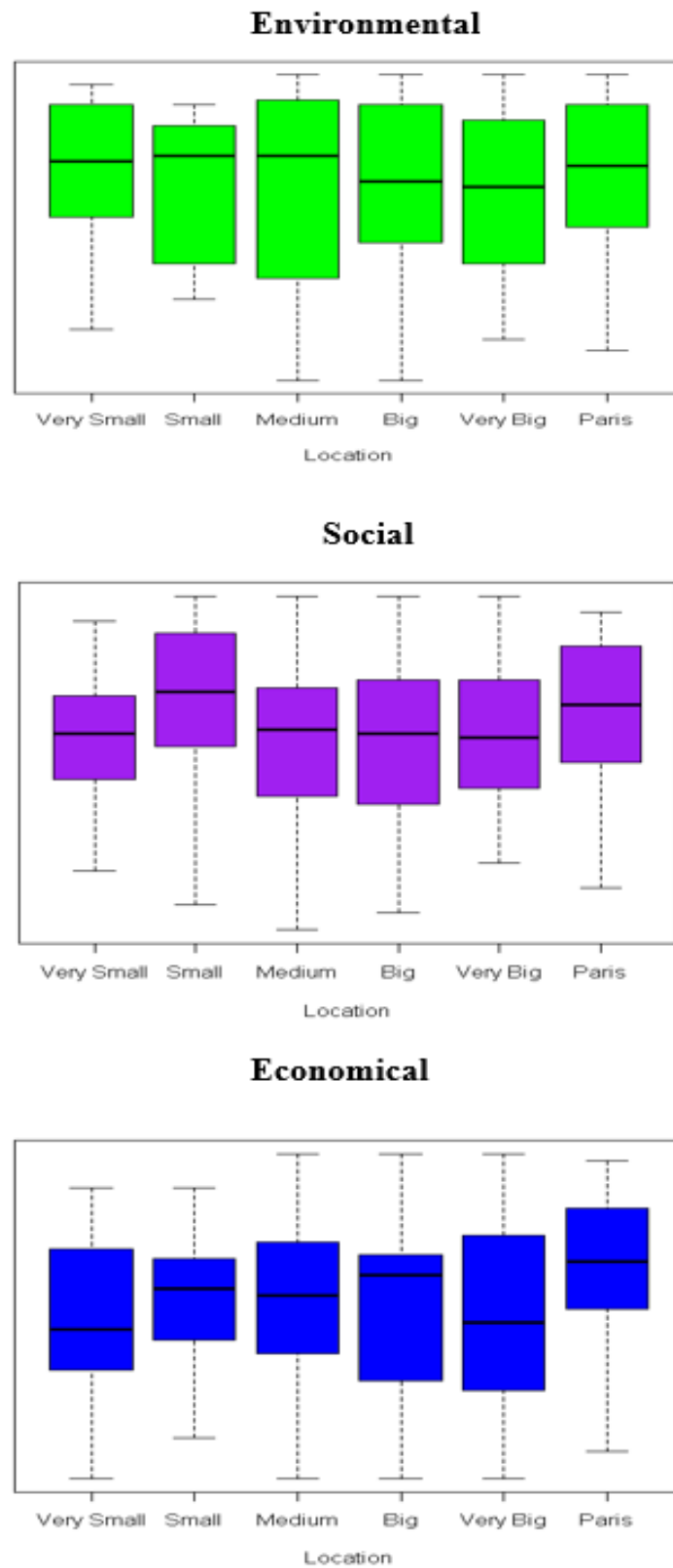


Fig.3.46. The impact of ICT on Environment Sustainability in France

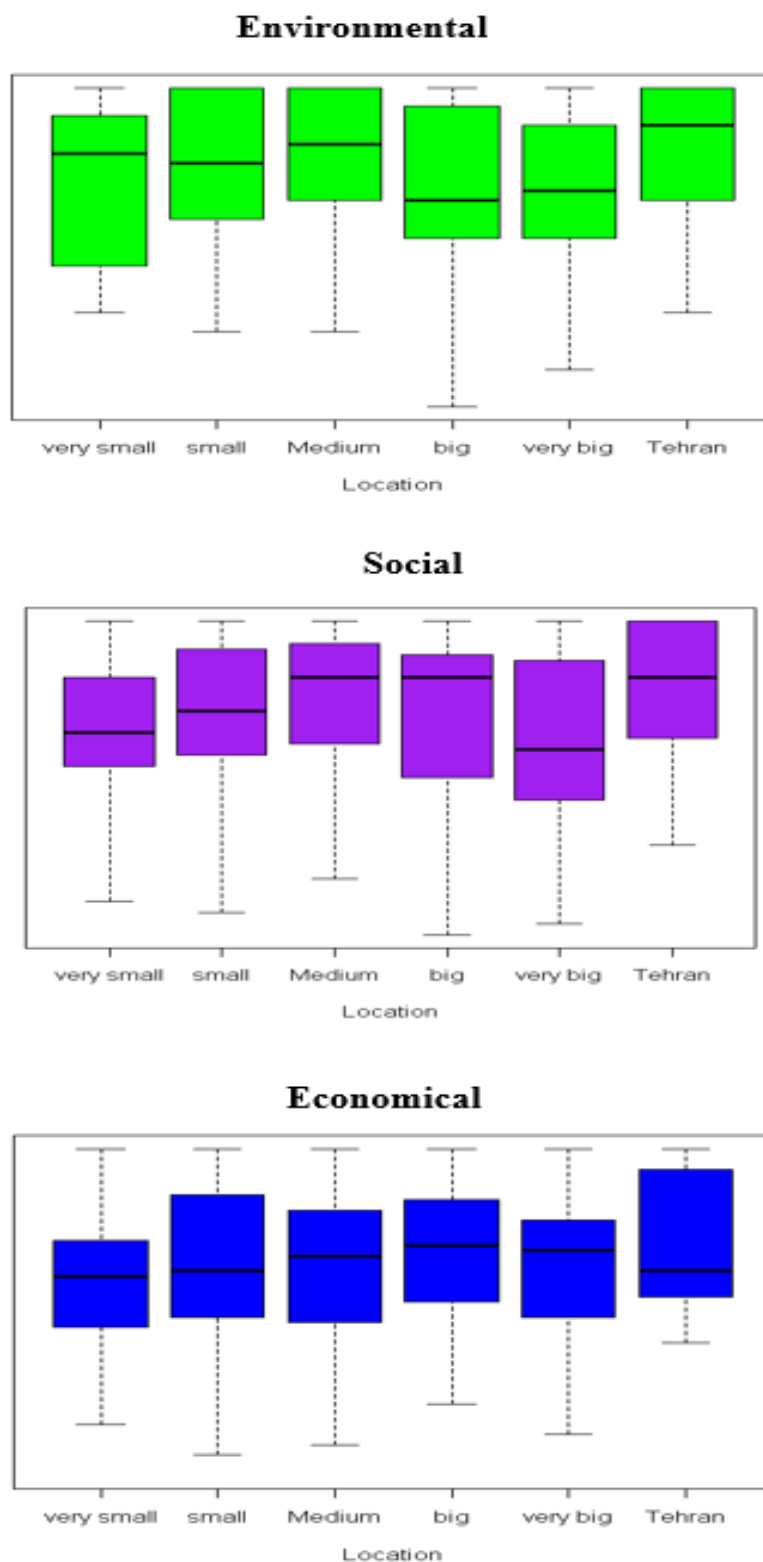


Fig.3.47. The impact of ICT on Environment Sustainability in Iran

2.3.4.2. The spatial relationship between ICT and Sustainable Development

Up to this point, the impact of ICT on the dimensions of sustainable development was investigated and measured. This section discusses the spatial analysis of the relationship

between ICT and its independent variables (economic, social, and environmental) in the cities studied. To be clear, do cities close to each other have the same opinion on the variables under consideration or do they have different opinions?

The OLS model was used to diagnose multicollinearity among ICT and the independent variables. OLS describes the process and provides a global model for the dependent variable. The term "global" refers to the application of a single regression equation to represent a process to all of the features in the case study, assuming that relationships are fixed. Therefore I examined the OLS summary, which includes various diagnostics such as how well the model is performing and how each independent variable aids the model. After performing the OLS, we must ensure that the model passes six checks. A model is properly specified if it passes six checks. These checks are for expected coefficient relationships, and each independent variable is statistically significant. Residuals should not be clustered in locations or values, all VIF values should be less than 7.5, the Jarque-Bera test should be used to ensure that residuals are normally distributed, and model performance should be evaluated (Zhu et al., 2020; Daniel Cardozo et al., 2012; Khormi & Kumar, 2011).

Table 3.12. Summary of global OLS results

Variables	Coefficients value	Std. Error	t-statistic	Probability (P-value)	VIF
France					
Intercept	1.754818	0.407169	4.309797	0.000152*	-----
Economic	0.217503	0.093809	2.318578	0.027185*	1.426883
Social	0.229445	0.097313	2.357819	0.024875*	1.238972
Environmental	0.488126	0.063403	7.698726	0.000000*	1.671220
Iran					
Intercept	1.911462	1.313864	0.693726	0.005457*	----
Economic	0.373646	0.028623	1.634333	0.017090*	1.238046
Social	0.142982	0.096204	0.728741	0.074210*	1.105192
Environmental	0.260798	0.058075	1.649845	0.013852*	1.234968

Table 3.13. OLS diagnostics statistics

Parameters	Values	P-value
France		
Joint F-statistic	39.142413	0.000000*
Joint wald statistic	105.484378	0.000000*
Koenker (BP) Statistic	0.233392	0.009720*
Jarque-Bera Statistic	0.209153	0.000706*
Iran		
Joint F-statistic	11.777330	0.001823*
Joint wald statistic	17.636922	0.005414*
Koenker (BP) Statistic	0.208337	0.009762*
Jarque-Bera Statistic	0.699419	0.006893*

France: R2 Adjusted = 0.770932; AIC = 33.376037, **Iran:** R2 Adjusted = 0.628561; AIC = 44.798655; *Significant Parameter at 0.05 level.

According to the above results, the model passed all six checks and is a good model for performing the GWR. For example, Table 13 shows that all predictors returned VIF values that were slightly greater than 1.0 but less than 7.5, indicating that none of the variables are

redundant. Furthermore, Moran's I tool-based Figures 48 and 49 show that residuals are not clustered or spatially autocorrelated. Misspecification, or using the incorrect type of regression model, can result in statistically significant spatial autocorrelation (Table 13). The Jarque-Bera Statistic demonstrates that the model has normally distributed residuals (Kashki et al., 2021; Hosseinkhah et al., 2016).

To view the model's performance The adjusted R-squared must be checked. The adjusted R-squared statistic is derived from the regression equation and is used to quantify model performance (how well independent variables model dependent variables). The percentage of variance in the dependent variable explained by variance in the independent variables is expressed as adjusted R-squared. Akaike's Information Criterion (AIC) is a statistic that estimates the relative quality of a statistical model for data and can be used to compare multiple models that use the same dependent variable. A better model has a higher adjusted R-squared value and a lower AIC value for the same dependent variable in different models. According to Table 14, R2 Adjusted in France and Iran are 0.77 and 0.68, respectively, and AIC are 33.37 and 44.79 (Hassaan et al., 2021; Ndid Nkeki & Beecroft Osirike, 2013).

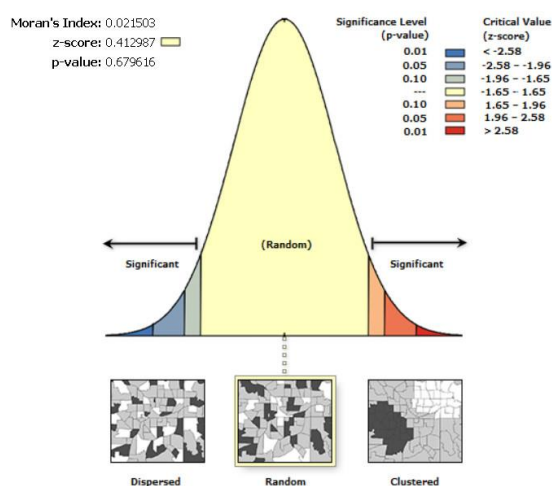


Fig3.48. Residuals distribution in France

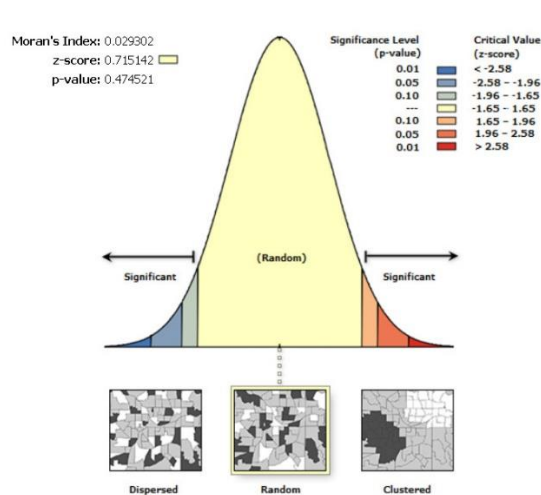


Fig.3.49. Residuals distribution in Iran

Figures 50 and 51 show the Regression Model's standard residuals (First row maps) and Local R2 (Second row maps). The standard residuals predict a difference between predicted and observed ICT. As you can see, both countries are randomly distributed, which is good because it means all factors have been considered. In other words, it indicates that the model is not biased, whereas the red areas indicate that there is a significant difference between the predicted and observed variables. As a result, it is the overestimated area. The blue areas are those that were not predicted. Furthermore, mapping the GWR residuals indicates that it is randomly distributed. This indicates that the model has been properly specified (Kashki et al., 2021).

These figures also depict the R2 value as a spatial smoothing of the GWR model, indicating the states where the model's prediction and relationship strength are improved. R2 measures the proportion of variation in the dependent variable that is accounted for by model variation, with possible values ranging from 0 to 1 (Wu, 2020). The case studies show significant regional variation. The R2 values for France and Iran are 0.79 and 0.67 (Table 15), respectively,

indicating a strong significant relationship between ICT and sustainability dimensions. As expected, the GWR model improved the explaining power of the OLS model (Sajjad et al., 2022; Zhu et al., 2020, Gelebo et al., 2022).

Table 3.14. Model Fit

Variables	France		Iran	
	GWR	OLS	GWR	OLS
ALCc	32.37700	33.376037	43.4368	44.798655
R2	0.7959	0.770932	0.6763	0.63256
R2 Adjusted	0.7855	0.741361	0.6416	0.628561

This pattern indicates that the relationship is undergoing local fluctuation. However, the best fit in France for the Economic and Environmental dimensions was found in the group of Cities located in the East and Southeast, and for the Social dimension in the North and Northeast. All dimensions were discovered in Iran in a group of cities located in the northwestern part of the country. In other words, these cities have a meaningful relationship and a stronger correlation than other cities based on the specified repetitions (Ndidi Nkeki & Beecroft Osirike, 2013).

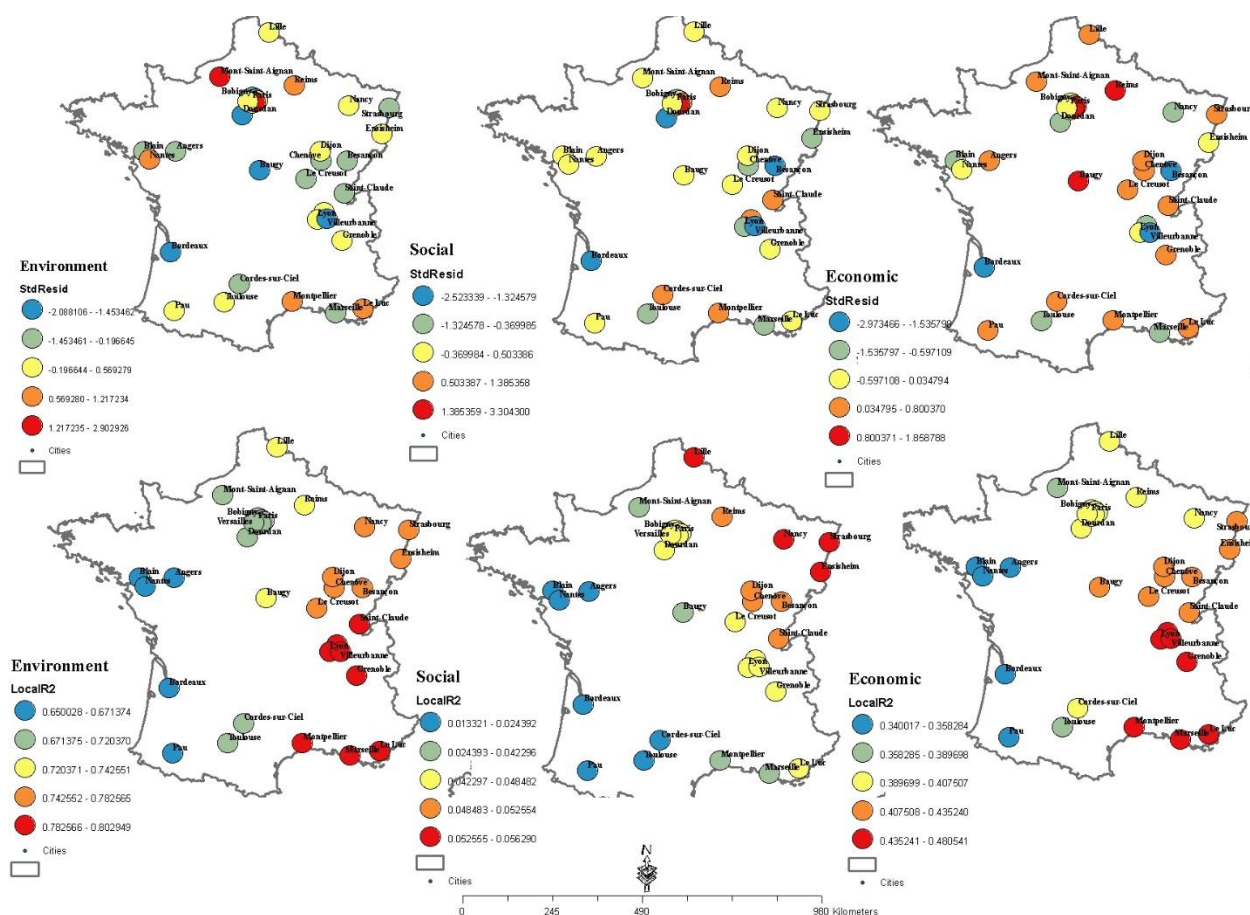


Fig.3.50. Standard residuals and Local R2 of the Model

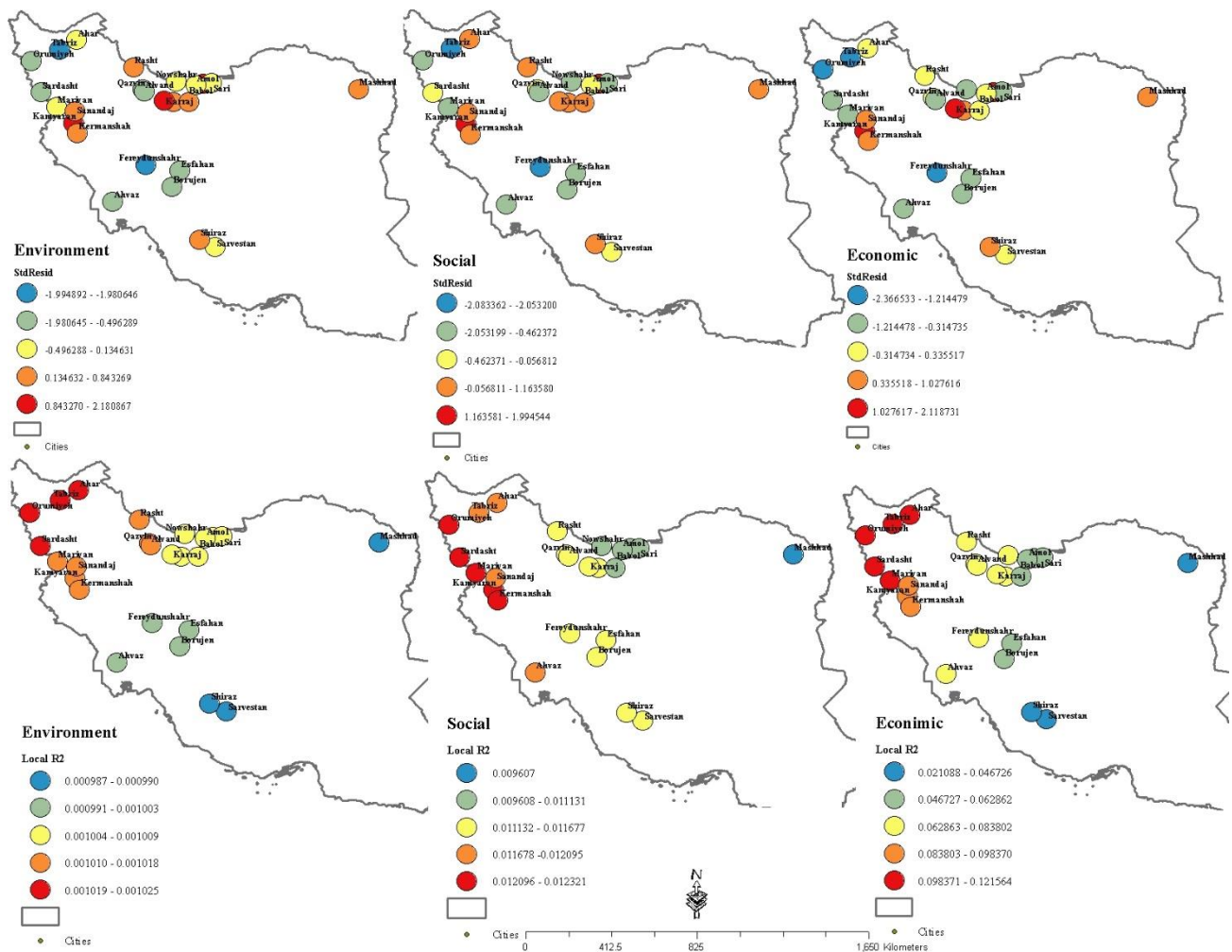


Fig.3.51. Standard residuals and Local R2 of the Model

3.3. Qualitative Findings

This section analyzes and examines the fourth, fifth, and sixth research questions using qualitative data and MAXQDA software. The fourth and fifth questions are based on villagers' interviews, while the sixth question is based on ecovillages' interviews. During the analysis process, four-step qualitative data analysis strategies (Yıldırım & Şimşek, 2008) were used. The first step involved identifying codes “meaning units” from the participants’ answers to the questions in the interview form. The codes were arranged by clustering similar ones into a category or theme and separating dissimilar ones to create distinct categories (Karasar, 2012). In the second step, the meaning unit codes were sorted and placed in their emergent categories, and the categories were analyzed for themes or patterns. In step three, the categories were

examined for meaning and interpretation. In step four, a diagram was constructed to illustrate the codes and themes found in the data (Marjaei et al., 2019).

This section's findings are based on 51 interviews with participants, 40 from traditional villages and 11 from Ecovillages. To see how traditional villages can be transformed into eco-friendly communities. In addition, whether an ecovillage can help the villages studied to have more sustainable businesses (green businesses). Finally, the current ecovillages' commitment and responsibility for a sustainable future. Several steps were involved in qualitative analysis using MAXQUDA, including data recording, transcription, reading and rereading, memo writing, coding, identifying themes, grouping codes, and mapping and visualizing the results.

The main codes extracted from traditional village interviews were classified as economic, social, cultural, environmental, and technological dimensions, rural activities, State support, suggestions and solutions, and regional weaknesses. According to the codes extracted from the interviews and the nature of the questions, the main codes in the ecovillages' interviews were divided into technological, transformational, ecological, social, why ecovillage, difficulties of ecovillage, and economic spaces.

3.3.1. Traditional villages to Ecovillage

Q4. How can traditional villages transform into ecovillage and adopt ecovillage lifestyles?

The fourth question will be examined in this section. First, the complete set of interview data (from Iran and France) is examined, and the existing codes are examined in order to respond to this question. The interviews will then be examined separately for Iran and France in the following stage.

The cloud code tool was used to compare the interview results of Iranian and French villages in one glance. The most important code, according to figure 50, has been saving natural resources and energy. Moreover, among the most important codes that have been repeatedly repeated in the interviews are solidarity, biodiversity conservation, waste management, Increasing awareness, green entrepreneurship, creating job opportunities, energy consumption, green buildings, educational workshops, and so on.



Fig.3.52. Code Cloud of all documents

Therefore, the results are analyzed using the aforementioned classifications. The MaxMap tool was used for this purpose, which analyzes the codes of the subset in relation to the desired dimension. The thickness of the link between the main code and the subset code, which represents its weight or frequency, can be used to determine its significance. It can also be seen next to each subcode of the country and village where the subcode is most frequently repeated.

Economic: There is no denying the significance of the economic aspect in transforming traditional villages into ecovillages. In interviews conducted in villages, they spoke extensively about this. In terms of economic codes and subcategory codes, entrepreneurship, self-sufficiency, local economy, development of the tourism industry, small businesses, competitive and innovative economies, and women's empowerment codes received a lot of attention in the interviews (Fig 51). Given human beings' inherent proclivity for welfare and ongoing efforts to improve their economic situation in life, it is possible to use and develop some strategies to support local economies and achieve self-sufficiency in local communities. Using local products is one way to reduce a community's environmental impact and increase its self-efficacy (Loezer, 2011; Couchman, 2010). Localization of essential needs will strengthen the community's resilience to natural disasters and other unexpected events. On the other hand, it can save energy and resources needed for mechanized farming, transportation, and packaging, increase local employment opportunities, and reduce the need for imports and services to

ecovillages (Loezer, 2011; Vidickiene, 2013; Sherry, 2014). Strengthening local markets, as well as creating and improving local cooperation, can have an impact on economic empowerment and self-esteem in ecovillages (Bridger, 2001; Winston, 2012; Ardzijauskaite, 2009).

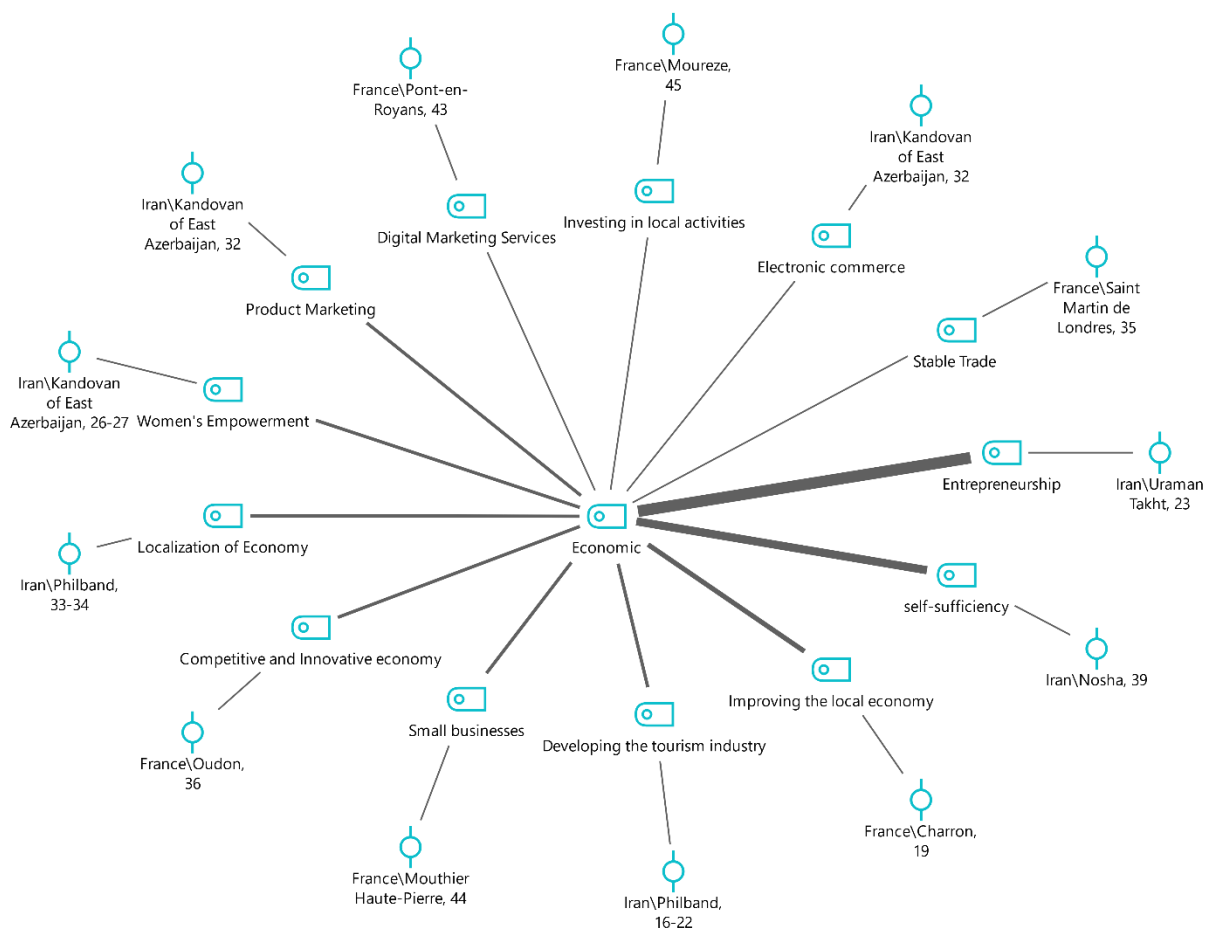


Fig.3. 53. Economic - Code-Sub codes-Segments Model

Social: One of the most important aspects of having an ecovillage is social capital. Because an ecovillage could indeed exist without community cohesion and solidarity in achieving a common goal. According to villagers, solidarity between communities, increasing people's awareness about a sustainable lifestyle, increasing communication between people and the rest of the world, increasing local cooperation, particularly between people and local rulers, using a collaborative approach in research projects in this Context, teaching to improve sustainable behaviors, such as changing individual behaviors towards sensitive ecosystems and the environment and how each person is responsible for nature, the flexibility, responsibility, and motivation are all important (Fig. 52). Thus, ecovillages create frameworks in which appropriate sustainable behaviors are expected to adhere to their communities' sustainability values. Participants all agreed that their community engages in activities centered on social

values with the goal of sustainability, such as creating community gardens and central halls (for meetings, dance, and music) that are open to the entire community. Collectivism strongly connects sustainability practices and values among ecovillages and is viewed as a means to disrupt individualistic ideals by community members. Residents expressed these values in interviews as a way to challenge the status quo, a capitalist system based on growth and exploitation (Temper et al., 2018, Caglar & Ulug, 2022). Finally, widespread participation of village members in these new practices (with their symbols, materials, merits, and social norms) contributes to the formation of this new structure and establishes new reproduction circuits that determine the path of activities toward sustainability and ecovillages (Roysen & Mertens, 2019).

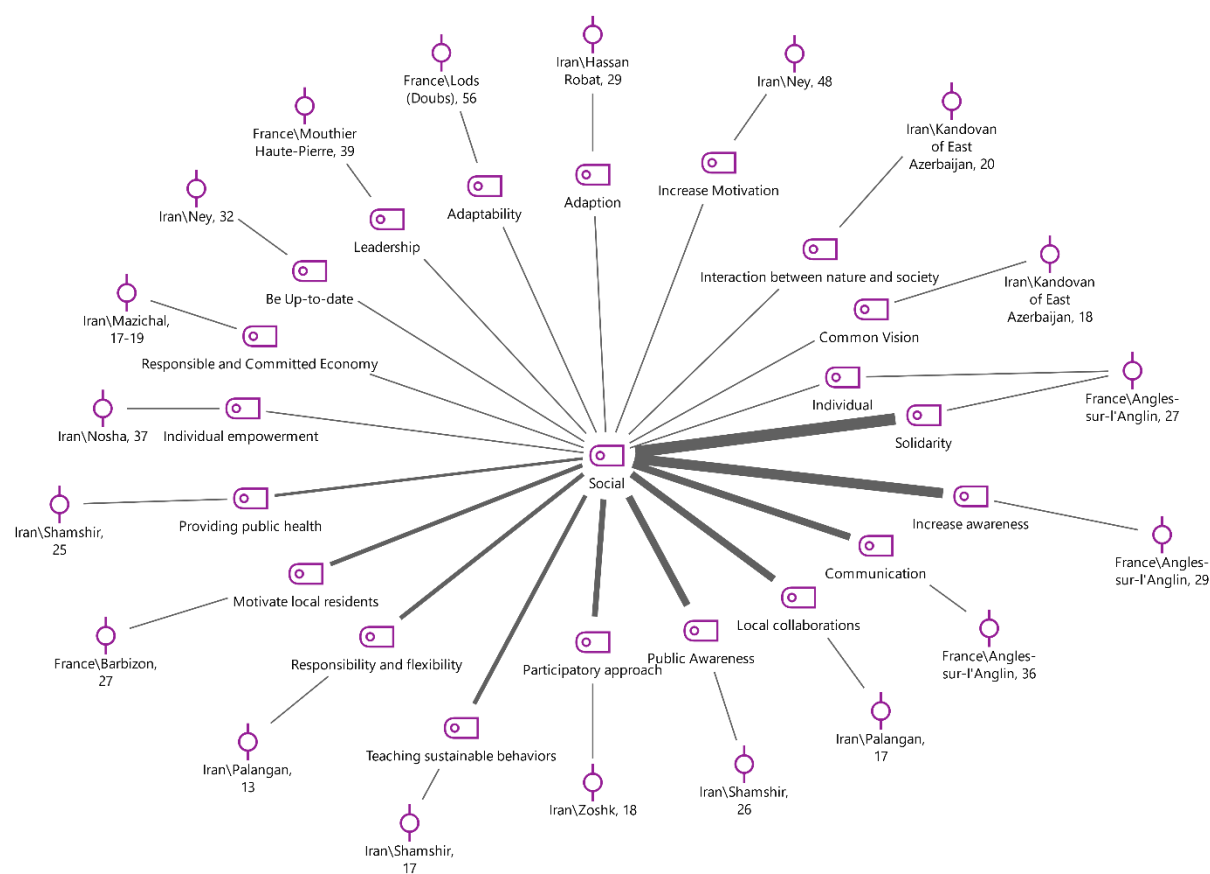


Fig.3.54. Social - Code-Sub codes-Segments Model

Ecological: The ecological codes with the highest frequency among the participating villagers are shown in Figure 53. The interviewees most frequently cited saving natural resources and energy, energy consumption, waste management, conservation of biodiversity, organic farming, green construction, and eco-responsible construction. For various reasons, saving energy can be considered a transferable strategy. When the environmental design approach is

based on protecting the environment and reducing energy consumption in the village, the behavior follows the harmony and compatibility with the environment unconsciously. Finally, since it reduces costs, saving energy and resources is usually considered acceptable behavior. As a result, ecovillages' lifestyles should be defined in such a way that they are compatible with minimum consumption and income requirements (Zamchevska, 2013; Simon Brown & Maser, 2010; Barani et al., 2018). Furthermore, organic agriculture and green techniques in the villages studied can have a significant impact on production and economic empowerment. Besides that, Waste and scrap management, and water and wastewater management are considered among other transferable strategies in this meta-analysis (Boyer, 2013; Zamchevska, 2013; Palojarvi et al. 2013; Sherry, 2014).

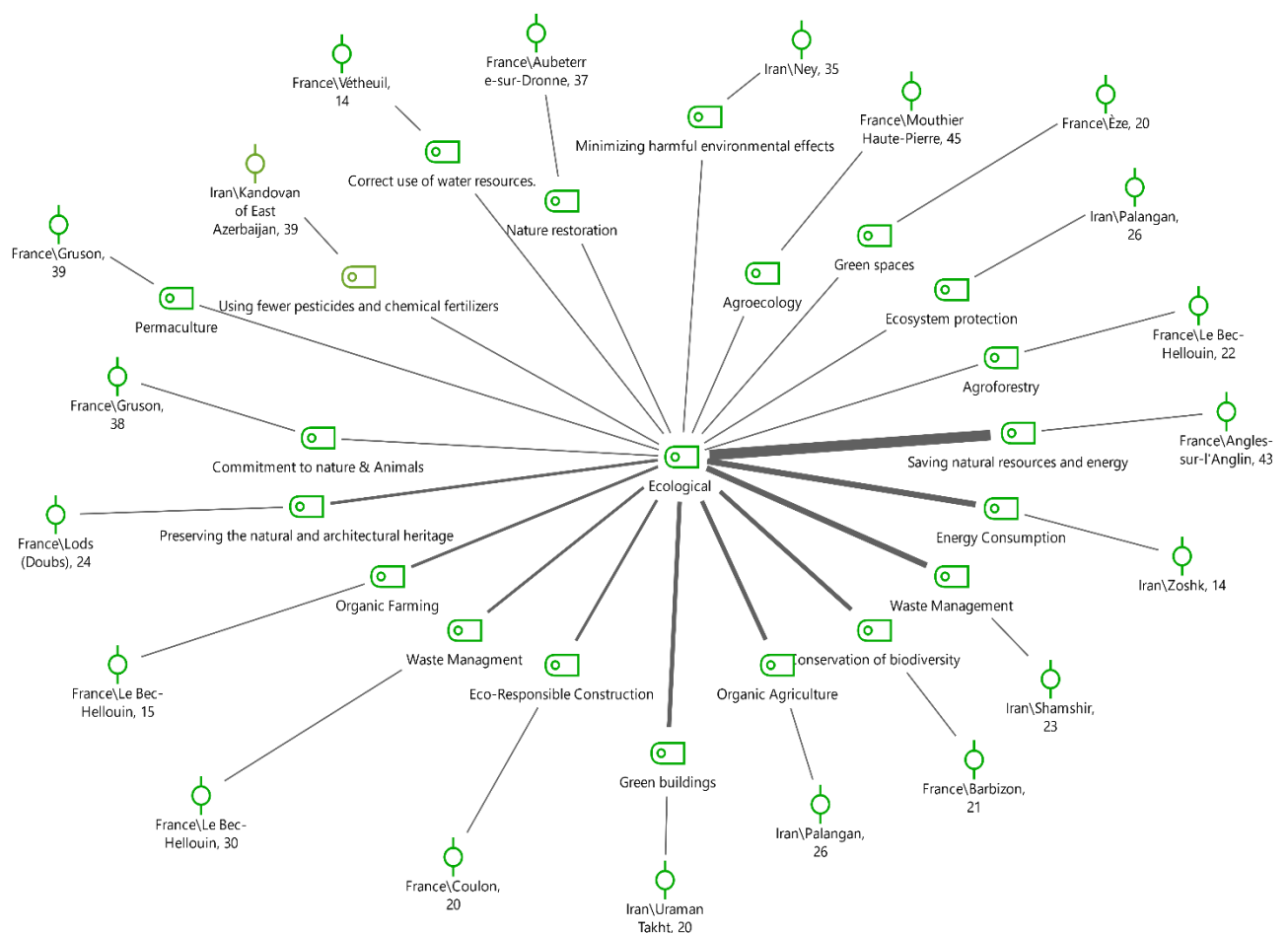


Fig.3. 55. Ecological - Code-Sub codes-Segments Model

Cultural: The interviewees most frequently mentioned the cultural codes of dance and design, culturalization of sustainability, planning of regional festivals, and culturalization of web usage. It must be noted that the inhabitants' happiness and optimistic attitude are among the

most crucial aspects of ecovillages. So that there is a central location for yoga music and dance in many of these communities.

It has also been critical to maintain cultural sustainability and its importance among the people. Culture can be developed by utilizing the core of the communities and the unique characteristics of that region. The organization of regional festivals, for example, can be a very important action since it encourages many messages to be sent to the people in order to preserve the local culture, connection, and sense of belonging to the region. These messages can inspire more people to protect the environment and nature. These cultural activities play a significant role in the transformation and long-term change. Since each area's culture has a direct relationship with people's beliefs, values, and beliefs, accepting a transformation in this manner will be very effective. in order for new beliefs and behaviors to be expressed, nurtured, and practiced. Hence, ecovillages are commonly described as places of experimentation and learning that can provide constructive learning spaces for the expression of a collaborative culture, such as cultivating and practicing how to live and operate together (Dawson, 2006; Litfin, 2014; Bradbury & Middlemiss, 2015; Mychajluk, 2017).

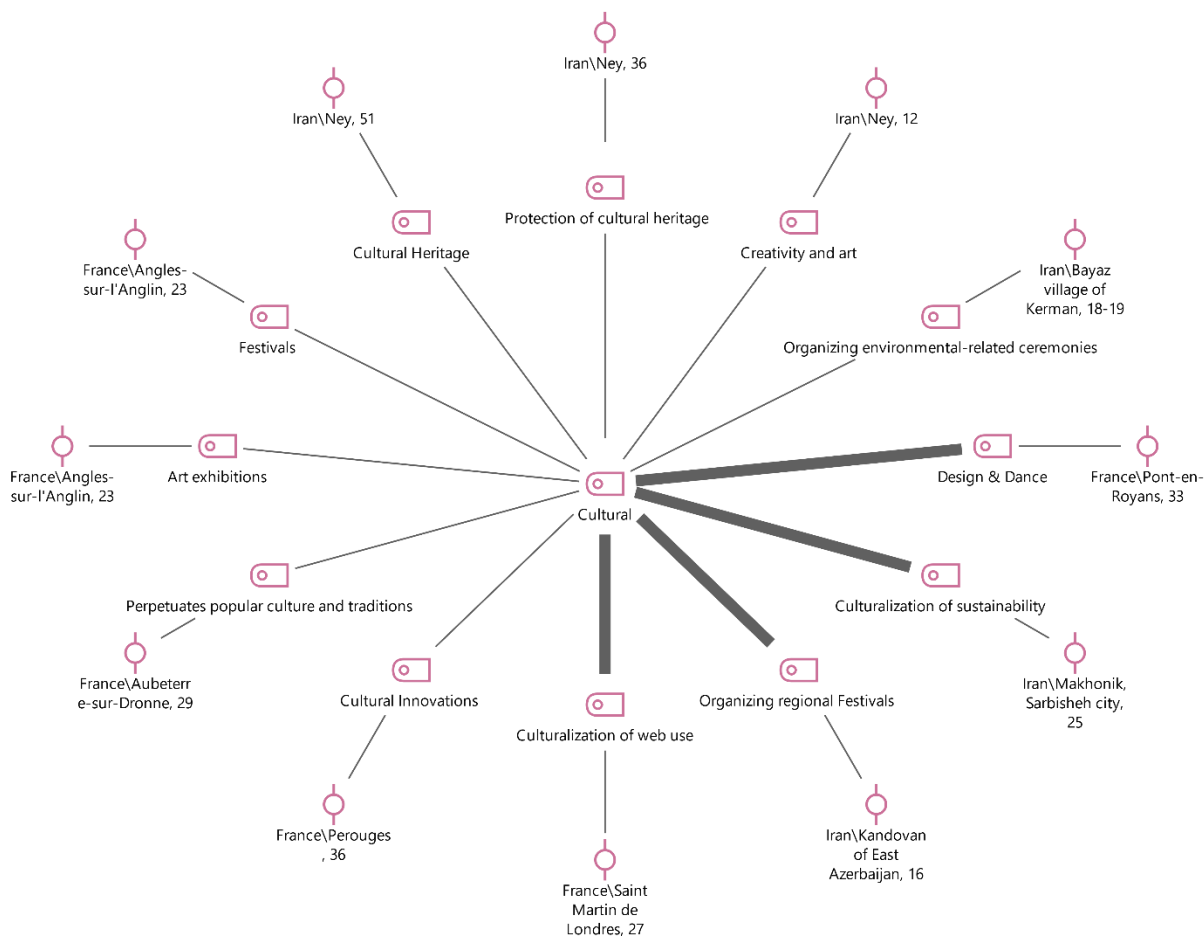


Fig .3.56. Cultural - Code-Sub codes-Segments Model

Technology Adaption: Many interviewees expressed an interest in technology in order to transform it into an ecovillage. Particularly in the area of modern agriculture, which occurred the most frequently. There were many frequencies of ICT, the Internet of Things, including sensors, the use of robotics in agriculture, digital advancements, and artificial intelligence in agriculture. The use of technology in traditional villages, particularly in agriculture, can play an important role in their transformation into ecovillages. Although it is expensive in the beginning, modern agriculture can increase productivity and be used for advanced fertilization and irrigation to make agriculture more sustainable. Field management data is also collected using other technologies such as satellite images or images captured by drones. Wireless field sensors collect data such as field humidity, ambient temperature, humidity, and plant evaporation and transpiration in orchards and vineyards (Wójcik et al., 2021). To accomplish this, it is critical that all farmers understand how to effectively use ICT to earn economic benefits and improve their quality of life. Smart agriculture and the Internet of Things are also becoming increasingly important, as evidenced by the interviews in both cases. This is where digitization comes into play, because it can facilitate the exchange of experiences among farmers, experts, and other stakeholders, in addition to improving agriculture productivity (Durst et al., 2018; Sellitto et al., 2018; Jakkuet al., 2023; Zambon et al., 2019; Kulatunga et al., 2017; Vázquez-López et al., 2021).

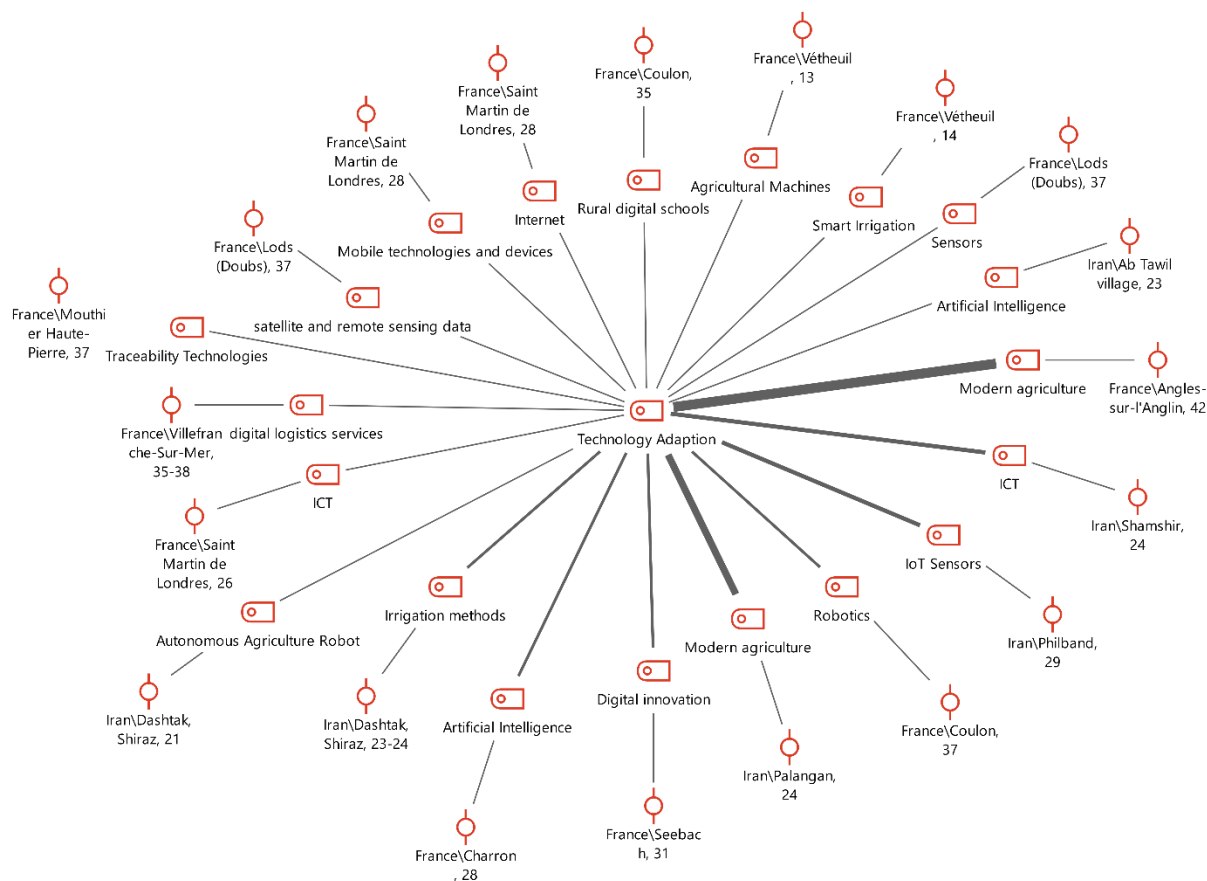


Fig.3.57. Technology Adaption - Code-Sub codes-Segments Model

State Support: Like other drastic changes, it requires the assistance and backing of the government to become an ecovillage. The participants have also raised this point. In this context, participants' opinions were dominated by investment and support, promotion of educational center construction, access to public health, and government support for a sustainable economy. Governance mechanisms, as embodiments of social dynamics and sustainability in ecovillages, facilitate transformative processes in which individual and collective negotiations become the principle of sustainable lifestyles. Elements of sustainability as a practice frequently emerge as a result of dialogue and compromise. Therefore, government assistance, on the one hand, by focusing on infrastructure and financial support, and on the other hand, by establishing a link between the residents and the rulers, can help to achieve this goal. Finally, converting a village to an ecovillage necessarily requires social and environmental innovation. Some participants believed that without government intervention and support, the cost of village infrastructure and new technologies would be prohibitively expensive. All theoretical and empirical visions of ecovillages, utopias, and heterotopias address governance issues. However, the desired outcome will not be achieved without the

participation of the local people (Hong & Vicdan, 2016; Humphreys, 2014; Visconti et al., 2014; Guillard & Roux, 2014).

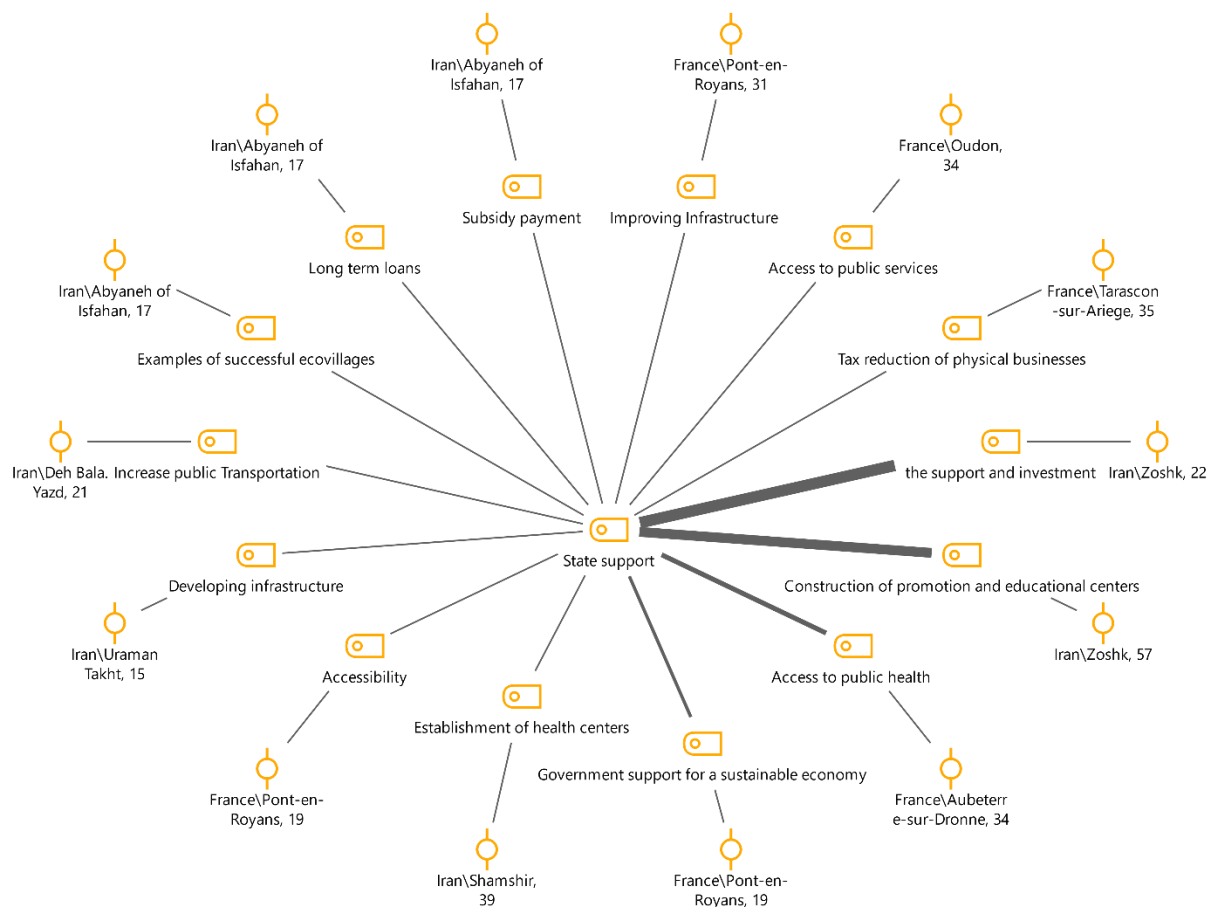


Fig.3.58.State Support - Code-Sub codes-Segments Model

Finally, based on the analysis of the codes extracted from the interviews conducted with the villagers, it is clear that in order to become an ecological village, all the economic, social, cultural, environmental, infrastructural, and government assistance is essential. Up until now, the data has been evaluated as a whole. Given the goal of comparing Iran and France, It is necessary to examine Iran and France using the principal codes comparatively.

Two case models were used to compare the total codes extracted in Iran and France. The two-case model is used to compare two documents, groups of documents, sets of documents, or a combination of these levels. This model can be used to observe the frequency of codes, such as related topics that appear in two cases or just one case. Additionally, it displays how frequently each item's codes are used.

The software displays the codes mentioned by the interviewees in the space between the two items. The most frequent codes in this model are listed along with how often they occur.

The results of this section give a broad overview of the conditions necessary for the development of sustainable lifestyles in rural Iran and France. Since each main code is compared separately with Iran and France, it is possible to examine the various participants' perspectives on each main code.

More specifically, these forms provide a more thorough analysis of the striking similarities and significant differences between Iran and France. The icon color is determined by the primary codes mentioned above. Green, for instance, represents environmental codes, blue is economic, social is purple, government support is orange and technological is red.

- ✚ Regarding the participants' comments concerning how to transform their village into an ecovillage, the codes related to the economic situation were repeated 46 times, 31 times in the Iranian interviews and 15 times in the French interviews. This issue demonstrates the importance of focusing on the economic dimension in villages. In Iran, they talked about the lack of employment and capital in the villages, whereas in France, they mostly talked about the improvement of employment in the villages (Fig.3.59). Entrepreneurship, self-sufficiency, tourism development, localization of the economy, empowerment of women in Iran, and development of the local economy, small businesses, and a competitive and innovative economy in France were mentioned more frequently by participants. As is well notable, both cases emphasize the development of the local economy. According to the interviews, the purpose of their insistence on the local economy was to increase village self-sufficiency and reduce rural-urban disparities. Consequently, most Iranian villages believed that many migrations from villages to cities had occurred in recent years. The majority of them were from the village's youth and were searching for employment. In France, due to the countryside's high dependency on cities and a lack of technology that is not as readily available in villages as it is in cities in order to advance economic goals.

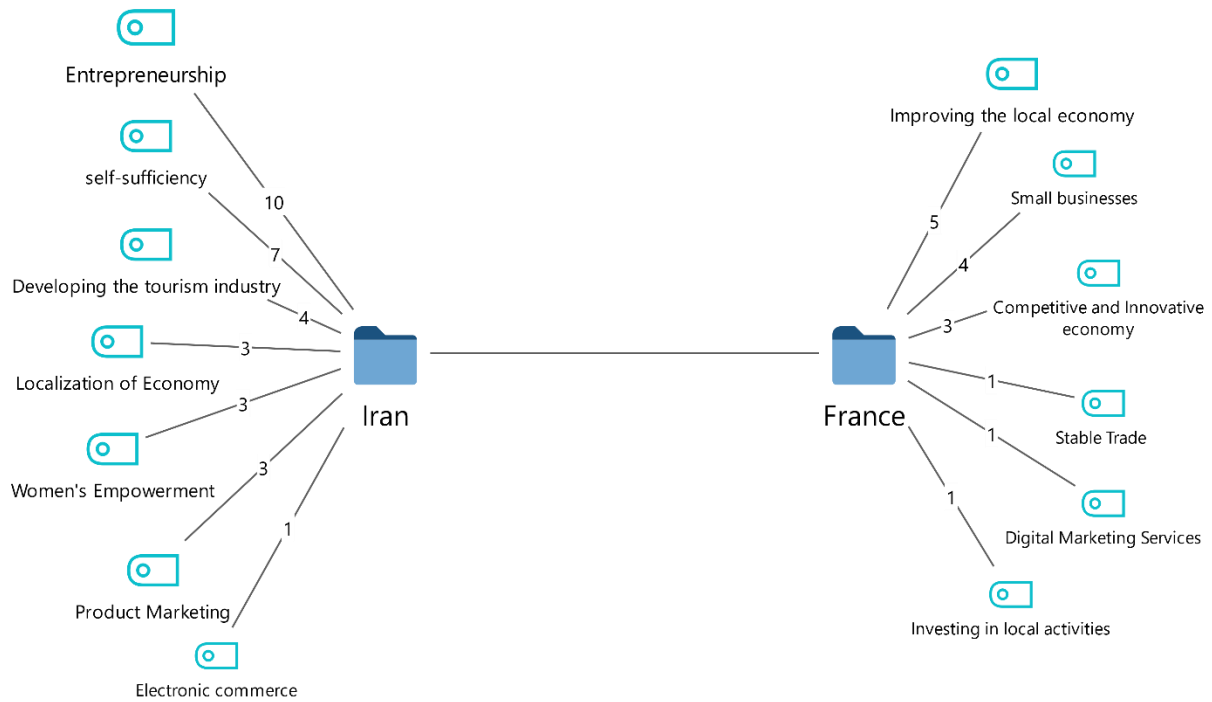


Fig.3.59. Two Cases Model-Economic

Concerning the social dimension, both Iran and France confirmed an increase in awareness and solidarity. To transform their traditional village into an ecovillage, they also emphasized teaching sustainable behaviors, a cooperative approach, responsible behavior and flexibility, communication, and local cooperation (Fig 58). To be more precise, participants made 145 comments on the social dimension in order to achieve a sustainable lifestyle or ecovillage. The social dimension has been given equal weight in Iran and France. Therefore, they were repeated 73 times in Iran and 72 times in France. The difference is that in France, they also emphasized villagers' individual characteristics such as equality and honesty, leadership, new ideas, generosity, and meditation.

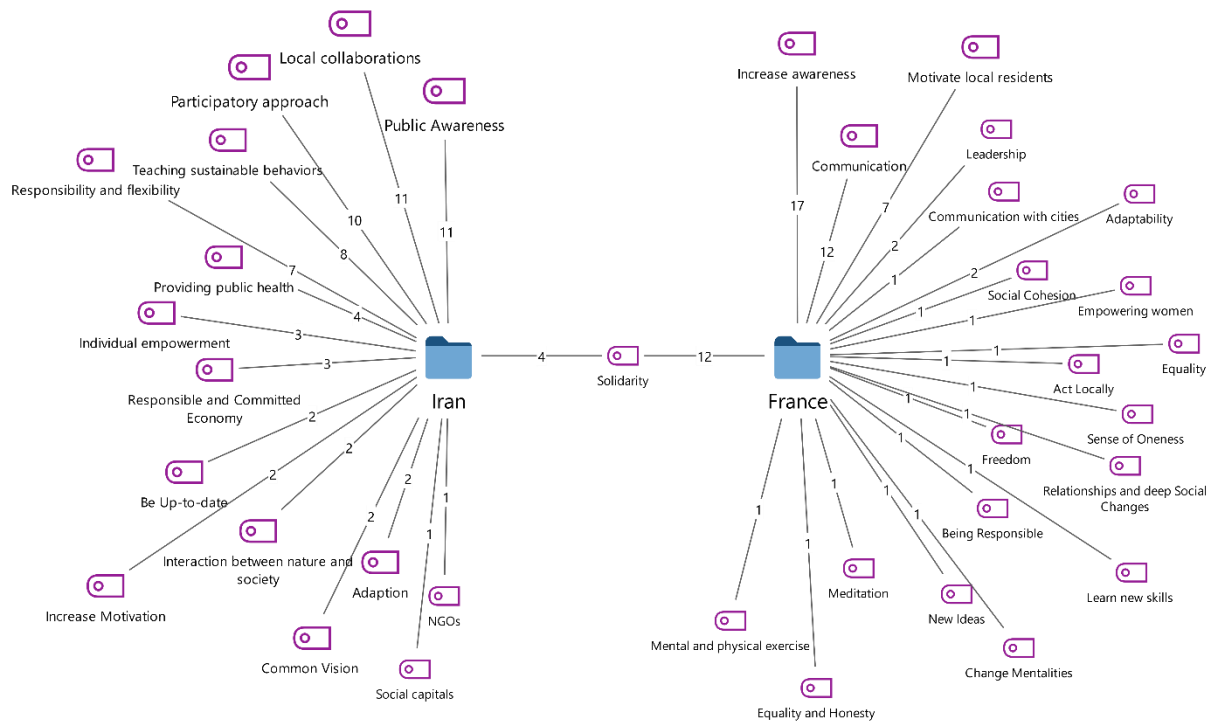


Fig.3.60. Two Cases Model-Social

- ✚ The most important code in the ecological dimension is saving natural resources and energy in French villages. In addition, biodiversity protection and Eco-responsible construction are highly valued in French villages. Interviewees in Iran, on the other hand, emphasized energy consumption, waste management, and green buildings (Fig 59). The significance of the ecological dimension in achieving a sustainable lifestyle or ecovillage was reiterated by the participants 165 times. In Iran and France, the codes associated with the ecological dimension were repeated 66 and 99 times respectively. In other words, French villagers placed a greater emphasis on ecological concerns than Iranian villagers did.

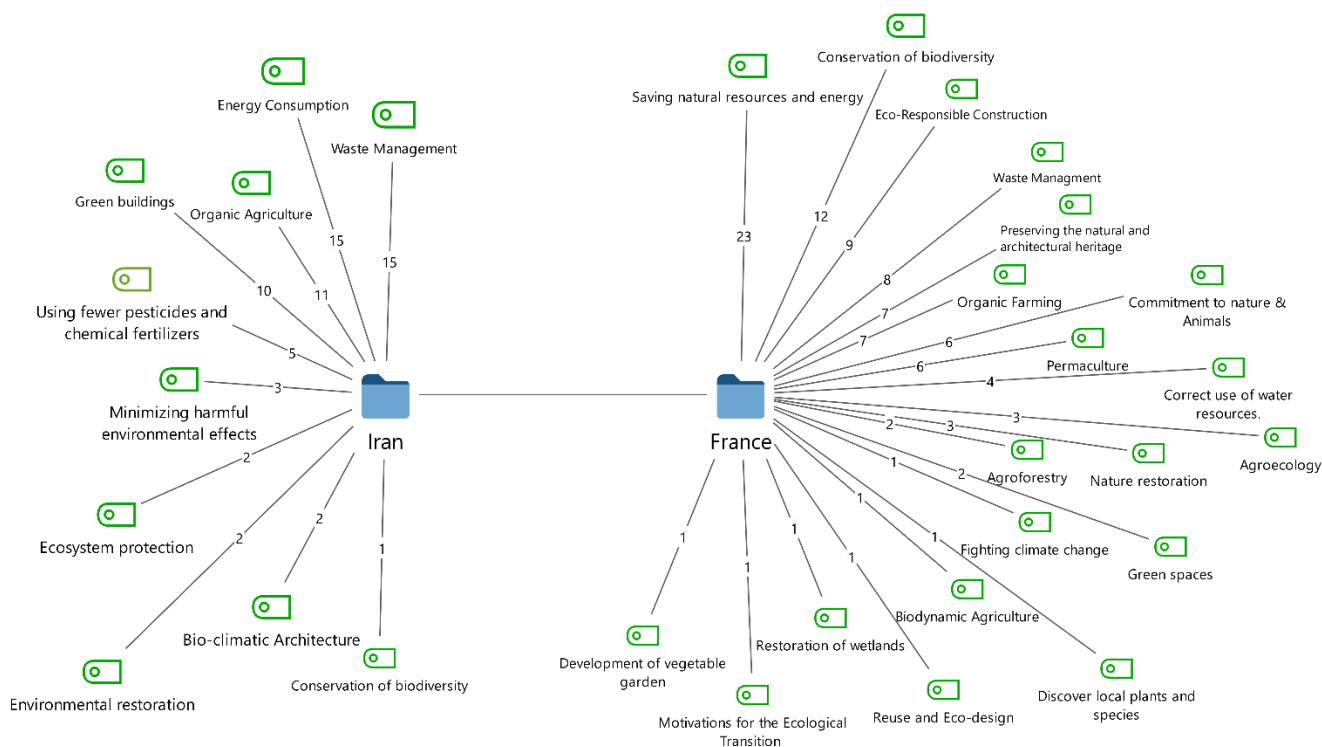


Fig.3.61. Two Cases Model-Ecological

✚ The significance of the cultural dimension in achieving a sustainable lifestyle or ecovillage was reiterated by the participants 17 times. In Iran and France, the codes associated with the ecological dimension were repeated 8 and 9 times respectively (60). According to figure 61, in the cultural field, France has placed a greater emphasis on design and dance, culturalization of web use, and art exhibitions, whereas Iran has placed a greater emphasis on the culturalization of sustainability, regional festivals, and cultural heritage. The cultural differences between the participants in the two cases were quite noticeable. In terms of religion, the majority of people in Iranian villages were Muslims, while the majority of people in French villages were Christians. Given that one of the main characteristics of an ecovillage is equality, freedom, and respect for all people in all religions, it is necessary to concentrate on this topic in the villages of the two cases. Given that both villages are religious, the religious and traditional intensity of the villages in Iran is higher than that of France. This is particularly true for women. Even though, women participate in economic activities, their rights are not always respected. Generally, in the cultural sector, solutions, planning, and arrangements should be provided based on each culture and region in to encourage local cooperation and solidarity between rural people with the goal of creating an ecovillage. This issue is not only noticeable in the two cases, but it also differ significantly between

Iranian villages. Consequently, there were various languages and ethnicities (Kurdish, Turkish, Lari, Gilaki), as well as various cultures, among the 20 villages that were studied. Due to this, the cultural dimension is a crucial component in encouraging intercultural motivation and solidarity in Iran as well as in France.

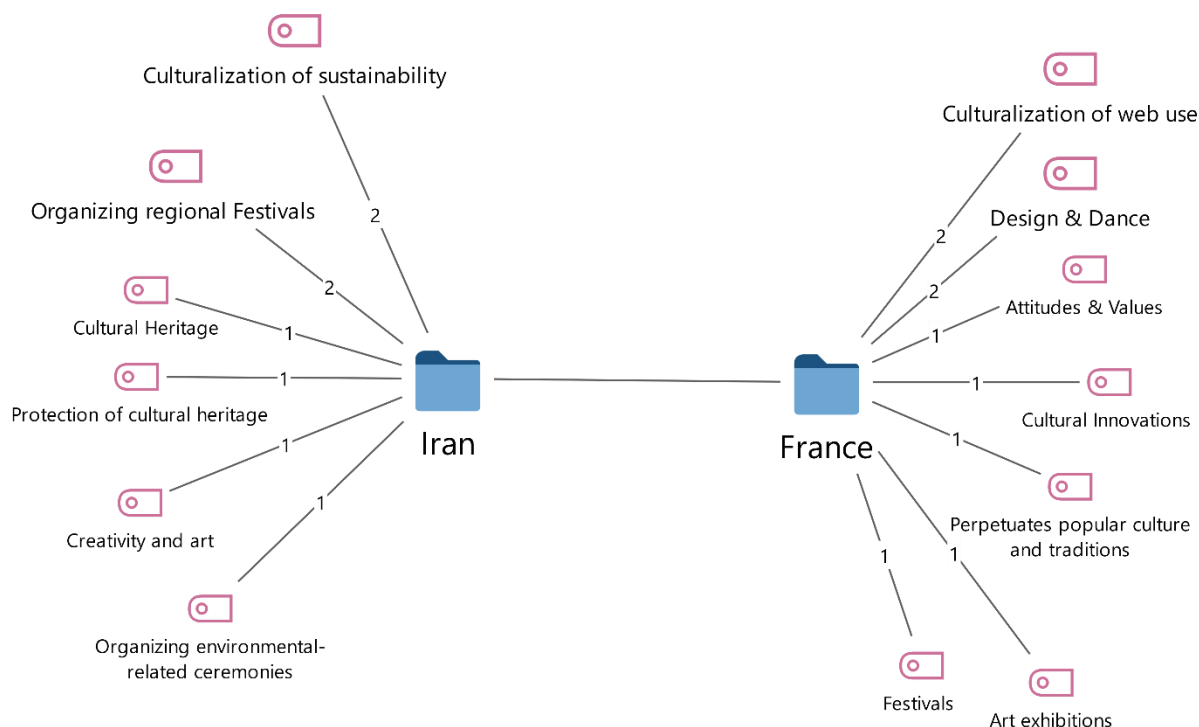


Fig.3.62. Two Cases Model-Cultural

✚ The importance of technology and its adoption in developing an ecovillage or sustainable lifestyle was mentioned 107 times by participants in their comments. In Iran and France, the relevant codes were repeated 46 and 61 times, respectively. In both Iran and France, villagers believed that the use of new technologies in agriculture, or modern agriculture, such as robotics in agriculture, smart irrigation, the Internet of Things, and sensors, had a significant impact on improving the economic situation on the one hand and making it easier to move towards sustainability on the other. The importance of ICT has been mentioned in both countries, but in Iran, the importance of ICT, or its weight, has been greater than in France. The reason for this can be attributed to Iran's villages' lack of ICT development (Fig 61).

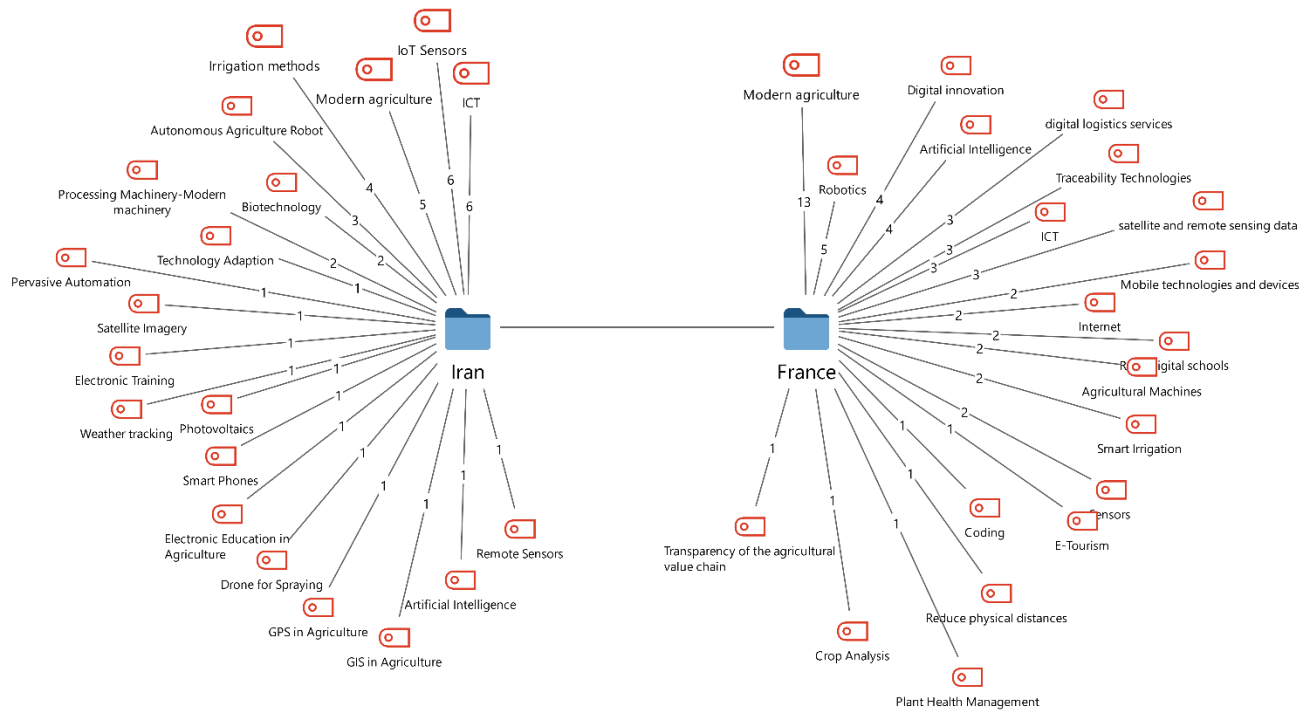


Fig.3.63. Two Cases Model-Technology

The attention of the interview participants was attracted to the government's support, as well as other important criteria for achieving a sustainable life. The codes for this dimension were repeated 56 times. With 35 repetitions, Iran gave government support the most weight, followed by France with 21 repetitions. This problem demonstrates two things. First, because there are not many jobs available in Iran's rural areas and there aren't many of them, along with a lack of capital, rural residents have the highest expectations of their government. Secondly, the government has not taken significant investment measures in recent years that are appropriate for rural development (Fig 62). In Iran, the government's support and investments in villages, promoting the construction of educational centers, developing necessary infrastructure, and expanding public transportation were more frequent. In France, access to public health, government support for sustainability issues, and tax reductions were the most frequently cited by participants. The importance of government attention to public access and infrastructure development is highlighted in both cases.

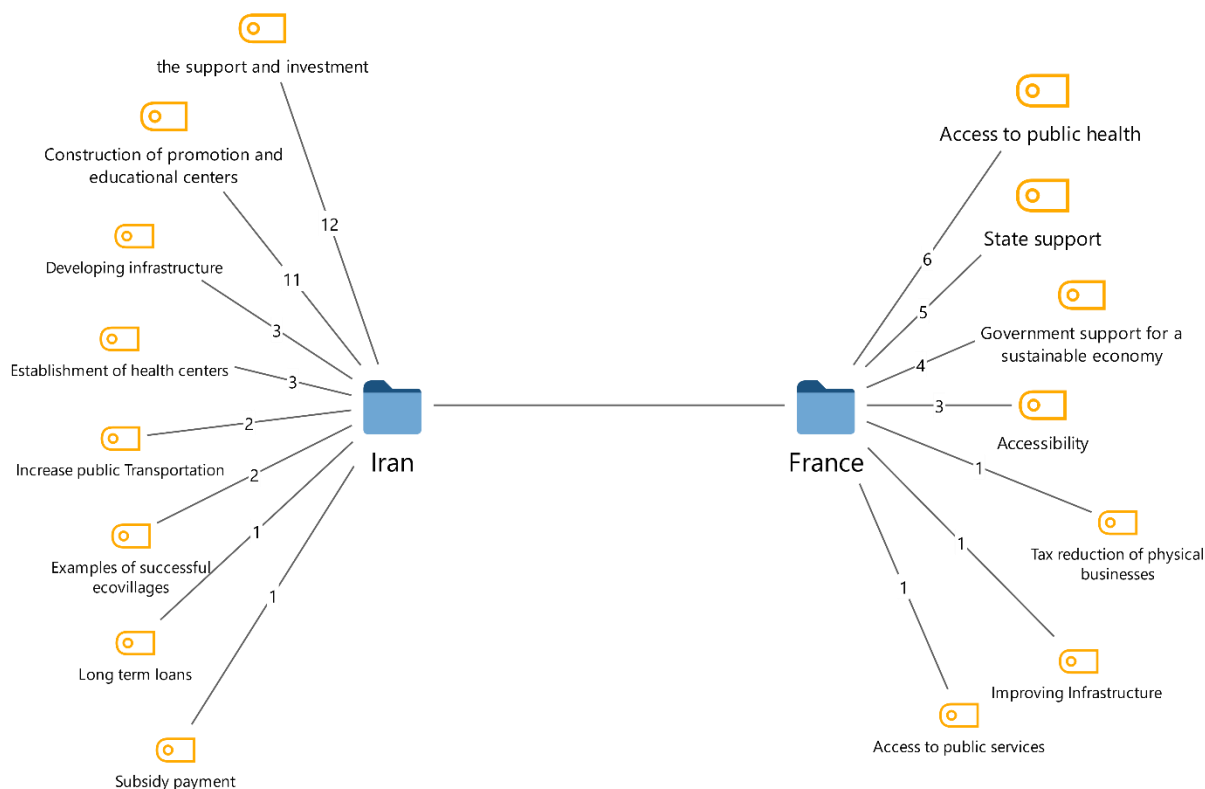


Fig.3.64. Two Cases Model-State Support

Three aspects are crucial for traditional villages to be transformed into ecovillage, according to the findings. The first is realizing that every project process should get the same emphasis because a sustainable process is just as important as a sustainable village. This covers preliminary study and creation, development and application, and realistic ongoing upkeep of the ecovillage itself. For instance, the majority of the residents in the French villages that were studied thought that their community was very similar to an ecovillage. It is crucial that the villagers are informed about this situation so they can recognize their differences and similarities with regard to a true ecovillage.

Second, decision-making processes and operating processes must be decided by the relevant parties. Because ecovillages require highly developed skills, social capital, and careful community design, this is an important aspect to consider. The majority of the villagers as well as the ecovillages examined in this study emphasized the significance of the social component. Therefore, the majority of participants only mentioned the code "Solidarity" as a common code. Many of the participants who were interviewed also mentioned other social capitals, including raising individual awareness, communication, motivation, leadership, and adaptability in France, as well as raising public awareness, local cooperation, collaborative approaches, training sustainable behaviors, responsibility, and flexibility (in Iran).

Thirdly, adopting a sustainable lifestyle and creating an ecovillage require modifications or the construction of certain infrastructure, both of which are difficult for many villages to do on their own, particularly in Iran. The interviews showed that employment diversity and job creation in Iran are significantly lower than in France, which is why this is the case. The villagers gave this issue a lot of consideration, including government investments, support, and investments in public transportation, public health services, and government support for a stable economy (in Iran) (in France).

3.3.2. Sustainable business environments

Q5. What is the state of the studied villages' business spaces, and what solutions are suitable for their sustainability with the goal of becoming an ecovillage?

The fifth question will be examined in this section. The goal of this question is to examine the state of rural business spaces or economic activities and provide solutions for these business spaces in order to have a sustainable future and become an ecovillage. Given that the villagers will play a reduced role as responsible persons in relation to the environment until they have a proper job and income, it is necessary to address this concern. Ecovillages are able to combine both economic and non-economic objectives in one wellbeing-focused governance process. Maximizing the quality of people's lives, their happiness or subjective well-being is the predominant aim of nearly every ecovillage (Hall, 2015). These communities are experimenting with ways of living that prioritize ecologically, relationally, economically and socially sustainable practices. As sites of experimentation and adaptation to sustainable lives in diverse local contexts, ecovillages have demonstrated ways of living collectively in community economies (Roelvink and Gibson-Graham, 2009; Price et al., 2020). Hence, it is critical to pay attention to the types of activities carried out in villages, as well as their strengths and weaknesses, in order to provide solutions in this field.

The economic activities that take place in the villages were discussed in the first stage. The participants' strengths and weaknesses from their interviews will be discussed in the following stage. Finally, an assessment and analysis are done out on the strategies and solutions that were deduced from the interviews.

Villages Activities: The participants focused on their job activities and the villagers in the early stages of the interview. Therefore, rural activities were separated as the primary code in this case because the type of activity and variety of activities in villages can aid in the provision of a solution for a sustainable business. More specifically, the participants were asked to describe

their occupations and the village's activities. 194 times, comments were made about the activities taking place in the target villages. 67 times in Iran and 127 times in France. As was already mentioned, France offers a wider range of jobs than Iran. So, while 7 codes were found for Iran, 16 codes were found for activities in France. The most frequently used codes in Iran were related to agriculture (17), animal husbandry (13), and tourism activities (12), while in France they were local services (19), wholesale and retail trade (16), and agriculture (13).

Finally, the most frequently mentioned Activities in the interviews were local services, retail and wholesale, agriculture, arts and crafts, Manufacturing, Public Administration, in France and agriculture, animal husbandry, Handicrafts, tourism activities, and horticulture in Iran have more than 10 frequency in the participant's comments. According to interviews, the variety of economic activities in Iranian villages is much lower than in France. Agriculture was given more weight or repetition in both countries (Fig 63).

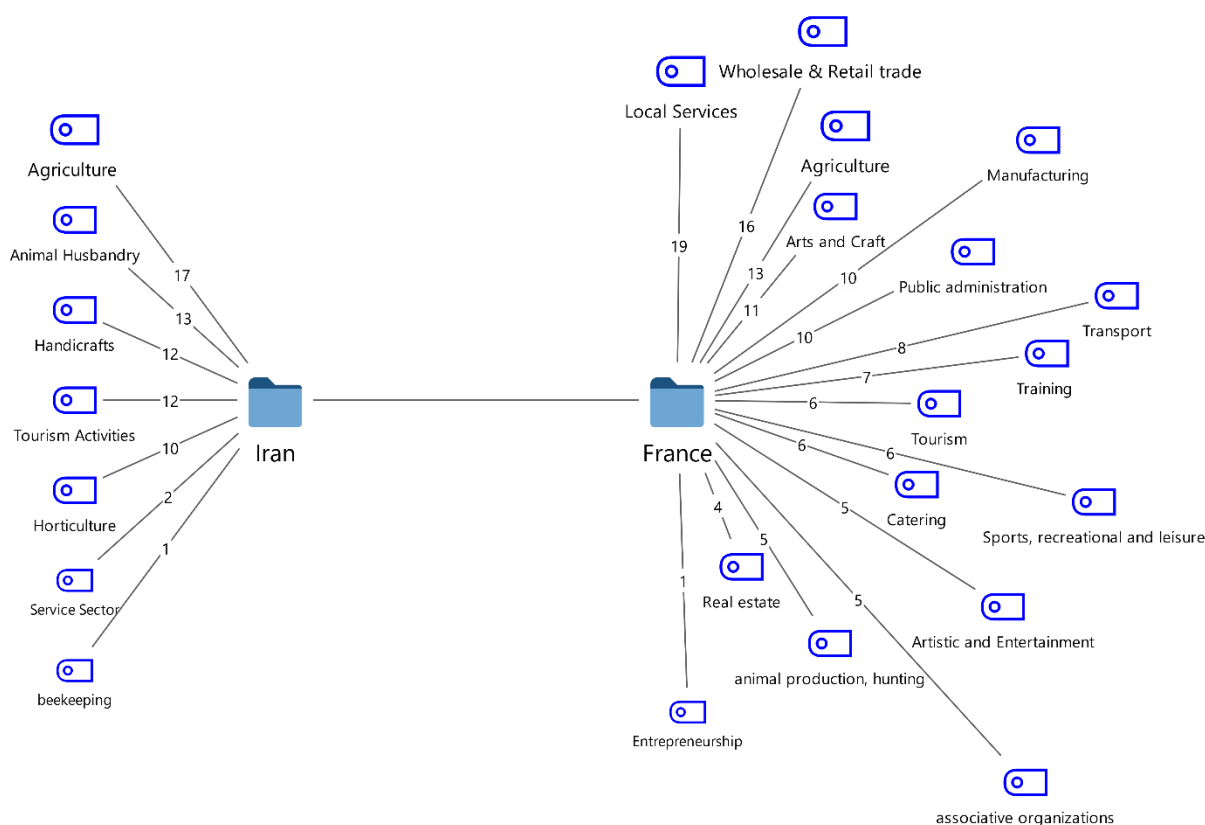


Fig.3.65. Two Cases Model-Activities

Given that the participants mentioned the village's strengths and weaknesses during the interviews, each one are examined as the main code.

Weaknesses: In order to have a sustainable business environment and develop into an ecovillage, the villagers highlighted the shortcomings of their area. Their assessments of the region's weaknesses were revised 55 times during the interviews (47 times in Iran and 8 times in France). Fewer weaknesses were pointed out by the French villagers because they felt they already lived sustainably and were very similar to the ecovillage. However, some of them contend that we already have a stable business and don't need to make many modifications (Fig 64).

The villagers in Iran believed that the region's most considerable weaknesses were the lack of employment, the lack of proper infrastructure, the lack of government support, and villagers' desire to migrate to cities, as well as seasonality of income and a lack of public transportation in this context. Villagers in France have also expressed concern about the rural population decline, the lack of workshops for sustainable living, the lack of information about sustainable lifestyles, and the lack of financial support. In both cases, they mentioned the village population decline and migration to cities, and they expressed significant concern about this during the interviews.

In Iran, they also mentioned a lack of appropriate technology, a lack of motivation among people to strive for a sustainable life, a lack of skilled human resources, a lack of Publics transportation, and other issues. The lack of technology is caused by a lack of proper infrastructure in the villages, as the villagers repeatedly stated in their interviews.

Since the villagers emphasized unlimited migration of village youth to cities, this has also contributed to a shortage of skilled workers in the villages. These incidents have contributed too many villagers' lack of motivation and effort to change. However, the villagers in France have revealed their weaknesses in a different way. Therefore, they mostly pointed to a lack of tourism development teams, large local businesses, and so on.

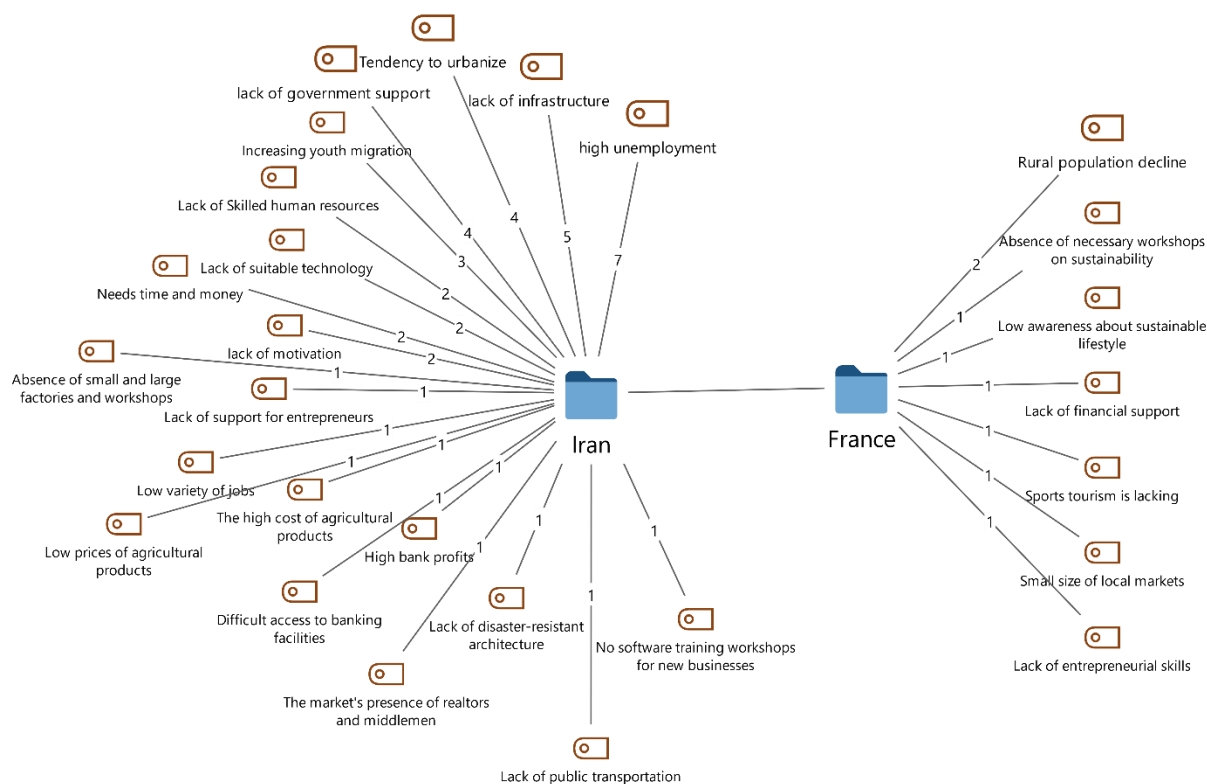


Fig.3.66. Two Cases Model- Weaknesses

Strengths: The participants' perspectives on the region's strengths were repeated 35 times, 17 times in Iran and 30 times in France. Villagers in Iran identified 11 and French villagers identified 17 great strengths in their region (Fig. 65). In Iran, they mainly cited an increase in tourism activities, the fertility of the land for suitable agriculture, the presence of a significant number of young graduates, a young and active workforce, the diversity of agricultural products, and an increase in private investors' motivation to invest in the village. While in France, the most significant strengths of their region are their village's sustainable lifestyle, suitable transport between rural and urban areas, the existence of classes on meditation, increasing sports activities in the village, and minimum environmental destruction. They also emphasized the diversity of vegetation, the existence of friendly relations between villagers, the existence of non-agricultural activities, and the availability of suitable services for disabled and elderly people.

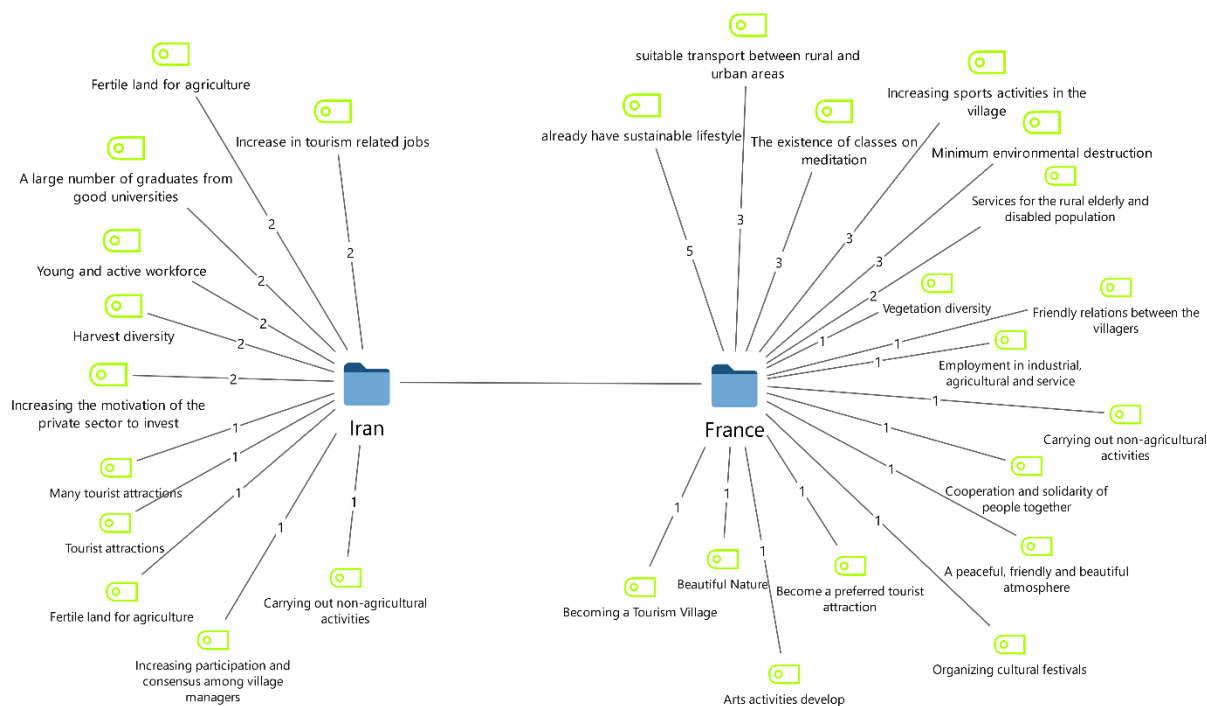


Fig.3.67. Two Cases Model- Strengths

Solution Suggestions: Given that, villagers who live in the same village are more familiar with the village's strengths and weaknesses. Therefore, it is critical that their solutions for achieving a sustainable business be investigated. A sustainable business that moves in the direction of a sustainable future was mentioned 171 times in the comments made by the participants. These include 69 repetitions related to Iranian participants and 101 repetitions related to French participants (Fig. 66).

Moreover, Villagers in both cases believe that educational workshops, supporting small businesses, creating job opportunities, and improving public transportation in their community are some of the most crucial ways to achieve this stability, according to the suggested solutions. If we compare Iran and France, it can be seen that France has prioritized educational workshops, the growth of sustainable tourism, alternative forms of transportation, the development of public transportation, and increased cooperation between public and local authorities. Iranian participants also prioritize supporting small businesses, increasing employment opportunities, and developing the necessary infrastructure for green businesses.

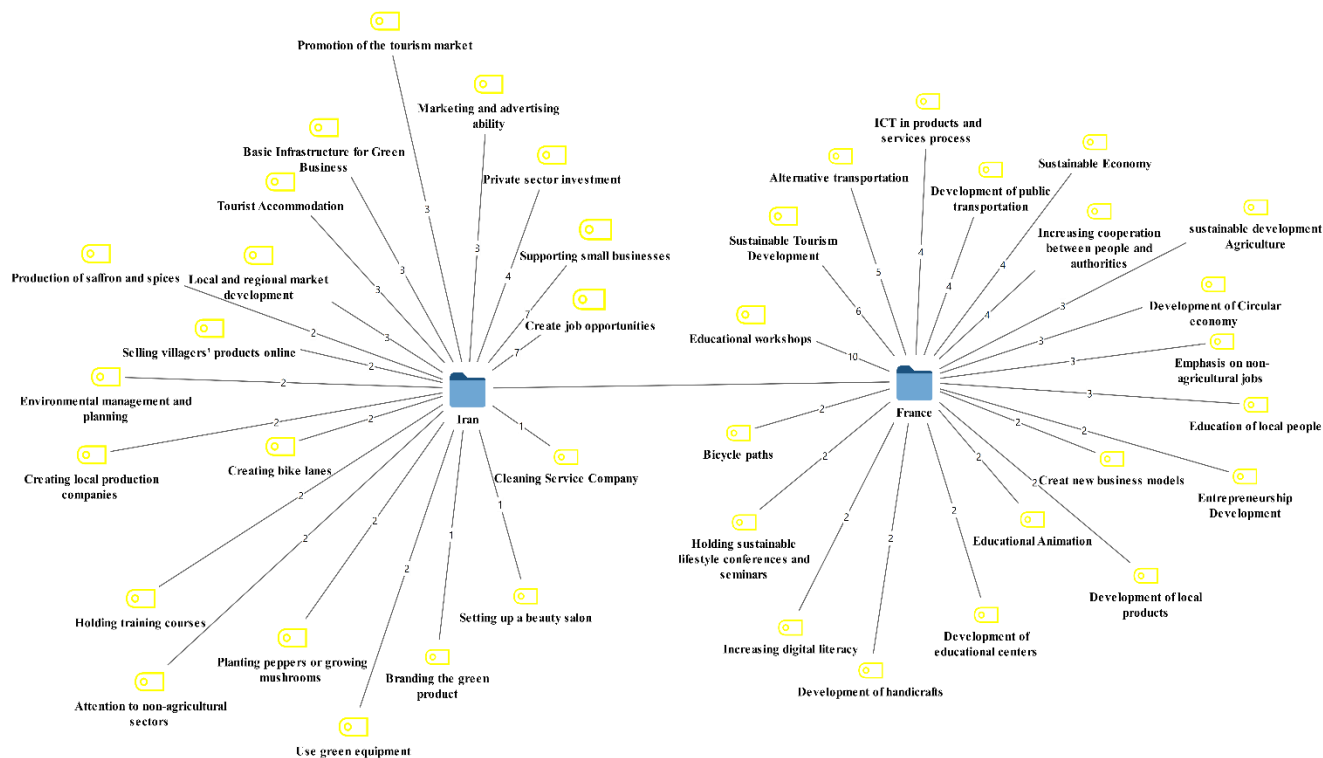


Fig.3.68. Two Cases Model- Solution Suggestions

According to the findings, the economic activities in the studied Iranian villages were much less diverse than those in the French villages. They mentioned seven economic activities in Iran and sixteen in France. Hence, it is critical to focus on the economic sector of Iran's villages. However, this is not because the economic sector of French villages does not require attention; rather, the type of attention considered necessary is different. For example, in Iran, more the emphasis should be placed on creating business opportunities, while in France; more emphasis should be placed on the sustainability and greenness of activities.

One participant held the opinion that people cannot take action to protect the environment or the planet until their basic needs are met. In other words, it is not true that paying attention to the environment leads to the growth of green businesses, but it can lay the groundwork for this kind of employment in the direction of sustainable development by paying attention to the growth of the rural economy and job security. However, when villagers have job security, they more readily adopt a sustainable lifestyle. Hence, the economy and businesses will naturally move in that direction, prioritizing the creation of green jobs or the greening of existing jobs with the goal of addressing environmental problems and enhancing social welfare.

In addition, some other participants mentioned that their villages in Iran have recently become popular tourist destinations, attracting a large number of visitors each year. However, there are

few facilities and a foundation for sustaining and growing tourism. Furthermore, they state that fundamental changes in this field are required in order to establish new and sustainable businesses. For example, in attractions villages, appropriate infrastructure and measures such as tourism projects and handicrafts can be developed. Among them is the construction of a parking lot, the access road to the village, paving within the village to facilitate tourist movement, the construction of an anthropological museum and handicrafts, and the holding of various educational workshops on how to attract tourists in the direction of economic development. In this context, one of the participants stated that when tourists visit our village, people do not receive money for providing products or services to tourists as a form of hospitality. Because they regard tourists as visitors. Therefore, it is critical to raise awareness and educate people about how to treat tourists and to expand economic activities centered on tourism.

Despite the creation of new opportunities such as tourism in most villages, most people's activities in Iran are still based on agriculture, which requires attention to new sustainable businesses and increased entrepreneurial opportunities despite major economic, social, and environmental threats. Meanwhile, in France, village tourism is used to increase business opportunities.

For this reason, it is important to consider the strengths and weaknesses of the villages and it should be acknowledged that these could be used to provide appropriate future solutions. Specifically, the population remaining in the villages, which is mentioned in the majority of the interviews in both cases. Meanwhile, it should not underestimate informing and raising awareness among village residents about the role they can play in preserving their environment in the face of today's climate changes and environmental challenges. It is also possible to use the villagers' strengths as motivation and an opportunity to further these goals.

Generally, it is not just a matter of gratitude or aesthetics to protect nature and open spaces; it is a matter of survival. If a predominantly rural territory has high-quality landscapes, natural environments, and cultural heritage, but its balance is fragile, it can lose its potential over time. Therefore, the protection and management of natural and cultural heritage, particularly through proper management of natural environments and landscapes, land use planning, assisting in the definition and direction of development projects, economic and social development with leadership and coordination of economic measures, are essential. To ensure the quality of life in the villages, it is necessary to educate and inform the people about the extent to which their

unsustainable activities endanger the environment and future generations. Whereas globalized economic models view innovation as a means to an end, sustainable communities, also known as ecovillages, view social innovation as the foundation of their development.

However, in France, some participants believed that their village businesses were presently sustainable and had minimal negative environmental impacts, whereas others believed that their villages had the potential to acquire and have sustainable businesses in the future. One of the participants in France believed that creating motivations for more people to live in villages, as well as developing tourism, could lead to economic development. Moreover, to achieve long-term goals, it is additionally critical to prioritize small businesses and invest in local activities rather than working in nearby towns or villages.

Therefore, having a sustainable lifestyle in French villages in the future is promising, and they have a better economic and employment situation than Iranian villages. Because they are not concerned about their economic or job situation, they are more motivated to live a sustainable lifestyle. They are more aware of the potential of their village and position, as well as the importance of living a sustainable lifestyle with a low environmental impact. Finally, it is critical to consider the villagers' definition of sustainability and the extent to which it reaches the real criteria of a sustainable business or sustainable lifestyle.

Concerning the role that ecovillages can play in the sustainability of businesses and the economy of a village, it should be noted that ecovillages can assist businesses in becoming more flexible, creating economic value, and contributing to a healthy ecosystem and a strong community. Organizations must apply higher governance standards and fully understand their social and environmental impacts to remain competitive as businesses embrace sustainability. Increased trust, competitive advantage, improved employee engagement, less waste due to improved business processes, and stakeholder loyalty and trust are all clear benefits of this approach.

Given that job creation is one of the major problems and challenges in Iranian villages, and it was also mentioned in the interviews, one of the most important issues for becoming an ecovillage is job creation. On the one hand, it will prevent migration and the tendency of young people to move to cities, while on the other hand, it will provide the foundation for economic development and motivation for activities consistent with sustainable development. Economic prosperity and job security are also important aspects of ecovillages. The majority of those questioned supported a sustainable lifestyle but believed that infrastructure and government

support in these areas were insufficient. In this context, one of the villagers believed that because their village is located on a border and deprived area of Iran, fundamental and infrastructure changes, particularly in the field of new technologies are required for energy consumption, building construction, agriculture, and waste management.

As mentioned in the previous question (Q4) as well, acknowledging the sustainable process is an important aspect of achieving sustainable development/ecovillage/sustainable lifestyle/sustainable business. In terms of appropriate solutions, it should be realized that when a society lacks the fundamental conditions for development, it is impossible to speak of sustainable development. Moreover, this is no exception in the case of sustainable business and ecovillage.

3.3.3. Commitment and responsibility of the Current ecovillages

Q6. How committed and responsible are the current ecovillages to a sustainable lifestyle for a sustainable future?

The sixth question will be examined in this section. Given that the research has emphasized the perspectives of urban dwellers and villagers, it is necessary to address those who live in ecovillages at this stage. In order to achieve this goal, 11 ecovillages in France were interviewed. The findings of the interviews are analyzed and examined in this section to determine whether the ecovillages practice sustainable lifestyles as they claim.

The majority of participants who live in an ecovillage express their views that they value humans and biodiversity equally and live in a residence of peace and strengthening respect for generational, cultural, and religious differences, as well as conflict of ideas, which is based on shared values and a transparent framework. They also place a strong emphasis on management in their interactions with the outside world. They open their minds to other people's differences, allowing them to grow and expand their consciousness. They have all chosen this way of life because they believe that bringing together different skills, experiences, and identities is a real solution to the world's problems of unsustainable lifestyles. Specifically, the problems caused by common individualism and the world's capitalist system.

These societies value population intelligence in order to maintain a harmonious relationship among themselves, believing that it is the foundation of a common life. Maintaining internal and external activities, communicating with everyone, and being aware of one's own strengths and weaknesses are all considered necessary.

Each Ecovillage resident has chosen to be a positive influence in their community and to share a common vision so that everyone can fully express their abilities and serve the common goal. To finally witness the implementation of a long-term economic, relational, ecological, social, and humanitarian model.

Some Ecovillage residents discussed their plans to construct independent educational facilities and greenhouses during the interview. In these programs, they integrate people's skills to develop projects, training, events, and hope to succeed in a self-sufficient (heavenly) place. Believing that anything is possible if individuals openly expand your knowledge in a stable environment.

Building house-farms that focus on food production and solar energy collection is being done at Catfarm Ecovillage. The ecovillage is also engaged in a project known as "Geodesic Domes," where they concentrate on constructing greenhouses for crops, places for art, music, and design, and bike paths as an alternative mode of transportation.

Ecovillagers see themselves as extremely responsible and committed to the environment, so the majority of their activities consist around this topic. For example, permanent or organic agriculture, such as ecosystem restoration, energy consumption, and transportation, has attracted considerable attention. Apart from environmental concerns, they value social and cultural issues.

Sustainability issues are addressed in the ecovillage "Le Mallouestan" (The name of this ecovillage, which was originally "Malloué," was changed because the first pioneer was an Iranian, and later the suffix -stan, which indicates a place in Persian, was added.) with the goal of creating a culture of sustainability that considers all of its impacts in order to preserve the earth for future generations. Therefore, it strives with moral values to respect the environment and human beings, emphasizing biodiversity, love, the enjoyment of life, communication, and helping those who need help. Groups of young people in this ecovillage have established a large 7-hectare farm. Individuals here would not mistreat animals, but rather coexist with them. They are confronted with climate change as they experiment and seek more responsible ways of living. In other words, they establish an environment that is responsible, sustainable, and self-sufficient (food, energy, water).

The following sections (Fig. 67) discuss the business spaces or economic activities that the studied ecovillages had. Permaculture, agriculture, education and teaching, eco-tourism, green start-ups, horticulture, handicrafts, livestock, and entrepreneurship are the most common

activities. They also engage in activities such as launching cultural activities in the form of theater, forestry, art, therapeutic longevity activities, and even research and research works. As previously stated, the majority of the businesses in the studied ecovillages are permaculture. Many ecovillages use permaculture to achieve smart, lean (no waste), and resource-conscious operations, which usually results in economically optimal design. The use of synergy and waste-free resource generation, which are not usually present in conventional business design, may be the unique aspect of using permaculture design in business (Hall, 2016). Not only permaculture but also other economic dimensions are interconnected with the environmental dimension and sustainability. Therefore, ecovillages may be considered unique places to illuminate a broader understanding of the aspects of various economies. Diverse economies are understood to include characteristics other than markets and monetary flows in which human needs are met through multi-layered relational exchanges (Gibson-Graham, 2008; Gibson-Graham et al., 2013, 2016).

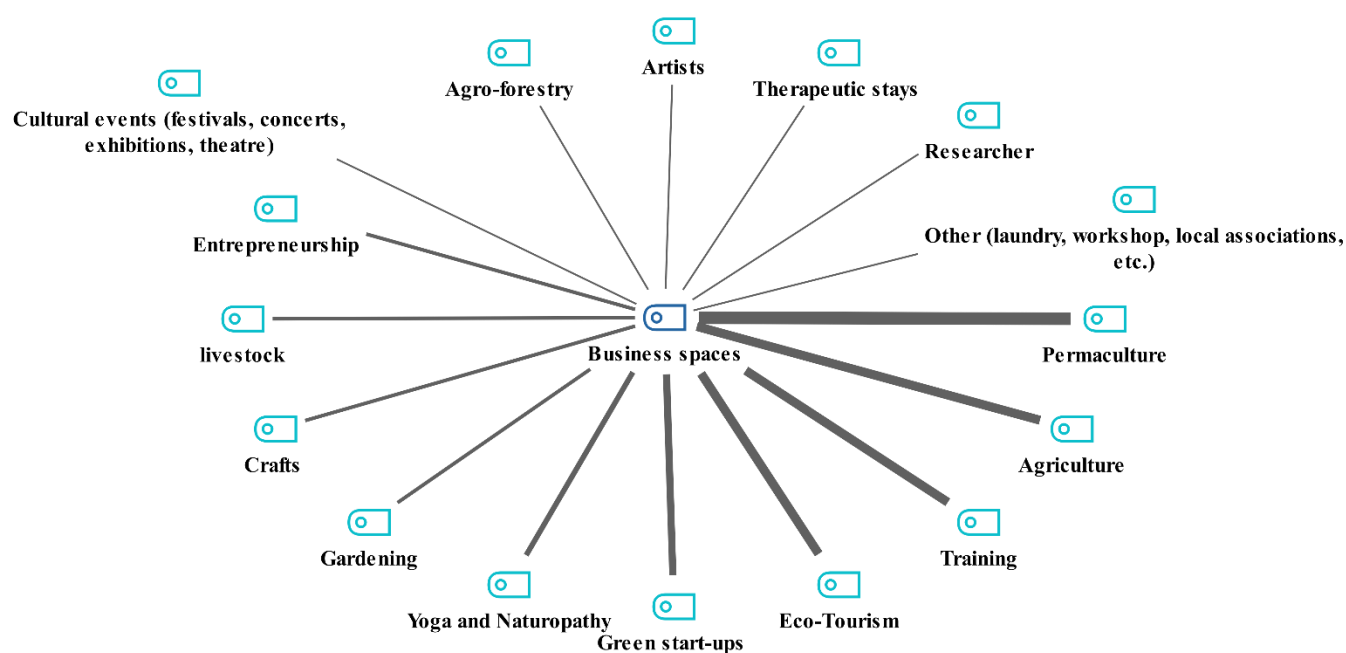


Fig.3.69. Business Spaces of the studied Ecovillages

Figure 68 depicts the most important sustainable lifestyle criteria from the perspective of those who currently live in an ecovillage, based on the Single-Case Model and interviews in the ecovillage. As can be seen, residents of the Ecovillage believe in being responsible, cooperating and communicating, the Internet of Things, alternative transportation, waste and wastewater recycling, permaculture, reducing energy consumption, respect for nature, humans and animals, peace, and justice. In addition, one of the most important aspects of their ecovillage

lifestyle is solidarity. In addition, you can see which Ecovillage is most related to which criteria in this figure.

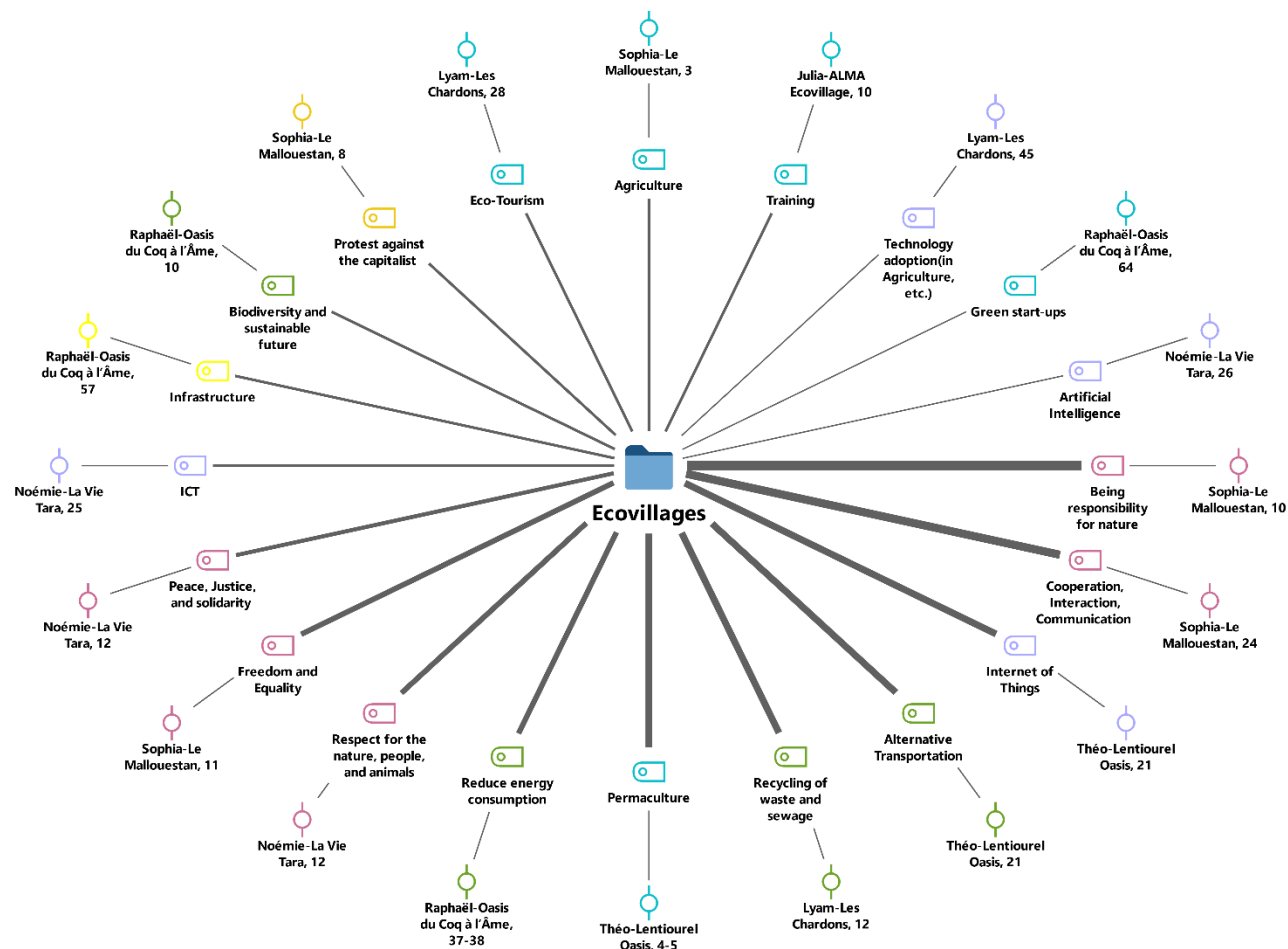


Fig.3.70. Ecovillages - Single-Case Model

Interviewees were asked about the reasons for their migration and living in the desired ecovillages in order to identify the reason for the formation of ecovillages in France (Fig.70). The majority of them responded that they joined these ecovillages out of a sense of responsibility to nature and the environment, injustice in urban systems, and opposition to the capitalist system, or that they were the main members of one of the ecovillages themselves from the beginning. One of the interviewees explains the reason for choosing to live in the ecovillage, one of the interviewees explains why they chose to live in the ecovillage, saying that life in the ecovillage "La Vie Tara" is made up of awakened people of all ages and perspectives who are preparing for significant social changes. It emphasizes collaboration with others who share similar goals, values, and beliefs in order to create a self-sufficient, holistic life. These communities are focused on perpetual culture, connection with nature, self-healing, sharing, helping, and strengthening each other in health and awareness, with space for self-

improvement. This is a rare occurrence in densely populated urban areas. Hence, according to the interviews, the majority of those who live in ecovillages have relocated from big cities. Many people expressed their reasons for the city's overcrowding, the importance of material possessions, and the disregard for human values. As well as they believed that in ecovillages, it doesn't matter where people come from, whether they are male or female, or what race they are; everyone is friendly and respectful.

They were also interviewed about the challenges of living in ecovillages. The majority of them mentioned the destruction of the environment by tourists (in the last decade, ecovillages have received a lot of attention, which is why tourist trips to these places are very common these days), low population, economic system challenges, and reliance on cities (Fig.69). Another issue raised is ecovillages' lack of complete self-sufficiency. Although self-sufficiency is one of the founding principles, ecovillages cannot be completely independent of cities or other places; however, this does not mean that ecovillages must be completely self-sufficient or isolated from the surrounding community. In an ideal situation, an ecovillage can maintain its economic strength while also engaging in exchanges and relationships with other communities. Despite the fact that some of the ecovillages under study had residents with outside jobs (full- or part-time), their private businesses, or other sources of capital to support their livelihoods. Most rely on increased tourism to help local producers and programs that educate locals and visitors about the environment to generate income streams (Milani Price et al., 2020; Steves, 2017; Hall, 2015). Visitors who spend their money on locally produced handmade goods or organic food, or even just spend their free time in different and long-term ecovillages. and take part in educational initiatives, which ultimately helps to support the income flow into the ecovillage economy. These ecovillages also get the chance to showcase alternative lifestyles thanks to the tourism they receive. The broader sociopolitical imperatives of ecovillages as centers of social and economic innovation may, in turn, be sustained by sustainable living in a community and ethical production and consumption. These interactions with the market economy demonstrate that the two can coexist without the market economy dominating the social economy (Schmid, 2018; Pesh et al., 2018; Dawson, 2006; Steves, 2017). Supporting the ideological and financial sustainability of ecovillages may be accomplished by extending the dimensions of sustainability and community ownership practices to the larger community. Communities that practice sustainable living can grow their own economies and spread those practices outside of their own borders by interacting with the larger local economy. In this

manner, the Zebb and Sieben ecovillages in Germany were able to encourage others to support the neighborhood "bio-region" by creating organic food networks (Seyfang et al., 2014).

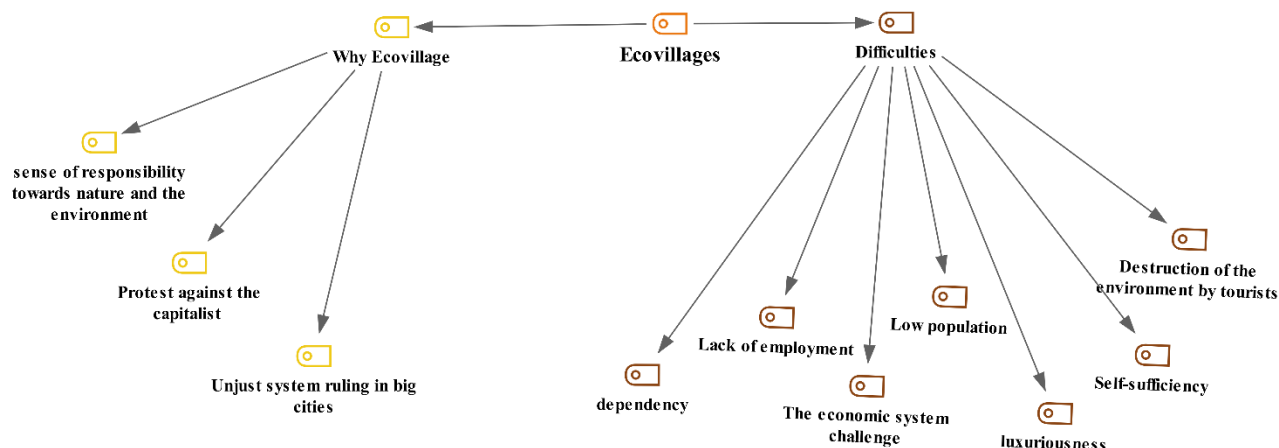


Fig.71. Ecovillages - Hierarchical Code-Subcodes Model

Following that, they were questioned on the actions required for cities and villages to become ecovillages. They believed that the villages needed motivation, adaptability, communication with the outside world, and the elimination of traditional hierarchies (Fig.71). One of the highest priorities of ecovillages is to provide common spaces for everyone, including women and children, free of traditional roles. Since ecovillages have a specific vision of dismantling traditional hierarchies and leadership patterns, as well as a broader vision in which the local village is not isolated from the globalized society. According to one of the participants, common spaces and resource sharing are not more or less equal in traditional villages. To transform traditional villages into ecovillages, it is extremely crucial to motivate people to preserve the environment and improve communication with nature through innovations and joint social activities that increase people's cohesion and sense of belonging. In the field of cities, they believed that early stages of management and planning, cultural transformation or culturalization of a sustainable lifestyle, government support, and infrastructure changes are critical (Fig.70). Some believe that such a lifestyle is possible in villages and small communities, according to one participant. However, it is also possible in large cities since Ecovillage is about lifestyle rather than a place. It takes more time and requires more changes, especially in terms of infrastructure, management, and planning. Accelerating the development of new technologies, such as the Internet of Things (IoT) and artificial intelligence could be a solution. With a perspective on managing sewage and urban waste, renovating buildings to

save energy, creating new green buildings, and Reducing greenhouse gas emissions. One participant in this segment believes that telecommunications and technology companies must collaborate with governments to increase people's communication and social interactions, as well as their understanding of current changes, in order to move more populated cities toward sustainability. Another interviewee noted that one of the causes of city instability is improper construction, particularly of buildings, as well as improper transportation, which causes a lot of environmental damage. Therefore, building decarbonization, which is one of the most cost-effective ways to reduce climate change, alternative transportation, and bicycle rails could be appropriate solutions in this field. Accordingly, Ecovillages are one of a growing number of grassroots initiatives that are transforming society. They merit more consideration due to their obvious success in developing alternatives, lowering carbon emissions, solving issues, and being innovative. The ecovillage is a part of a sizable network of social and political initiatives, such as the Transition Town Movement, cooperatives, urban or community gardens, and The Occupy Movement (Yates, 2015; Wright, 2013; Celata & Sanna, 2019). This lifestyle must be taken into account as a base station in a transformative network in urban planning towards sustainability if we want to effectively stop harmful environmental impacts and climate change. These kinds of initiatives significantly improve the lives of participants and contribute to broadening the transformative scope of social empowerment in the face of climate change, even though we are aware that individual projects, particularly those that take place in urban areas, do not always result in change at the fundamental structural level (Wright, 2010; Igalla et al., 2019; North & Longhurst, 2013). Further, some researchers support the visualization of real utopias, including democratic-egalitarian projects of individuals who start social, political, and cultural changes as well as utopian projects that offer the chance for introspection and change. These projects range from gradual socio-cultural transformation through diffusion through the creation of alternative socio-economic relations spaces (Wright, 2010; Sekulova et al., 2017; Vicdan & Hong, 2018; Casey et al., 2020).

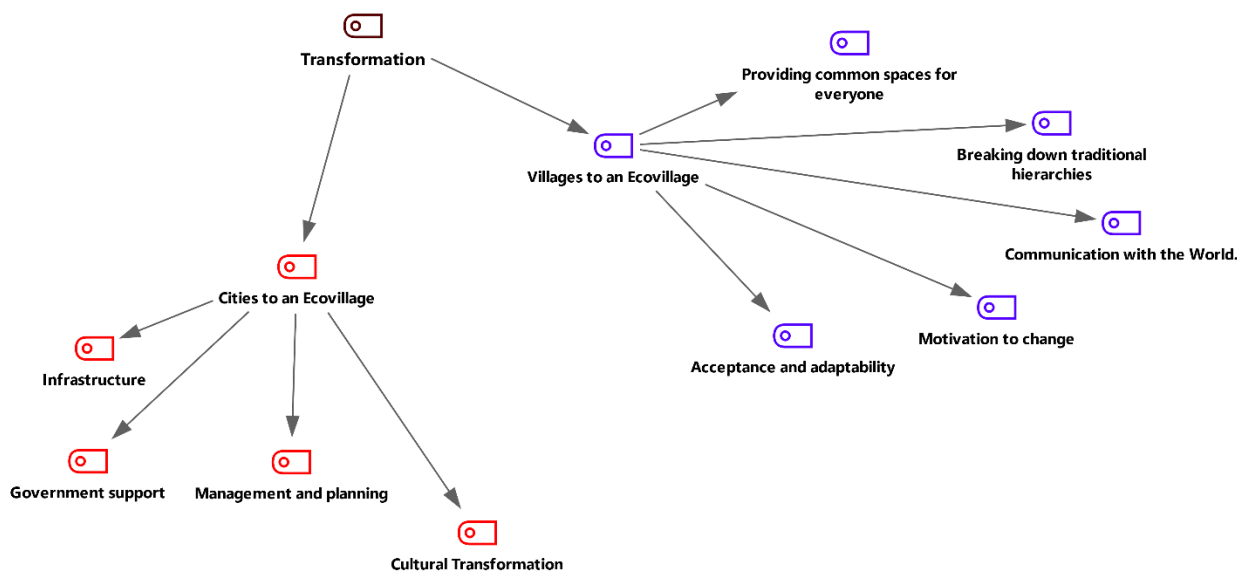


Fig.3.72. Ecovillage-Transformation - Hierarchical Code-Subcodes Model

Up to this point, the investigation of business spaces, the reasons of residents' migration to the ecovillage, their difficulties, and the transformation of villages and cities into ecovillages have all been looked at. The technological, ecological, and social criteria that the participants placed a lot of emphasis on, will be discussed in the sections that follow.

In terms of technology, ICT, telecommunication, agricultural technology adoption, the Internet of Things, and artificial intelligence have been highlighted (Fig. 71). Despite the fact that some researchers assume that ecovillage and technology are two unfamiliar concepts with an unnatural fit. However, whether this technology is used to advance societal values, it has the potential to accelerate the transition to a regenerative world by improving cooperation, sharing information, facilitating communication, reducing greenhouse gases, alternative transportation, green businesses, and finally green and sustainable construction. Ecovillages are a source of technological innovation, but only when the ecological motive takes priority over modernist ideas of growth and innovation. This can be seen in how they collectively submit to communal covenants and a collective lifestyle that accommodates diverse attitudes toward technology use while readjusting its purpose. Self-sufficiency, however, is about much more than food production, and interconnection is important when you are part of a decentralized network. Presently, everyone is seeking to help their members collaborate remotely, and when they host their own ICT tools and use open-source software, they are less dependent on large corporations. Which significantly raises community and network flexibility and capacity. Some residents of the ecovillages under study supported the adoption of technology for the

improvement of these communities, while others compared it. Despite the fact that there are many different perspectives on technology, environmental factors affect them all. Others attempt to spend as little time as possible in front of a screen or connected to the Internet, while some people spend the majority of their day using digital technologies and are adept at using new inventions. However, they all concur that because they enable various aspects of sustainable development, new or contemporary inventions such as ICT and the Internet of Things have a place in their collective experimentation. This also meant that they frequently disagreed about which type of technology to deploy. Sustainability debates, like much of society, revolve around the need to change consumption patterns, alternative transportation, and the best path to achieve it, which is not always clear. The collective understanding that this is an attempt to create a sustainable period in line with the combination of social, environmental, and economic dimensions as well as new technologies in one format is unique in the way of life of the studied ecovillages. In general, technology plays an important role in people's daily lives in society, from the vehicles they use to the building they live in, and is directly related to their commitments to living a sustainable life in order to reduce harmful effects on the environment. Therefore, it's crucial to try to achieve a balance between technology use and a life style that is environmentally, socially, and economically sustainable (Rubin, 2019; Nathan, 2008; Kirby, 2017; Papenfuss & Merritt, 2019; Wittmayer et al., 2019; Grinde et al., 2017).

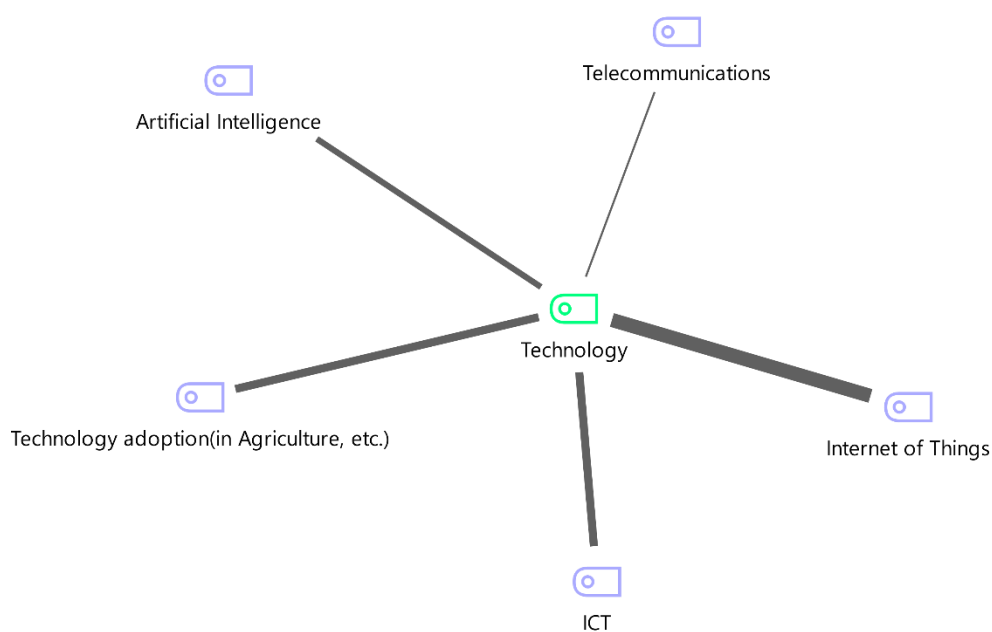


Fig.3.73. Technology - Single-Case Model

The ecological dimension mentions recycling of waste and wastewater management, alternative transportation, reduce energy consumption, biodiversity with the goal of a sustainable future and earth conservation (Fig. 72). This dimension is critical because the main purpose of establishing ecovillages was to maintain these criteria in order to have a sustainable future. The studied eco-villages believe that in order to preserve their environment, they take actions such as preserving natural habitats, producing food, wood, and other biological resources locally, processing organic waste produced on site, and recycling. They emphasize solid waste management, wastewater treatment, the use of renewable energy sources (solar, wind, etc.) rather than fossil fuels, organic waste composting, domestic wastewater treatment, and the avoidance of toxic substances and chemical fertilizers. The participants placed a strong emphasis on the success of residents' individual waste recycling practices, believing that it played a significant role in reducing pollution. While individual decisions play a role in these declines, community culture, policies, and decision-making processes are important factors in the underlying nature of these declines. Through their choices in building practices, infrastructure, social institutions, and community culture, these communities specifically organized themselves to have a less damaging and more restorative relationship with the natural world. These communities' innovations include extensive sharing networks, collaborative decision-making, innovative energy sources and networks, cluster development, wastewater management, biodiversity, and green and natural housing. Therefore, living in an ecovillage or adopting this sustainable lifestyle can have a significant impact on a person's energy consumption and carbon emissions when compared to living in an urban or rural configuration (Sherry and Ormsby, 2016; Bayulken and Huisingh, 2015; Litfin, 2013; Sherry, 2019; Seyfang, 2010; Boyer, 2015).

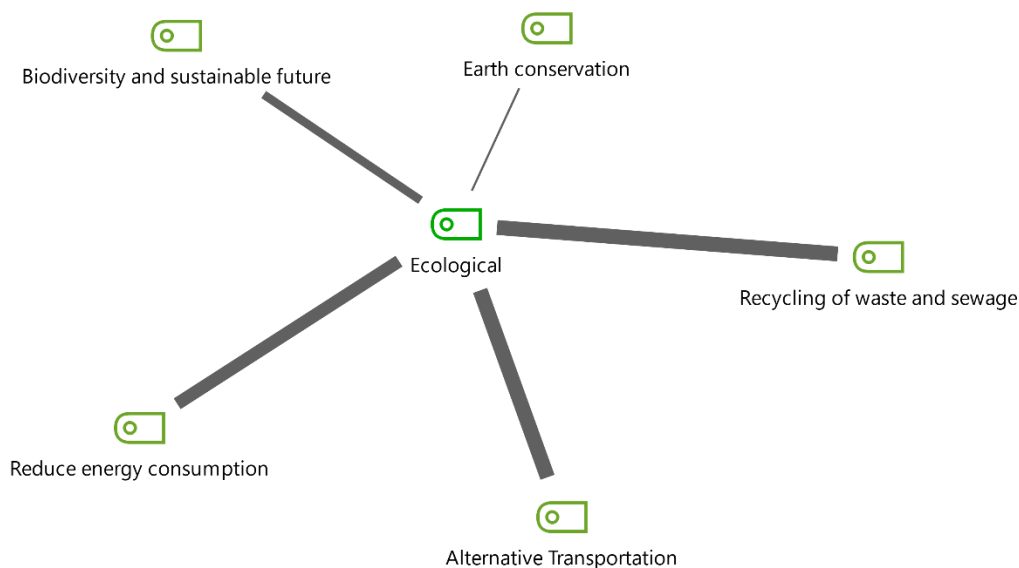


Fig.3.74. Ecological - Single-Case Model

Respect for nature, humans, and animals, gender equality, education, common vision, solidarity, cooperation, and communication, environmental responsibility, peace, justice, and solidarity, compatibility, freedom, and equality are all considered in the social dimension (Fig. 73). The foundation of Ecovillage is the community and social standards of a group of people, so an Ecovillage lifestyle is not possible without social cohesion and solidarity. There must be a coherent vision, a common driving strength, and all residents must be on the committee with this vision. This Common approach is important for connecting discussions of sustainability transformations to ecovillages and sustainability-focused initiatives. The more fundamental and lasting transformations happen when the underlying values, beliefs, and ideals shift in a way to support certain practices and behaviors. While ecovillages are transformative, the community practices of the ecovillages studied reveal them as a source of inspiration and experimentation for transformative change. Finally, social capital reveals the mechanisms that facilitate sustainable transformations. Moreover, shared values in societies greatly strengthen the sense of belonging as an important source of motivation for collective action based on common ideals (Avelino & Kunze, 2009; Brown et al., 2019; Pelling, 2010; O'Brien, 2018). Furthermore, education is the most effective societal mechanism for dealing with the century's greatest challenge, namely, sustainable development (Barani et al., 2018), which results in the accumulation of human capital and capacity building. Furthermore, learning and exchanging information with other sustainable communities is regarded as one of the final stages of the ecovillages' lifecycle (Vidickiene, 2013). However, in many current meta-analysis studies, ecovillages are described as "Live Laboratories of Sustainability" (Winston, 2012;

Ardzijauskaitė, 2009; Zamchevska, 2013; Loezer, 2011; Boyer, 2013; Sherry, 2014), which instructs how to live sustainability, such as Farm in Tennessee (Carroll, 2010).

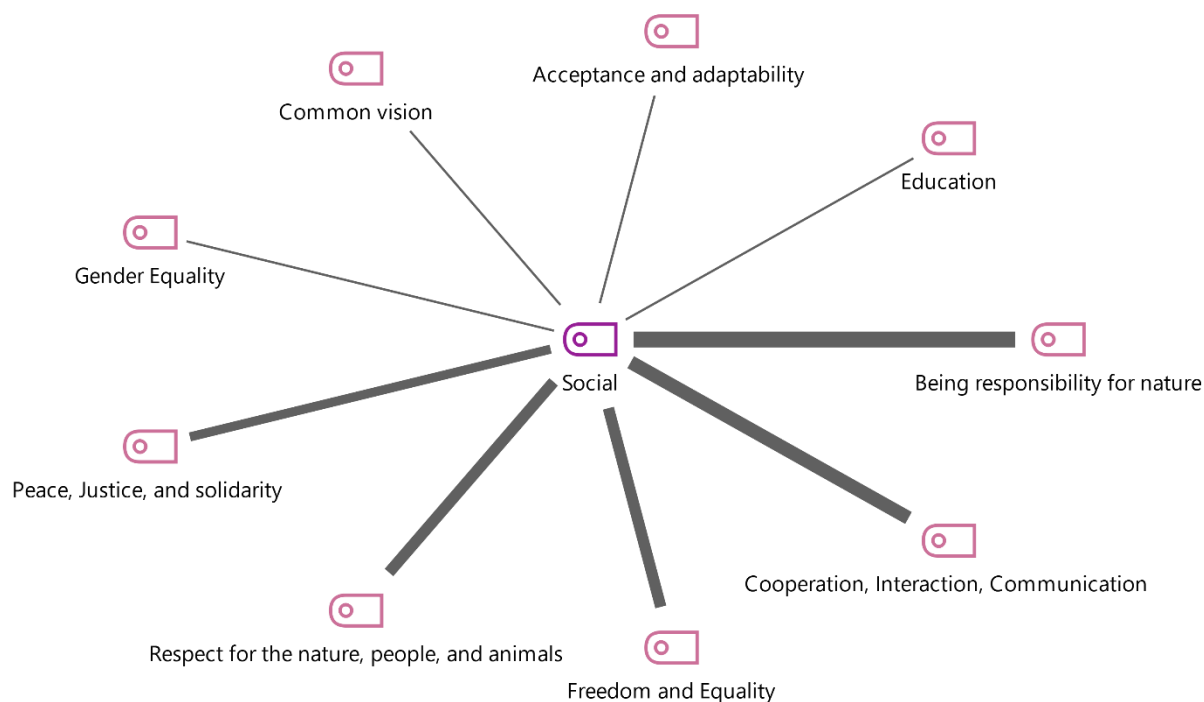


Fig.3.75. Social - Single-Case Model

The results from the 11 ecovillages in France provide specific examples of how sustainable practices can be implemented in a community setting. These ecovillages serve as models for other communities to adopt sustainable practices, such as community-supported agriculture, renewable energy projects, and eco-tourism. By showcasing the economic benefits and environmental impact of these practices, ecovillages can inspire other communities to adopt similar practices and contribute to a broader environmental transition.

Furthermore, the ecovillages' emphasis on social and environmental responsibility highlights the importance of community engagement in promoting sustainability. This engagement can be extended to neighboring communities and municipalities, encouraging them to also adopt sustainable practices and contributing to a broader transition to a more sustainable future.

Overall, the experiences of ecovillages in France demonstrate the potential for small-scale sustainable initiatives to have a significant impact in promoting environmental sustainability, which can lead to a broader environmental transition.

Ecovillages represent promising models of sustainable living, with their experiences providing valuable insights and practical examples of sustainable living practices that can be adopted by

individuals, communities, and governments to promote a more sustainable way of life. The 11 ecovillages studied in France demonstrate the potential for ecovillages to serve as models for sustainable living, and their lessons learned can be applied to other contexts and locations, with adaptations based on local conditions and cultural factors.

Furthermore, the successes and challenges faced by ecovillages can inspire and mobilize broader environmental movements, encouraging individuals and communities to take action to promote a more sustainable way of life. Ecovillages can therefore play an important role in influencing policy and governance, with their experiences and practices informing and influencing policy decisions, promoting the adoption of more sustainable practices and the development of supportive infrastructure and systems.

In particular, ecovillages can inform and influence institutional governance, promoting the adoption of policies and regulations that incentivize sustainable practices while discouraging unsustainable ones. This can include measures such as implementing land-use policies, promoting sustainable transportation options, and managing waste and water resources. Technology can also play a critical role in supporting ecovillages and promoting sustainable practices, by providing decision-making tools and data analytics to aid in the transformation towards sustainability.

Overall, ecovillages represent a promising model for sustainable living that can serve as an inspiration, a source of knowledge, and a catalyst for change, ultimately contributing to the broader goal of promoting sustainable development at the societal scale.

3.4. The Modeling

Q7. Can we define a model for achieving urban-rural sustainability based on Ecovillage and ICT?

The Seventh question will be examined in this section. The goal of this question is to provide an appropriate model for achieving urban-rural sustainability through ecovillage and ICT. This section categorizes quantitative and qualitative research findings in general. This modeling is intended to provide a simple representation of reality that shows what is thought to be required for this reality. Therefore, the entire research results are evaluated at a glance in this model.

In the first stage, the most important features of ecovillages were identified based on the resident preferences in cities (first question), and the second stage is to determine ICT development in relation to environmental sustainability in order to create smart cities (second question). Moreover, the third

stage is the relationship between sustainable development and ICT to achieve urban ecovillage communities (third question), the fourth stage is evaluating the possibilities for traditional villages to be transformed into ecovillage lifestyles (fourth question), and the fifth stage is suitable solutions for the sustainability of business spaces with the aim of becoming an ecovillage (fifth question). Finally, the sixth stage is the commitment of current ecovillages to a sustainable lifestyle (sixth question) (Fig. 3.76).

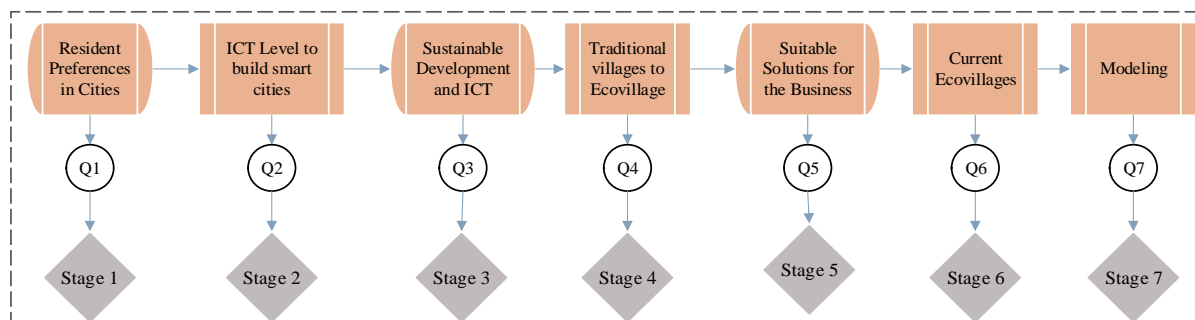


Fig.3.76. the basic structure of the model

3.4.1. Resident Preferences in Cities

In this section, significant dimensions and indicators were established using the structural equation model. From the perspective of urban residents in Iran, the individual aspects, transportation, and access, social, economic, and cultural aspects were the most crucial aspects of establishing an ecovillage. The most significant dimensions in France were access and transportation, followed by economic, agricultural, social, and individual factors. From a broad perspective, it is evident that the residents in both situations place a significant emphasis on access to transportation, economic factors, social factors, and individual factors. Small cities in Iran were generally more focused on all dimensions, whereas big cities in Iran were more focused on the environmental, economic, individual, and social aspects. Large cities in France concentrated almost equally on all dimensions but less on the cultural and architectural ones. Smaller cities put more emphasis on the environment, culture, architecture, accessibility, and transportation (Fig 3.77).

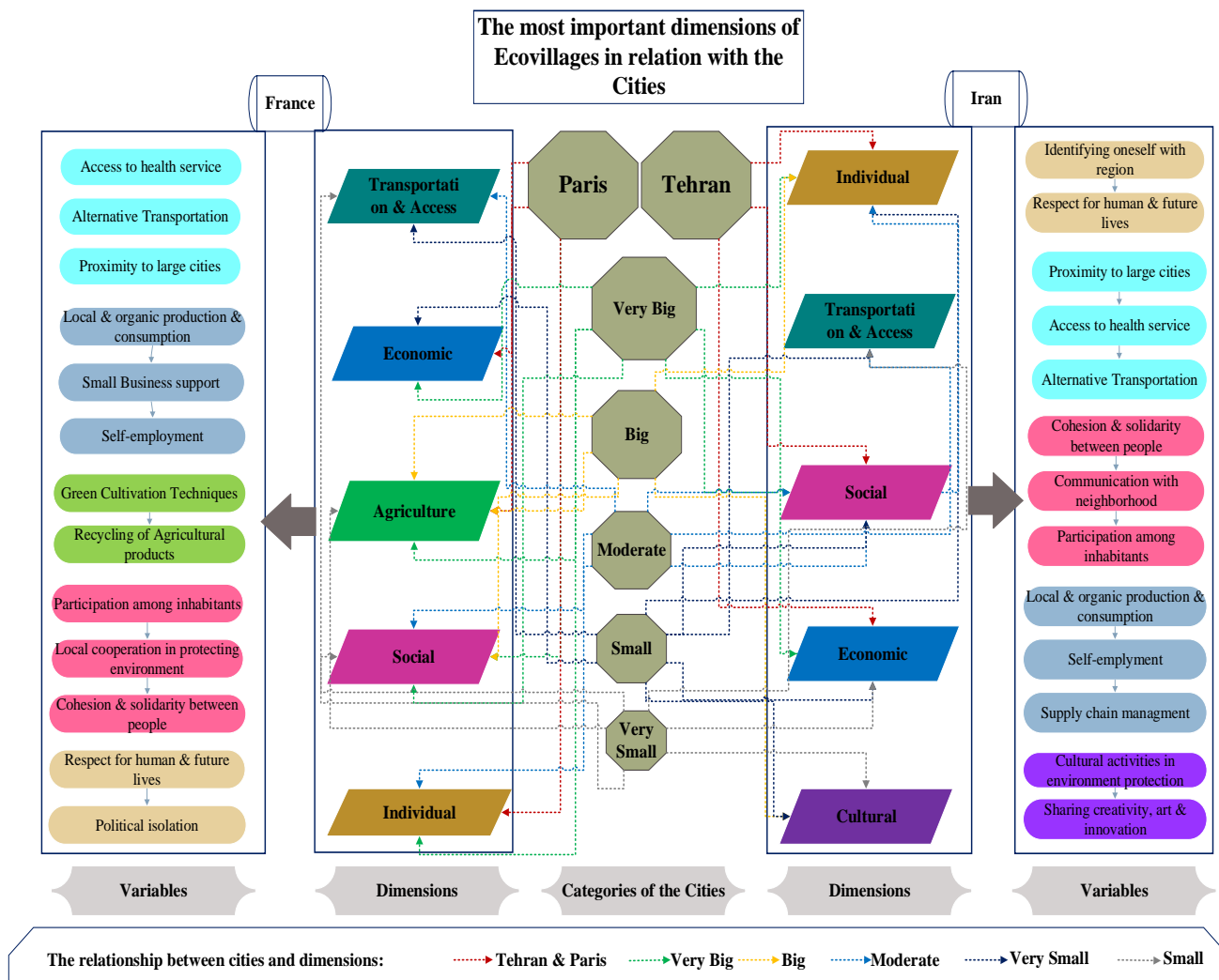


Fig. 3.77. Modeling of Resident Preferences in Cities

3.4.2. ICT Level to Build Smart Cities

In this section, the importance of information and communication technology in achieving digital cities was emphasized. Residents' ICT according to what kind of devices they use or in other words what kind of devices they own in order to use ICT. Additionally, the amount of Internet access, social network usage, and E-commerce was assessed. Finally, the impact of the Covid-19 epidemic on locals' use of ICT was evaluated. Those who have a consistent Internet connection have more devices on their property and have access to the Internet. People who only have access to the Internet at home and at work use fewer devices. France's citizens used the Internet more frequently than Iranians did on a daily basis. In the two countries, different social media platforms were used. In both cases, the relationship between management system learning and word processing is a direct relationship; that is, as management system knowledge increases, so does word processing knowledge. On the other hand, French people are more

knowledgeable about web design than about online research, while Iranians are more knowledgeable about online research than about web design. In terms of company ICT level, it should be noted that 93.3% of companies in France and 85% of companies in Iran use computers. In addition, 78.5% of companies in France and 69.3% of companies in Iran have Internet access. Furthermore, in France, 79.0% of businesses have their own website, whereas, in Iran, 63.4% have a website. Finally, the Covid-19 epidemic has had a significant impact on both countries' advances in ICT (Fig. 3.78).

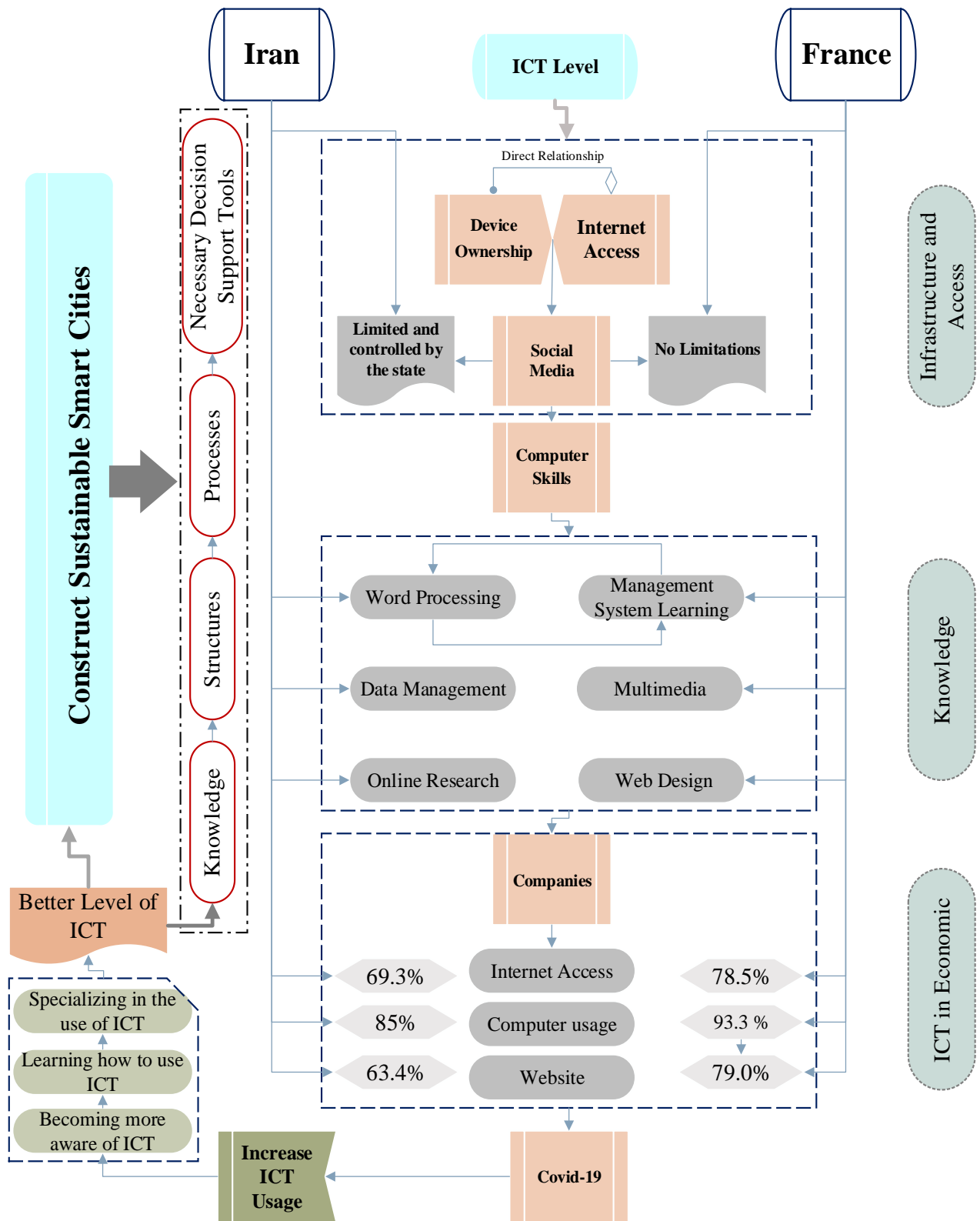


Fig.3.78. Modeling of ICT Level to Build Smart Cities

3.4.3. ICT and Sustainable Development

The role of ICT in the development of sustainability and its spatial relationship was emphasized at this stage. In general, information and communication technology (ICT) plays the most important role in the environmental aspect of sustainable development. In France, the indicators of "improving product quality," "communication with customers," "cultural institutionalization of technology in business," and "cost reduction" received more attention, whereas in Iran, the indicators of "growing business-to-business partnerships," "finding new businesses," "increasing productivity," "communicating with successful entrepreneurs," and "improving product quality" received more attention. In France, ICT plays a greater role in "solidarity and cooperation," "technical knowledge," "learning new skills," and "cooperation with other regions" in the social dimension. In Iran, however, the emphasis was more on "raising awareness," "creative and innovative ideas," and "technical knowledge." In terms of the environment, "saving energy," "improving waste management," and "advanced pollution-reduction technologies" were the most important indicators in France. While in Iran, the indicators influenced by ICT were "environmental awareness," "care more about climate change," and "environmental commitment" (Fig. 3.79).

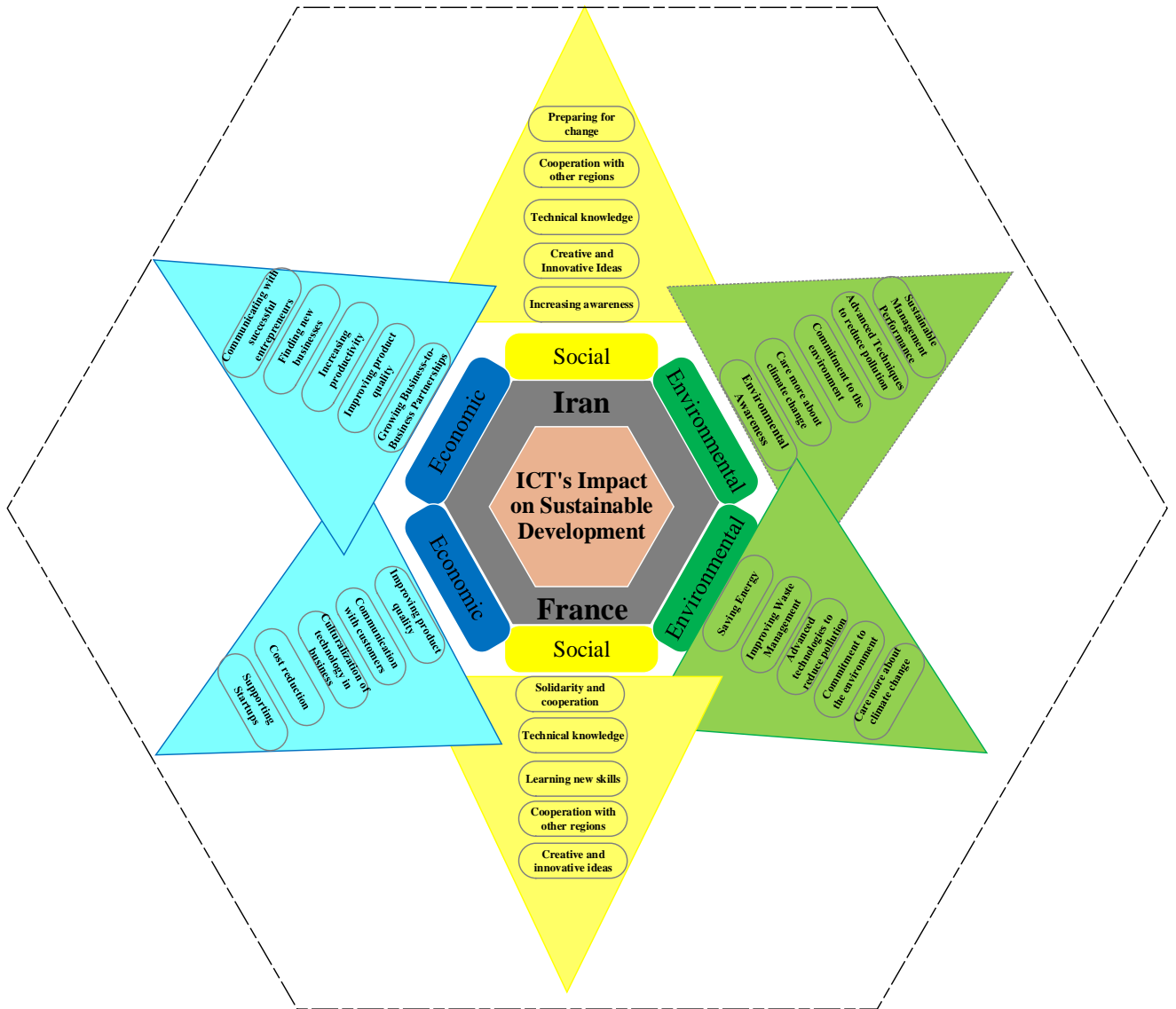


Fig. 3.79. Modeling of ICT and Sustainable Development

3.4.4. Traditional villages to Ecovillage

This section looked into the process of transforming traditional villages into ecovillages. In terms of economics, the most important criteria for becoming an ecovillage in Iran are entrepreneurship, self-sufficiency, tourism activities, localization of the economy, and women's empowerment. In France, the emphasis was on the development of the local economy, small businesses, a competitive and innovative economy, and sustainable business. In Iran, public awareness, local cooperation, education of sustainable behaviors, responsibility, and flexibility were all taken into account. Awareness raising, communication, local people motivation, leadership, city connections, and adaptability were all critical in France.

In terms of the environment, waste management, energy consumption, organic agriculture, and green buildings were all taken into account in Iran. In France, villagers prioritized natural resources and energy, biodiversity protection, environmentally responsible construction, and waste management. Moreover, Culturalization of sustainability, regional festival organization, cultural heritage in Iran, Culturalization of web use, design and dance, and attitudes and values were all considered in the cultural sector. On other hand, Iranian and French villages were very similar in terms of technology, placing a strong emphasis on modern agriculture. To be more specific, satellite images, irrigation techniques, IoT sensors, agricultural robots, and modern machinery were given more attention in Iran. Additionally, robotics, digital innovation, artificial intelligence, tracking technologies, and ICT received more attention in France. In addition, The building of educational facilities, the expansion of infrastructure, and the establishment of health facilities were all mentioned as examples of government support in Iran. In France, they mainly meant increased accessibility, public health access, government support for economic sustainability, and lower taxes. Finally, three factors are required for the success of an ecovillage (Fig.3.80).

- ✓ First, focus on the project process as much as the ultimate objective.
- ✓ Second, pay particular attention to decision-making and operational processes.
- ✓ Third, implementing infrastructure reconstruction and modernization.

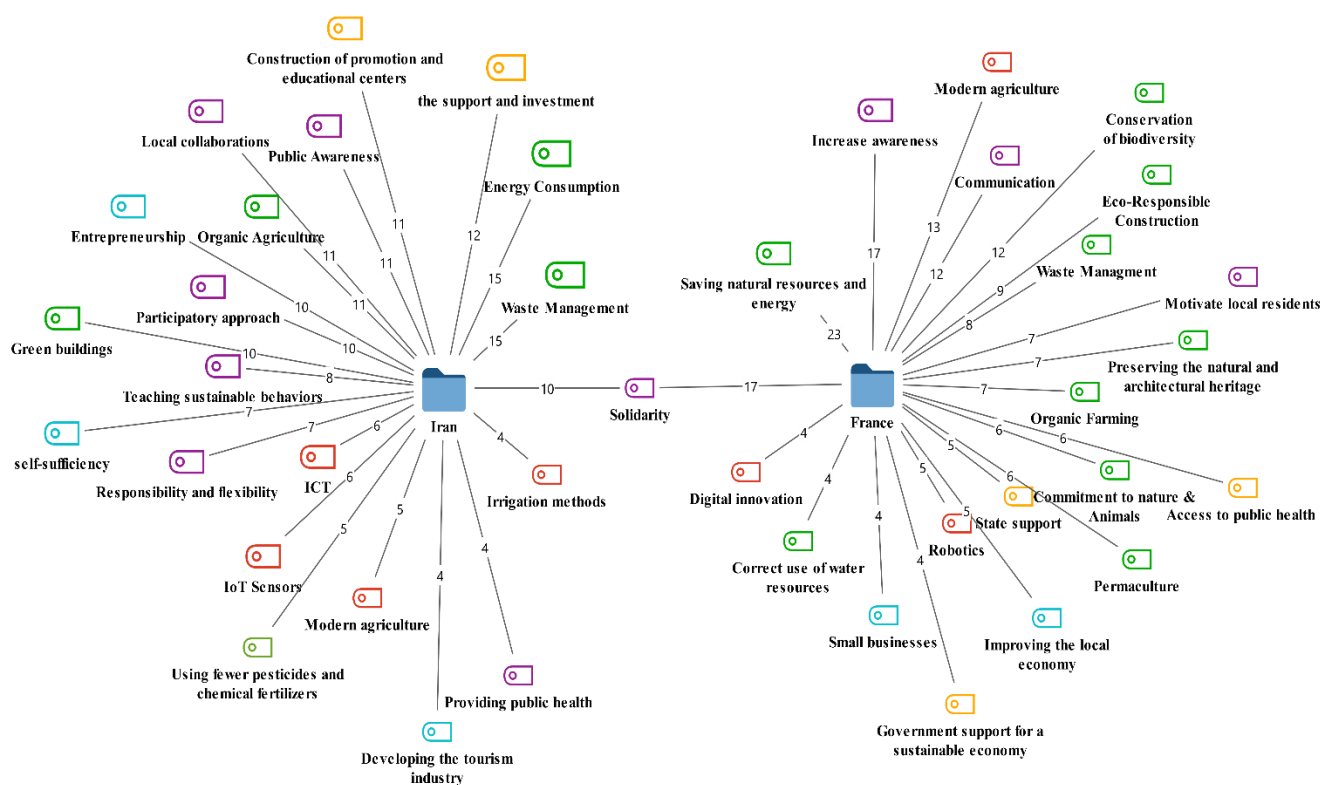


Fig. 3.80. Modeling of Traditional villages to Ecovillage

3.4.5. Suitable Solutions for the Business

In this question, an attempt was made to examine the state of rural Business spaces or the economic activities they were carrying out, and then to provide solutions for these Business spaces in order to have a sustainable future and become an ecovillage.

According to the findings, agriculture, animal husbandry, handicrafts, and tourist activities constituted the majority of the economic activities in the studied villages in Iran. In France, however, most of them were local services, wholesale and retail trade, agriculture, arts and crafts, and manufacturing. Moreover, the participants' strengths and weaknesses were discussed in order to create sustainable business spaces in the studied rural areas. The villagers in Iran mentioned the following weaknesses: high unemployment, a lack of proper infrastructure, a tendency of villagers to migrate to cities, a lack of government support, and an increase in the migration of rural youth. In France, the village population was reduced, there was a lack of sustainable development workshops, a lack of awareness about sustainable lifestyles, and a lack of government support. Finally, the villagers in Iran showed more weaknesses than the villagers in France. In terms of strength, the villagers in France illustrated greater strength than the villagers in Iran. Therefore, in Iran, they pointed to an increase in tourism-related jobs, the fertility of agricultural land, a large number of university graduates, and young and active

workforces. Most participants in France believed that their village currently practices a sustainable lifestyle. They also see proper transportation between the village and the city, meditation classes, increased sports activities in the village, minimal environmental destruction, the accessibility of suitable services and infrastructure for the disabled and elderly, and the diversity of vegetation as village strengths (Fig. 3.81).

In this regard, the participants in Iran are most interested in creating job opportunities, supporting small businesses, private sector investment, marketing, and advertising ability, tourism market development, basic infrastructure for green businesses, tourist accommodation, and the development of local and regional markets as solutions.

Educational workshops, the development of sustainable tourism, alternative transportation, the use of ICT in the process of producing services, the development of public transportation, the development of a sustainable economy, increased communication between people and officials, and the development of sustainable agriculture are all important in France, were the best solutions for running a sustainable business were considered.

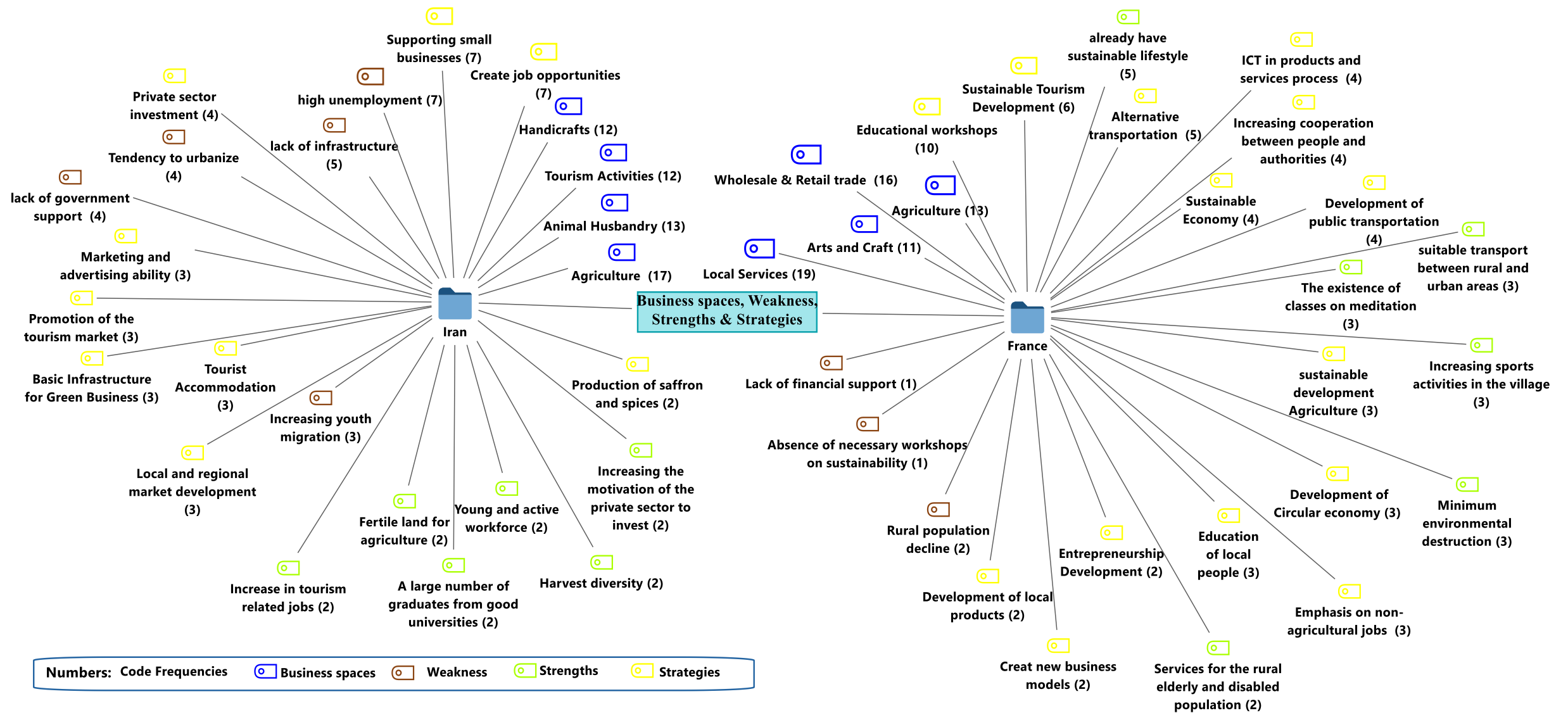


Fig. 3.81. Modeling of Suitable Solutions for the Business

3.4.6. Current Ecovillages

The sixth step examined and analyzed the commitment and responsibility that ecovillages have in conformance with a sustainable lifestyle. At this point, residents of the studied ecovillages has spoken about their ecovillage and its adherence to the ecovillage's main core principle, which is sustainability. They also discussed the existing business spaces, the reasons for migrating to Ecovillage, the difficulties, and the transformation of traditional villages and cities to Ecovillage. Finally, the ecovillage's characteristics were classified into codes and subcodes. The findings demonstrated that ecovillages have the necessary social and environmental commitment and responsibility to live a sustainable lifestyle.

However, challenges were raised in terms of economic inadequacy and the negative effects of tourists on the nature of the region. Given that self-sufficiency is one of the fundamental principles of ecovillages, it is necessary to acknowledge that not only ecovillage communities but also cities and villages, cannot be completely self-sufficient and have no need from the outside world. It is meaningless, especially if an ecovillage intends to use ICT and technology to advance its goals, because one of the fundamental principles of using technology is communication with the outside world, both socially and economically. In an idealistic situation, an ecovillage can maintain its economic strength while also establishing connections and economic cooperation with other regions. Because the main goal here is to continue living a sustainable lifestyle while preserving the environment and resources (Fig. 3.82).

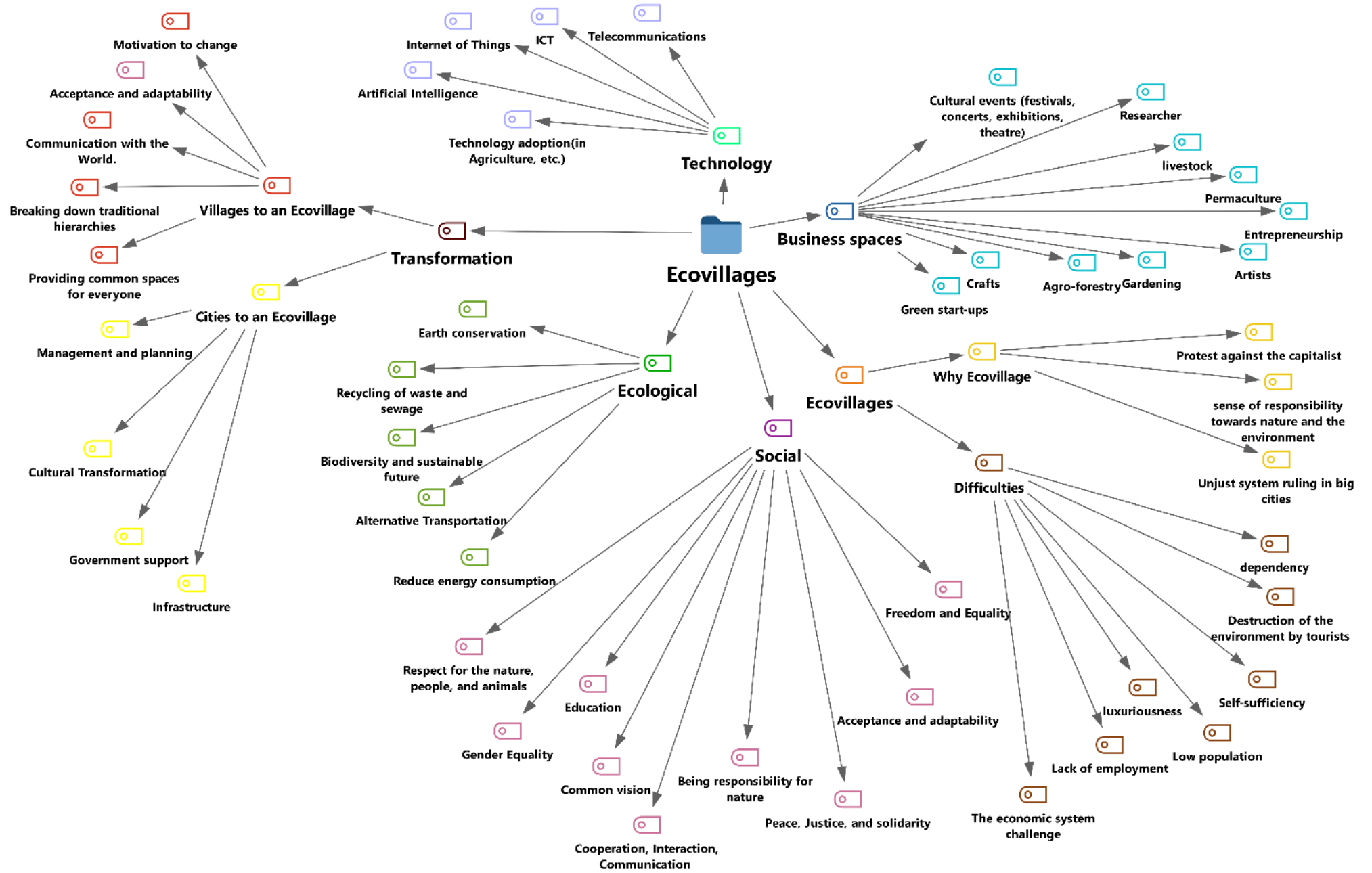


Fig. 3.82. Modeling Current Ecovillages

3.4.7. The whole Model

The final framework of each stage and its entirety was shown separately and in a comparative manner in previous stages. In this section, the modeling of all research findings as a whole is discussed (Fig.3.83). This model demonstrates that in order to achieve urban sustainability, cities must be transformed, which necessitates the participation of all members of society. Citizens can help by changing their beliefs, values, attitudes, and lifestyle. Companies play an important role in this field in the following stage by changing their strategies and employing sustainable models. In other words, in addition to emphasizing the economic benefit and increasing profits, they should consider the effects on society and the environment. This action and sense of responsibility should include all companies, including private, public, shareholders, and civil organizations, with the goal of changing the strategy toward sustainability. Next, governments are one of the most powerful influencers in this field, as their actions can accelerate the transformation and provide the necessary infrastructure. Specifically, access to public services for all citizens and the implementation of long-term projects in this area. For example, the development of alternative modes of transportation will be critical in this field. This can be accomplished in a variety of ways, including changing the fuel and energy of transportation vehicles and, on the other hand, creating conditions for better and faster bicycle use in the city. In order to achieve this transformation, infrastructure and technology changes will be required in the following stage. ICT for increased communication, awareness, and skills, as well as the Internet of Things, are critical for smart buildings and green economic activities. The cooperation and investment of governments is critical at this stage.

Following that, the villages' transformation was modeled toward sustainability, which is very important to investigate due to the direct connection with nature and the important role of these communities. Important factors influencing this transformation include social, economic, and environmental dimensions, government support, and technology acceptance. A sustainable business environment is one of the most important criteria for village sustainability. According to the researcher, the most important strategies for village transformation are the presence of educational centers on sustainability, green businesses, and green lifestyle, an emphasis on non-agricultural jobs, the use of technology in activities, and the use of a collaborative approach in project implementation. It has something to do with villages. Finally, for these transformations, it is very important to have a flexible and successful model as a lifestyle,

which is Ecovillage here. The transformation of current societies, both urban and rural, will be a prelude to the sustainability of urban-rural societies.

Achieving urban-rural sustainability is a complex process that requires collaboration among all members of society, including residents, companies, and governments. This requires taking proactive steps to ensure that areas are prepared to undergo sustainable transformations. One such step is to identify and establish targets and goals for sustainable growth that are specific to each area. Residents can play an important role in this process by being provided with education, awareness, and involvement opportunities. This can be achieved through initiatives such as educational campaigns and involvement in decision-making processes. In addition, residents can be encouraged to participate in sustainable practices through various incentives such as tax credits, reduced utility bills, and subsidies for sustainable products. The creation of renewable energy cooperatives and car-sharing programs can also help to foster a sense of community and encourage sustainable practices. These measures can help to facilitate the transition towards urban-rural sustainability and promote the creation of more sustainable and resilient communities. Further research is needed to explore the effectiveness of these strategies and identify additional policy lessons that can contribute to the achievement of urban-rural sustainability.

To build sustainable areas, it is crucial to involve residents in the planning and implementation of sustainability initiatives in their communities. This can be achieved through community consultation, participatory planning processes, and collaborative decision-making forums. A multifaceted approach is necessary, which involves the implementation of green growth and equity principles to promote environmentally sustainable growth that is also socially inclusive and equitable. It is essential to ensure that growth does not come at the expense of the environment or marginalized communities.

Private, public, stakeholders, and civil organizations all have a role to play in building sustainable areas. Private entities can invest in green technology and promote sustainable business practices, while public entities can develop policies and regulations to incentivize sustainable practices. Stakeholders and civil organizations can engage with communities to raise awareness and advocate for sustainability. The deployment of renewable energy infrastructure, such as solar panels, wind turbines, and geothermal energy systems, can also contribute to the sustainable development of areas.

To prepare for the transformation towards sustainable areas, it is necessary to take proactive steps to ensure that the areas are ready to undergo sustainable transformations. This includes identifying and setting targets and goals for achieving sustainable growth based on each area. For example, residents can be provided with education and awareness initiatives, involvement opportunities, and initiatives such as educational campaigns and involvement in decision-making processes. Moreover, encouraging them to participate in sustainable practices through various incentives such as tax credits, reduced utility bills, subsidies for sustainable products, and the creation of a sense of community by renewable energy cooperatives and car-sharing programs can also be beneficial.

In the pursuit of sustainable smart cities, institutional governance can play a critical role in promoting sustainability by ensuring that policies and regulations are in place to facilitate sustainable practices. This can be achieved through the implementation of land-use policies, promoting sustainable transportation options, and managing waste and water resources. Regulation strategies that incentivize sustainable practices and discourage unsustainable ones are necessary to promote sustainable transformation.

Furthermore, technology can be an essential tool in achieving sustainable transformation. Decision-making tools and data analytics can help facilitate the transformation towards sustainability, while knowledge dissemination and transfer can be improved by providing easy access to information and resources needed for sustainable management practices.

In addition, access to technology and ICT usage can help bridge the digital divide and provide equal opportunities for all citizens to participate in sustainable transformation. Policies and initiatives that prioritize technology access and education, as well as community outreach programs that promote digital literacy and ICT skills, can help increase technology adoption and promote sustainable smart cities.

In summary, institutional governance and technology adoption are crucial components of building sustainable smart cities and promoting sustainable management practices. Policymakers and city planners must work together to establish regulations that promote sustainability, while also ensuring that citizens have access to the technology and skills needed to participate in sustainable transformation.

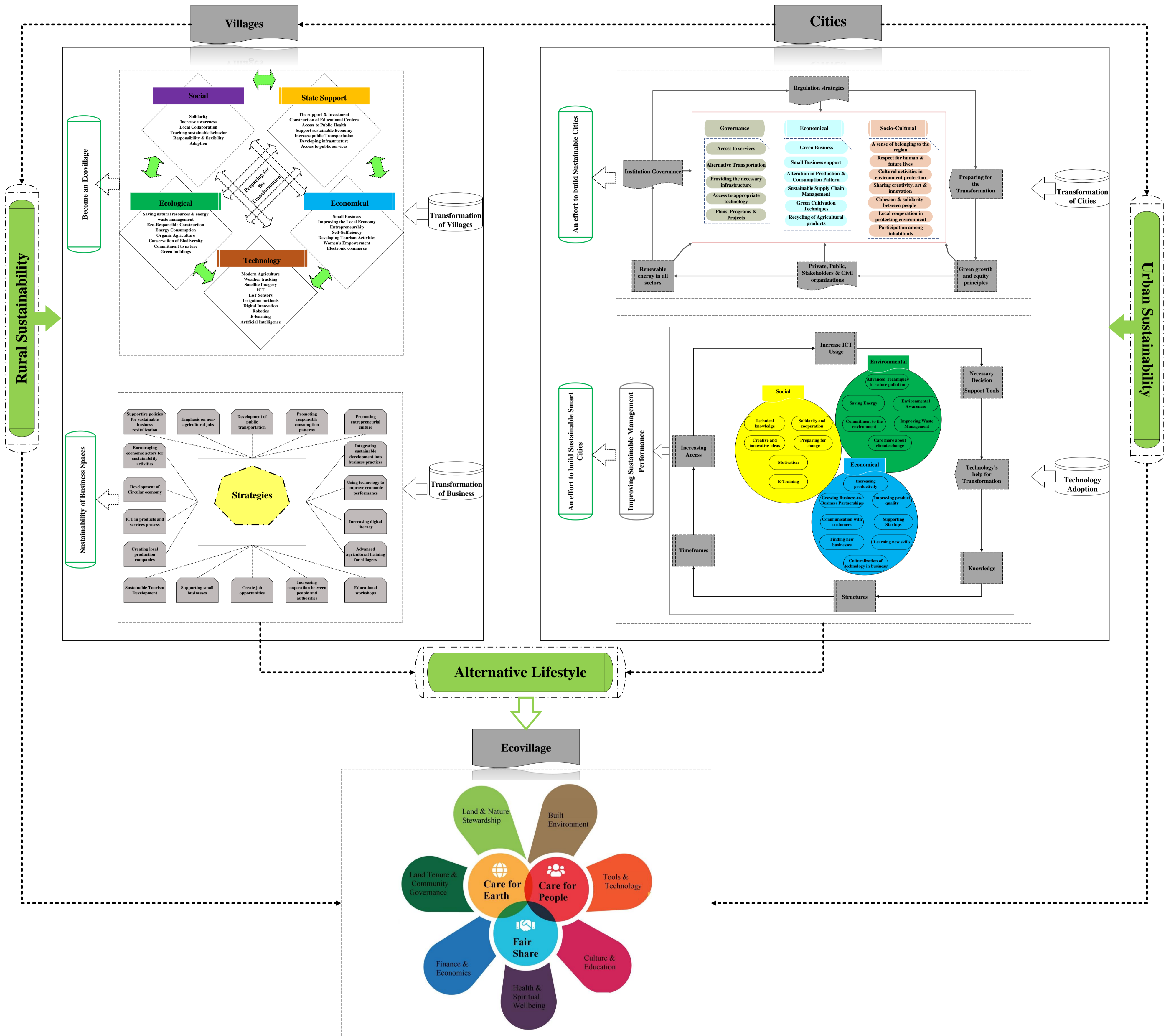


Fig. 3.83. Modeling Environmental Sustainability

Summary

The findings of quantitative and qualitative research were discussed in this chapter. On the one hand, quantitative methods were used to investigate and analyze city dwellers' perspectives on the ecovillage, the level of ICT development in relation to environmental sustainability in order to build smart cities, and the relationship between ICT and sustainable development. On the other hand, the qualitative method was used to investigate and analyze the transition of traditional villages to ecovillages, the relationship between ecovillages and sustainable business, and the commitment and responsibility of French ecovillages. Finally, the most effective model based on ecovillages and ICT for achieving urban-rural sustainability was presented.

Conclusion

Ecovillages all over the world are developing processes and solutions to address the known and unknown social and environmental challenges that communities are facing as a result of climate change. Ecovillage has peacefully pioneered many socially and environmentally sustainable technologies to create eco-friendly communities on the outskirts of mainstream society. Hence, based on Ecovillage and ICT, this study aims to achieve environmental sustainability in urban-rural areas. In other words, was conducted in light of the environmental problems caused by climate change, unsustainable lifestyles, and a lack of awareness among urban and rural residents about their role in these challenges. Hence, in my research, I presented two solutions. The first is to change the lifestyle toward sustainability by following the urban ecovillage model. The other is the application of new knowledge and technologies, such as ICT, to accelerate sustainable development in areas such as renewable energy, alternative transportation systems, sustainable agricultural methods, public health, construction and urban infrastructure, and so on.

Therefore, the main goal of this thesis is to present an appropriate model for achieving urban-rural sustainability using Ecovillage and ICT. To achieve this main goal, I established six sub-goals. The first to third objectives were based on data collected from urban areas with 1100 respondents, 500 in France and 510 in Iran (via Probability Sampling), the fourth and fifth objectives were based on data collected from rural areas with 40 semi-structured interviews, 20 villages in Iran, and 20 villages in France (via Convenience Sampling), and the sixth objective was based on data collected from 11 active ecovillages in France (by snowball sampling).

According to the findings of the study, achieving environmental sustainability through Ecovillage and ICT in each region can differ depending on the priority of needs, acceptance of changes by society, culture, the ICT infrastructure, and government policies. However, the issue that all regions face is that in order to achieve long-term sustainability and a sustainable future, residents, businesses, organizations, and governments must adapt to changes and

transformations toward sustainability. It is possible to provide greater adaptation and readiness of the society to the upcoming environmental and climatic changes by establishing the transformation of residents' beliefs, values, and lifestyles towards becoming sustainable. Changes in company strategy and responsibility for environmental issues, along with economic profits and the use of sustainable business models, on the other hand, provide the foundation for greater adaptation to environmental problems. Finally, providing infrastructure, technologies, and specific government policies are critical in accelerating this process.

As previously stated, adaptation to sustainability can vary depending on the situation and location. Given their population and size, cities cannot create green and sustainable buildings unless the government focuses on infrastructure such as alternative transportation and safe and fast bicycle paths in urban routes. For example, in Iranian cities, respondents with a greater emphasis on social, individual, and cultural aspects demonstrate that social awareness and culturalization of sustainable lifestyles, as well as the importance of residents' roles in environmental issues, are critical. This is not to say that other aspects are unimportant, but it does demonstrate the importance of prioritization in the early stages of community preparation. Meanwhile, in France, they focused more on economic factors. However, in the end, both of them placed a high value on transportation and access. These distinctions were visible in the role of ICT in sustainability. Therefore, in France, they believe that ICT plays a role in improving product quality, solidarity and cooperation, and energy conservation, whereas in Iran, they believe that it focuses on creating new job opportunities and raising environmental awareness.

Many cities with high ICT penetration must have also acquired the necessary knowledge, institutions, and tools to identify the ICT best practices they require, adapt them to their individual needs and features, and incorporate them into their strategic plans. Less developed regions, on the other hand, lack the essential structures and knowledge to adapt and apply ICT best practices.

In general, the level of ICT in France and Iran was almost the same but if we want to be more specific, France was higher than Iran, with capitals, very large and large cities performing better

than the others in various geographical locations. In addition, the differences between big cities and small cities in Iran were more than in France. The reason for this is that in Iran the policies, technologies, and strategies are more for Tehran and big cities. According to the findings, Iranians have the same level of ICT knowledge as the French; the only difference is the quality of equipment in Iran. In other words, the responders use the same internet daily, but the speed of the internet obviously varies. In Iran, for example, the government restricts internet access and controls social media. Hence, the main difference between Iran and France is the government's policies and ICT infrastructure. Iran's national ICT policy must be based on a far higher awareness of local infrastructure challenges. Furthermore, governments must play a significant role if countries are to compete in the information arena.

Therefore, governments' roles in the sustainable smart city process are critical in enhancing new technology applications. Government efforts can be critical in promoting ICT universality and ending the digital divide. This digital divide can differ between cities, social classes, and even the elderly (more detailed research is needed in this field). Governments should then develop ICT-related urban development plans and increase investment in information and communication technology projects across the board. Due to its inadequate infrastructure, Iran needs to take these measures in particular. The Iranian government must remove restrictions on social media and Internet use, support ICT innovation, and help accelerate the adoption of ICT services nationwide.

Uneven ICT infrastructure across various geographic regions has grown to be a significant obstacle to achieving the fundamental elements of becoming sustainable smart cities. The dynamic association among ICT, geographical locations, and sustainable smart cities are complicated and subject to change over time.

Therefore, it is argued that only extremely real and well-thought-out national initiatives can counteract hard technical determinism. It is very crucial for a developing country like Iran to have a national ICT strategy as a foundation for realizing ICT's enormous potential, promoting development, utilizing technology, and alleviating communication problems. Accordingly, the

government must play a significant role, not just as a big user, but also as a regulator, promoter, and diffuser.

Hence, In order to develop digital cities, it is necessary to address the areas and local governments with the least amount of ICT influence, in order to select the most appropriate ICT methods and interventions, integrate them into their strategic approaches, and finally adopt and implement them in a timely and sustainable manner. Such as gathering the necessary data on the city's current situation based on available data, estimating the need for the best performance and ICT interventions, defining possible custom scenarios for the best ICT performance and interventions, and encouraging and supporting companies to make greater use of ICT.

Respondents in Iranian villages emphasized the economic aspects of the village to begin and take steps toward a sustainable lifestyle, believing that they cannot achieve a sustainable lifestyle until they achieve economic development and their basic needs are met. This can be attributed to a decrease in economic activity caused by the migration of active and young people, climate change, and a lack of technology in agricultural activities in Iran's villages. On the other hand, villagers in France believed that their current lifestyle is not far from the lifestyle of ecovillages. This issue stems from the lack of knowledge among the villagers about the sustainable lifestyle of Ecovillage. So that every village that does, some environmental activities cannot simply be an ecovillage. The differences between Iranian villages and French villages were obvious, from the variety of economic activities that were more prevalent in France to the villages' strengths and weaknesses.

Therefore, as a long-term initiative, the ecovillage concept advocates for the integration or synthesis of geographically diverse knowledge for more community-based management or place-based development that incorporates the individual to form a larger region. In this setting, society passes on to future generations more sustainable practices mediated by narratives, norms, and procedures. Sustainability knowledge is conveyed holistically in geographical terms through residents, who express sustainability knowledge as narratives, values, and beliefs. This highlights the need of considering individuals' perspectives on these values,

beliefs, and narratives as spatial relationships. The geographical dimension can serve as a bridge between local and national policymaking and activities.

These findings may make it easier to put sustainable lifestyles into practice and provide new strategies to introduce legislation promoting sustainable lifestyles based on ecovillages. Because the objectives of an ecovillage are so different from those of today's society, planners must be more critical and evaluative of current non-sustainable rural/urban development methods that are incompatible with the goals of sustainability and fairness. The challenging reality is not an easy task, as it involves various societal actors with competing interests in the production of social reality. To overcome those opponents, planners will need to identify stakeholders that share common values in order to achieve sustainable living goals. To reach an agreement within the alliance, debate, communication, and deliberation should be encouraged.

In this thesis, we have explored the relationship between ecovillages and ICT, focusing on the potential for individual ICT use to contribute to broader environmental improvements in order to accelerate the transformation of unsustainable lifestyles into an ecovillage. Our findings suggest that there is a significant role for ICT in promoting and accelerating sustainability toward ecovillages, particularly in the areas of energy efficiency, waste reduction, and sustainable transportation.

Specifically, we found that the use of smart home technologies, such as energy monitoring systems and automated lighting and heating controls, can help society to reduce its energy consumption and carbon footprint. Similarly, the adoption of digital communication tools, such as video conferencing and online collaboration platforms, can help to reduce the need for travel and promote more sustainable work practices.

Importantly, we also found that individual ICT use must be coupled with broader technological innovations and systems-level changes in order to achieve significant environmental improvements in order to achieve ecovillages. For example, the development of local renewable energy systems, such as solar and wind power, can help to reduce the reliance of areas on fossil fuels and promote greater energy independence. Similarly, the implementation

of circular economy principles, such as closed-loop waste management systems, can help to reduce waste and promote greater resource efficiency.

In order to implement these technological innovations and systems-level changes, a range of stakeholders must be involved, including residents, local governments, community organizations, and private sector actors. It is important that these stakeholders work together in a collaborative and inclusive manner, taking into account the unique needs and perspectives of each group.

In conclusion, our findings suggest that individual ICT use can play a significant role in contributing to environmental improvements in order to achieve a sustainable lifestyle like ecovillages. However, to fully realize the potential of ICT to create a more sustainable and resilient future, broader technological innovations, systems-level and social-level changes are necessary. The key challenge is to integrate individual ICT use into larger-scale technological and organizational systems that can facilitate the adoption of sustainable practices across the ecovillage community. In addition, increasing internet access for all classes of the society and all areas (like white areas that are with no internet) is important for achieving this goal.

One important step towards achieving this goal is to build more collaborative and inclusive relationships between the different stakeholders involved in ecovillage development, including residents, local authorities, and technological innovators. By working together and leveraging each other's strengths, we can identify opportunities for technological innovation and sustainable development that can benefit the ecovillage community as a whole.

Furthermore, it is important to recognize that responsibility for technological innovation and sustainability must be shared among all stakeholders. While individual residents can play an important role in driving change through their own ICT use, it is also the responsibility of local authorities and technological innovators to develop broader systems-level changes that can support sustainable practices in ecovillages. By working together and taking a collaborative and inclusive approach, we can build more sustainable and resilient ecovillages that promote a better future for all.

Otherwise stated, ecovillages and their sustainable lifestyles have the potential to bring about significant environmental transformation at the societal scale. However, this potential can only be realized if we take into account the deeply entrenched economic, social, and cultural structures that shape our society.

One way in which ecovillages can contribute to environmental transformation is by providing a model of sustainable living that can be replicated and scaled up to the wider society. By demonstrating the practical feasibility and benefits of sustainable living, ecovillages can inspire and encourage individuals and communities to adopt more environmentally friendly lifestyles.

Furthermore, ecovillages can serve as experimental spaces for the development and testing of innovative technologies and systems that can promote sustainability. These technologies and systems can then be adapted and implemented at the societal level to promote sustainable development.

However, in order to fully harness the potential of ecovillages for environmental transformation, policy changes are necessary. Policies that promote sustainable development, such as incentives for renewable energy and green building practices, can help create an enabling environment for the growth of ecovillages and the adoption of sustainable lifestyles.

Finally, further research is needed to better understand the potential of ecovillages and their lifestyles for environmental transformation. This includes research on the effectiveness of ecovillages in promoting sustainability, the factors that contribute to their success, and the barriers to their wider adoption. By addressing these research gaps, we can better understand how ecovillages can contribute to a more sustainable future.

Therefore, in the following, some suggestions for each part of the studied area are presented based on the findings.

Cities

- ✓ Development of public transport and alternative transport whose fuel consumption has less negative effects on the environment.
- ✓ Creating safe and fast paths to cycling.

- ✓ Renovation and reconstruction of constructions in the form of green and sustainable buildings in a way that saves energy.
- ✓ Support of the government and organizations for plans and projects related to the development of urban sustainability, sustainable smart cities, and digital innovation in new construction.
- ✓ Increasing awareness about the importance of lifestyle transformation towards sustainability and creating a sustainable future.
- ✓ Government policies, proceedings and plans regarding sustainable urban development based on each region and city.
- ✓ Encouraging companies to change their strategies towards sustainability and emphasizing sustainable business models in line with the use of ICT and digital innovations in this process.
- ✓ Creating and improving ICT infrastructure.
- ✓ Motivating and encouraging residents to live a sustainable lifestyle.
- ✓ Development of the urban ecovillage idea as a sustainable lifestyle model in planning.

Villages in Iran

- Affirming the diversity of jobs and non-agricultural activities and supporting small businesses.
- Government and private investments to empower villagers.
- Developing plans and projects for the village's sustainable development, with a focus on ecovillage and a collaborative approach.
- Organizing educational workshops on environmental issues and adopting sustainable behaviors and lifestyles.
- Development of tourism activities based on the potential and capacity of the village.
- Empowering women to participate in economic, social and cultural activities.
- Increasing awareness about environmental issues, sense of responsibility and adaptability to changes.
- Providing technologies for proper waste management and agricultural development in rural areas.

- Culturalization for a sustainable lifestyle, and holding regional festivals in order to preserve cultural heritage and a greater sense of belonging in order to protect its environment.
- Modernizing Agriculture: Irrigation Techniques, IoT Sensors, Agricultural Robots
- Government support in creating educational facilities, developing road and transportation infrastructure and creating health facilities.
- Importance and attention to the transformation of traditional villages into ecovillages using regional plans and projects.

Villages in France

- Organizing educational workshops on environmental issues and adopting sustainable behaviors and lifestyles.
- Development of sustainable tourism: both to improve related activities and to warn tourists about environmental pollution and destruction.
- The use of ICT in the process of service production, the development of public transportation between villages and cities.
- Increasing communication between people and officials and developing sustainable agriculture.
- Motivating the local people to adopt a sustainable lifestyle based on the basic principles of Ecovillage.
- Saving natural resources and energy by building and operating solar panels and wind turbines.
- Modernizing Agriculture: Artificial Intelligence, Tracking Technologies, And Agricultural Robots.
- Government support in economic stability and tax reduction, increasing accessibility and access to public health.
- Importance and attention to the transformation of traditional villages into eco-villages using regional macro-plans and projects, as well as the strengthening and development of existing eco-villages.

Research significance and contribution

This study focuses on creating a model for environmental sustainability in France and Iran by providing ecovillage based on ICT. The findings of this study can help researchers, planners, urban and rural designers, and members of the sustainability community who are looking for sustainable ways to evaluate their plans before they are implemented. This research will benefit not only researchers and designers, but also developers, policymakers, and other stakeholders charged with developing design guidelines for sustainable urban and rural development. The overall significance of this partnership is to strengthen social, cultural, environmental, economic, technological, and infrastructure development in cities and villages through human-centered sustainable development aligned with technologies and infrastructure. The following examples demonstrate the significance of research:

- ✓ Paying attention to Ecovillage as a sustainable lifestyle, rather than a location, can be a significant step toward a more sustainable future in both traditional villages and cities. Hence, Ecovillage as a sustainable lifestyle is applicable not only to villages but also to cities. This issue is critical because it can serve as an introduction to including ecovillages in sustainability programs and projects in both urban and rural areas, as well as changing their lifestyles to be more sustainable by following a specific model.
- ✓ One other important topic addressed in this thesis is the use of ICT technology in ecovillages and the achievement of sustainable development. Therefore, the researcher addresses the relationship between sustainability, ICT, and geographic locations in order to achieve sustainable smart cities.
- ✓ In terms of methodology, a quantitative method was used for urban areas and a qualitative method was used for rural areas, based on the nature of the research objectives.
- ✓ Another important aspect of this research is the variety of case studies, as it not only focuses on urban and rural areas, but also studies and examines the ecovillages that exist in France. These case studies included 25 Iranian cities and 20 villages, 35 French cities and 20 villages, and 11 ecovillages in France. It took more than a year to collect information in this field.

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Appendix A: the Questionnaire

Part 1. Personal information:

Who are you?

1. You are: A man A woman

2. How old are you?

• 15-19 years

• 20-24 years old

• 25-29 years old

• 30-34 years

• 35-39 years

• 40-44 years

• 45-49 years old

• 50-54 years

• 55-59 years old

• 60-64 years

• 65 years or older

3. What socio-professional category do you belong to?

- Craftsman, merchant and entrepreneur
- Retirement
- Higher Intellectual Profession

- Student/apprentice
- Intermediate occupation
- Manual Worker
- Employee student
- Not Employed
- Other / no professional activity

4. Please enter your postal code:

5. If you are active, approximately how far is your work from your home?

- Less than 5 kilometers
- Between 5 and 15 kilometers
- More than 15 kilometers

6. If you are active: Including day breaks, how many times per week do you travel to and from work?

- I'm not moving
- Less than 5 times a week
- Between 5 and 7 times a week
- More than 7 times a week

7. How many children under the age of 14 live with you?

- 0
- 1
- 2
- 3 or more

8. What is your marital status: Married or domestic partner Single Never Married Widow Other

9. What is your level of education: High School diploma Without Diploma Bachelor Masters Doctorate Other

10. Did you experience a period of telecommuting during the pandemic crisis?

- No Yes (0-50%) Yes (50-100%) Yes (exclusively, 100%)

11. Did the pandemic situation affect your choice to live in a small town or village?

- No Yes, I thought about it Yes, I moved to another residence

12. What weather conditions do you think are preferable for your place of residence?

No matter Hot and dry climate Cold mountainous climate Temperate and humid climate Hot and humid climate

13. Do you know the concept of eco-village and do you agree with its definition? An ecovillage can be defined as a rural or urban community that is consciously designed through local participatory processes in the four dimensions of sustainability (social, cultural, ecological and economic) to regenerate social and natural environments. Examples are shown in the following pictures. **Do you know the concept and do you agree with this definition?**

I do not know and I do not agree I do not know but I agree I know but I do not agree I know and I agree

Why ? (optional):



Part 2: Residential Preferences

In the following questions, we assess residential preferences. Please indicate your opinion on each question. This notice may concern your main residence and will clarify the definition of an ecovillage.

So, General Question is: what is the role of the following in your residential neighborhood?

1-In your opinion, within an ecovillage, what do you think of Perception of nature? Is it:

- Very important
- Important
- Of moderate importance
- Not important
- Not important at all

1.1. Note from 1 to 5 what seems essential to you in the field of Perception of nature:

Indicators	1	2	3	4	5
Green space (artificial vegetation which is both socially effective, for the general public to use, and ecologically effective, ie to beautify the village)					
Biodiversity conservation (conservation of ecosystems and plant and animal species)					
Recovery of nature (reforestation, replanting of destroyed plants)					
Local people understand the environment (What do people know about the importance of the environment and its protection?)					

2. In your opinion, within an ecovillage, what do you think of recycling? Is it:

- Very important
- Important
- Of moderate importance
- Not important
- Not important at all

2.2. Write down from 1 to 5 what you think is essential in the field of recycling:

Indicators	1	2	3	4	5
Waste recycling in the production cycle (Converting waste into materials that can produce new products.)					
Waste recycling and composting infrastructure (creating access to relevant facilities in this regard)					
Urban, industrial and agricultural wastewater management (monitoring and prevention of the entry of this wastewater into villages and lakes)					
Wastewater treatment for irrigation (To save water consumption)					
Processing and converting surplus food (Reduce waste and create added value)					

2. In your opinion, within an ecovillage, what do you think of economic situation? Is it:

- Very important
- Important
- Of moderate importance
- Not important
- Not important at all

2.1. Based on Ecovillages, What is the role of following items to improve the economic situation? (Note from 1 to 5)

Indicators	1	2	3	4	5
Small Business Support					
self-employment in improving the local economy					
Supply chain management (the process of planning, executing and controlling supply chain operations in the most optimal way possible.)					
production and consumption of local and organic(food produced without the use of pesticides and chemical fertilizers)					
local ownership (inhabitants, own the surrounding land and gardens)					
Attention to tourist attractions					
creating employment opportunities in the tourism sector					

3. In your opinion, within an ecovillage, what is the role of following items to improve the Agriculture situation? (Note from 1 to 5)

Indicators	1	2	3	4	5
Organic farming					
Green cultivation techniques or permaculture (crop rotation, mulching, green maneuvers, combined agriculture, etc.)					
Recycling of agricultural products (Recycling of products such as fertilizers, animal feed, energy recovery, the manufacture of environmentally friendly bricks from agricultural waste to replace clay, etc.)					
Technology adoption in agriculture					

4. Based on Ecovillages, What do you think of the role of Culture / Art? It is:

- Very important
- Important
- Of moderate importance
- Not important
- Not important at all

4.1. In your opinion, what is the role of following items to improve the Culture situation in Ecovillages? (Note from 1 to 5)

Indicators	1	2	3	4	5
contribution of natural resources to art and local culture (The role of these natural resources in the sense of belonging and local culture of the region)					

cultural values (Focus on cultural attitudes and beliefs)					
The culture of mutual respect and solidarity (Improving relations between people in the community)					
sharing creativity, art and innovation (Enabling acceptance of innovation and new arts)					
artistic and cultural activities in environmental protection					

5. In your opinion, what is the role of following items to improve the Architecture situation in Ecovillages? (Note from 1 to 5)

Indicators	1	2	3	4	5
Attention to the aesthetics and architecture of buildings					
the use of natural and local materials in village architecture					
The importance of the resistance of buildings to climatic and environmental hazards					
the design, construction and builders in harmony with nature (Interaction between the body and the peripheral bed of the area)					

6. Based on Ecovillages, What do you think of the role of Social status? It is:

- Very important
- Important
- Of moderate importance
- Not important
- Not important at all

6.1. In your opinion, what is the role of following items to improve the Social situation in Ecovillages? (Note from 1 to 5)

Indicators	1	2	3	4	5
Promote participation among the inhabitants					
local cooperation in protecting the environment (Do not throw garbage, no pollution of lakes, rivers etc, do not hunt, fish illegally etc.)					
Identifying oneself with the village or the region (close link with the living environment)					
Cohesion, solidarity and unity between people (The Level of solidarity between people and its role in the preservation of the environment)					
Social interaction and communication with neighborhood units					
Respect for human, non-human and future lives (To achieve a sustainable way of life)					
Sensitization of populations to climate change (Increase awareness and information of villagers to fight against the destructive consequences of climate change)					
Extension education programs (to increase environmental awareness)					
Workshops on environmentally friendly communities					
Preserving old traditions (The need to revive local customs and preserve values)					
Acceptance of innovations (Being flexible)					
Political isolation (awareness of the political situation)					
Environmental awareness and human impact on it (How effective is human performance in environmental tastes?)					

7. In your opinion, what is the role of following items to improve the Access Status? (Note from 1 to 5)

Indicators	1	2	3	4	5
Proximity to large cities					
Access to the station					

Easy access to airports					
Access to health services (medical establishments)					
Access to appropriate technology (Internet, mobile phone, etc.)					
Improving the state of communication (communication routes, transport, internet)					

8. Based on Ecovillages, What type of transportation do you think is more suitable?

Car

Trains

Buses

Airplane

Bike

On foot

8.1. Note from 1 to 5 what seems essential to you to reduce pollutants in residential neighborhood?

Indicators	1	2	3	4	5
Increase walking trails					
Reducing vehicle use					
the existence of alternative transport					

Part 3: ICT and regional sustainability

In the following questions, we assess the role of ICT (Information and Communication Technologies) in improving the sustainability of rural or urban habitats. Please indicate your opinion by checking the appropriate box.

So, general Question is: *what is the role of ICT in accessing sustainability in your residential neighborhood?*

- ✓ Given that, sustainability includes three dimensions: economic, social, and environmental, so in here the questions are separately in these three dimensions:

1. In your opinion, what do you think of the role of ICT to achieve a better **Economic** situation?

- Very important
- Important
- Of moderate importance
- Not important
- Not important at all

1.1. Based on ICT, what is the role of the following items to improve the **Economic** Status? (Note from 1 to 5)

Indicators	1	2	3	4	5
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Improving distribution channels and communication with customers					
E-tourism (providing accurate and up-to-date information to users and tourists)					
The institutionalization of the culture of the use of ICT in business					
Creating an entrepreneurial culture (creativity, innovation, independence, responsibility, etc.)					
The digitization of electronic documents and signatures					
Promotion of product marketing and advertising					
Cost reduction					
The increase in productivity					
The structure of savings and investment					
Identifying new business opportunities					
The speed of learning business skills and processes					
Improving product quality					
Supporting start-ups					
Speeding up product development (speeding up the production process of products)					
Ease of communication with successful entrepreneurs					
Increasing business-to-business partnerships					

2. In your opinion, what do you think of the role of ICT to achieve a better **Social** situation?

- Very important
- Important
- Of moderate importance
- Not important
- Not important at all

2.1. Based on ICT, what is the role of following items to improve the **Social** Status? (Note from 1 to 5)

Indicators	1	2	3	4	5
The ease of communication with social media					
The ease of learning new skills					
The facility for cooperation with other regions					
Raising awareness					
The creation of technical knowledge					
The creation of creative and innovative ideas					
High self-confidence					
Preparing for change					
The creation of workshops					
Motivating people					
Solidarity and cooperation between people					
Growing adaptation (to new technologies and new businesses)					

3. In your opinion, what do you think of the role of ICT to achieve a better **Environmental** situation?

- Very important

- Important
- Of moderate importance
- Not important
- Not important at all

3.1. Based on ICT, what is the role of following items to improve the **Environmental** Status? (Note from 1 to 5)

Indicators	1	2	3	4	5
The use of advanced techniques to reduce pollution					
The growing commitment to the environment					
Improving waste management					
Raising environmental awareness					
Improving the performance of sustainable management					
Attention to climate change					
Energy savings					

Part4: The primary aim of this Part is to Evaluating the Level of Area ICT Development

Access to and Use of Information and Communication Technologies (ICTs):

1. Ownership of and Access to ICTs

1.1 Do you own any of these devices?

Devices	Yes	No, but I plan to buy one in the next 12 months	No, and I do not plan to buy one in the next 12 months
Desktop computer			
Laptop			
Smartphone			
Tablet device (e.g. iPad)			

2. Internet Access

2.1 Where do you access the Internet? (tick (✓) all that apply):

- Home Office Internet Cafe Do not access

2.2 You have access to the Internet through (tick (✓) all that apply):

- Dial-up connection ADSL connection Leased line Wireless Mobile devices

2.3 Which device do you use most frequently to access the Internet?

- Smartphone Tablet or iPad Laptop Desktop computer

2.4 You have broadband Internet connectivity at (tick (✓) all that apply):

- Home Office Internet Cafe Do not access

2.5 Where do you get access to broadband Internet in your university/institution? (Tick (✓) all that apply.)

- Classrooms Library Hostels Faculty rooms Laboratories Reception lounge
 Seminar halls Students' common rooms Open areas

2.6 I use the Internet:

- Daily Alternate days Once a week Irregularly Rarely Never

2.7 On average, how much time do you spend on Internet-related activities (email, browsing, social media) daily?

- <1 hour 1-2 hours 3-5 hours >5 hours Do not use daily

3. Use of ICTs

3.1 Please rate your skills in the following computer-related activities.

Computer and phone Skills	I can't use it	I can use it to a small extent	I can use it satisfactorily	I can use it well	I can use it very well
Word processor (e.g. Word)					
Spreadsheets (e.g. Excel)					
Presentation (e.g. PowerPoint)					
Email					
Search engines					
Databases					
Multimedia authoring					
Graphic editing					
Digital audio					
Web page design					
Learning Management System					
Web 2.0 tools (wikis, blogs, social networking and sharing tools)					
E-libraries					
E-journals					
E-books					
Translation software (e.g. Google Translate)					
Smartphone apps					

4. Social Media

4.1 Do you have a profile/account on a social media platform or platforms? Yes No

4.2 Which social media platforms do you use? (Tick (✓) all that apply.)

- Facebook Twitter Photo sharing (Instagram/Flickr/ Picasaweb, etc.)
 Google+ Research sharing sites (Academia.edu, ResearchGate.net, etc.)
 LinkedIn Social bookmarking sites (Delicious, ScoopIt, Pinterest, etc.)
 Blog (using Blogger)

4.3 How frequently do you update your social media status?

- Several times a day Once a day Once a week Once a fortnight
 Not very frequently Not at all

4.4. On average, how much time do you spend on social media daily?

- <1 hour 1-2 hours 3-5 hours >5 hours Do not use daily

5. Community Survey on ICT Usage and E-Commerce:

ICT	Questions		
	Does your company use computers?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	How many persons employed use computers for business purposes?	(Number)	
	Does your company have access to the Internet?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	How many persons employed use computers with access to the Internet for business purposes?	(Number)	
	Does your enterprise use DSL or any other type of fixed broadband connection to the Internet? (e.g. ADSL, SDSL, VDSL, fiber optics technology (FTTH), cable technology, etc.)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Does your enterprise have a Website?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	Does the Website have any of the following?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	a. Description of goods or services, price lists	<input type="checkbox"/>	<input type="checkbox"/>
	b. Online ordering or reservation or booking, e.g. shopping cart	<input type="checkbox"/>	<input type="checkbox"/>
	c. Possibility for visitors to customise or design online goods or services	<input type="checkbox"/>	<input type="checkbox"/>
	d. Links or references to the enterprise's social media profiles	<input type="checkbox"/>	<input type="checkbox"/>
	Does your enterprise use any of the following social media?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	a) Social networks (e.g. Facebook, LinkedIn, Xing, Viadeo, Yammer, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
	b) Enterprise's blog or microblogs (e.g. Twitter, Present.ly, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
	c) Multimedia content sharing websites (e.g. YouTube, Flickr, Picasa, SlideShare, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
	d) Wiki based knowledge sharing tools	<input type="checkbox"/>	<input type="checkbox"/>

6. Role of pandemic (covid-19) in using ICT

ICT	Clarification	Totally agree	Agree	Neutral	Disagree	Totally Disagree

Use of computers	I have used more computers in the last two years due to the pandemic.					
	My personal knowledge of computers has increased in the last two years due to pandemic.					
	In my company, we have used more computers in the last two years due to the epidemic.					
	I have used more Internet in the last two years due to pandemic.					
	My personal knowledge of Internet has increased in the last two years due to pandemic.					
	In my company, we have used more Internet in the last two years due to the epidemic.					
	I have used more Social Media in the last two years due to pandemic.					
	My personal knowledge of Social Media has increased in the last two years due to pandemic.					
	In my company, we have used more Social Media in the last two years due to the epidemic.					