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# Rural (digital) development (?).

A participatory design analysis of a project to bridge the digital divide in rural areas across Europe.

MSc Thesis

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*"Del porfirismo a la revolución (From the Porfirian Era to the Revolution)". David Alfaro Siqueiros, 1966.*

## Preface

I thought it was an original spark, a genuine interest that drove me to write about this. Perhaps I truly believed, deep in the bottom of my heart, that food systems need to be renewed. But to my disappointment, it was just something more difficult to escape than destiny: it was a plain and common cultural heritage. Over the years it hid somewhere in the most remote corners of my brain, and now, even to my unawareness, this motivation did not spark, it was secretly growing.

In Mexico, people talk about the different faces of food and I could not agree more. They say you can not argue with someone you have shared a meal with. That a war in Mexico began over a bakery and that even a French monarch suggested ending a rebellion with cakes. They say you are what you eat, and my grandmother used to say that wherever one can eat, there is always a space for two. In Mayan mythology they say that us, humans ( those of us living in the era of the fifth sun) are made of corn, after gods failed to create us from mud and straw. Some say we have two brains: one on the head, one in the belly. Eric once told me that you could learn more about your date from their plate than from any dating app, astrological sign or personality test. I believe food is polit-

ical, economic, environmental, social, romantic, entrepreneurial, poetic, stressful, corrupt, noble, fun, tiring, nostalgic and, in this work, academic. It comes as no surprise, then, that I attempt to dedicate most of my efforts, even when I am not an exemplary academic nor an outstanding chef, to what we grow on our fields, set in our tables and place in our bodies; to what constitutes us.

The sprouts of this thesis were about land use change in Xochimilco, in Mexico City. About how the rural landscape changed abruptly in a timelapse that my grandfather could not recognize the canals he swam in when he was a child. Xochimilco (“the place where the flowers grow” in Nahuatl, an indigenous Mexican language), has become yet another example of how the imposed notions of development threaten the livelihoods of rural inhabitants. In Mexico, this imposition started with the Spanish invasion, that dismantled indigenous land management system and replaced them with a more “developed” land administration. Nowadays these threatening ideals have a more friendly façade, while continuing to carry the same logic of displacement and external authority: the imposed notions of sustainable development.

But what does development actually is? Who decides that? What is sustainability?

My critique of development, and sustainability was inspired by the EZLN (stands for Zapatista Army of National Liberation in Spanish). An indigenous group in Mayan territory that emerged in 1994 to defend their land against transgenic crops in Mexico, pushed by the North American Free Trade Agreement (NAFTA). *La tierra es de quien la trabaja* (The land belongs to the ones who work it), that would have been the title of this thesis (perhaps it still is), because I want to remind us that, in agriculture and food, there are subtleties easily disregarded by the imposing force but deeply meaningful for the adopting side.

On one hand we see diet trends dressed as the ultimate discovery of green solutions. They oversee the intricacies of a global food supply chain that demands ingredients from the other side of the world, and at volumes that end up exceeding local production capacity and environmental recovery time. The fever for Chocolates in Switzerland, pistachios in Dubai and avocado toasts in Germany are destabilizing local economies, environments and social fabrics. For instance, drug cartels in Mexico (also since the NAFTA) saw the opportunity to have a taste of the agricultural market share with avocado production controlling not only the production of the “green gold” but the territory and the economic relevance it has with it. In the Palestinian West Bank, Israeli farmers harvest dates as a tactic of dispossession, diverting resources and Palestinian labor. *La tierra es de quien la trabaja*. Food is a market and a political tool.

On the other hand, development arrives in the form of new technologies. With the introduction of new technologies into the fields, yes, they might increase production and potentially benefit environmental conservation. But would that mean farmers will have more spare time to dedicate it to other areas of their lives? Who will operate the machines? Who will own the crops? Who will have sovereignty over the fields, farmers, seed owners, technology manufacturers, ICTs service providers? Will food be cheaper? Will food reach more people? Or will it continue to be the same system but now technified?

The EZLN might warn us about the dangers of excluding farmers in decisions concerning their fields, and about what does it mean to detach humans from the lands, this very humans made of corn. Food is a battle for space, for justice, to claim the lands that were worked with the hands. A sustainable food system is not just about the products or healthy options, it is also about doing the labor on the lands in a fair and dignified way.

I wrote this thesis, partly because it is an academic requirement to be accredited the title of Master in Metropolitan Analysis Design and Engineering, but also, I wrote this thesis as a labor of love to my land. This thesis is not only about food.

## Acknowledgements

This thesis process took me three and a half years to produce. Finding the topic took me three years, writing it was around four months. That means it simmered for 182 weeks. It had to pass through my early ideas, through many titles, many supervisors, many people. A lot of friends were surprised I was still working on it.

During this period, I went through three different jobs, I moved out of four houses, learned a new language, three wars broke out, my family shrank, and I even got married. All of that has left a mark, everything and everyone has a word, an intention in this thesis. As they say, good things are cooked on low fire. And although I would not be presumptuous enough to claim this is a good thesis, I also would not claim it has low fire.

I would like to thank and dedicate this thesis to Ian, Gabriela, Tadeo, Marcelino, Ofe, Quina, Toñito, La banda de Elisa 122, Hideliza, Don Moi, Alma, Manicha, Pablo, the other Pablo, Tuul, Olesito, Gabriel y Alejandra, Jorge, the other Jorge, Beto, Chava (not to Maro), Nathansito, Marco, Eric, Leo y Laura, Mateo, to my friends in FOB, Madelief and Floris, Diana, Jessi-k, Ivanna, and Rob.

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I thank you all in recognition of your role in shaping this thesis. For listening, suggesting, accompanying me, correcting, accounting, pushing me, reading, having fun, closing my computer, inspiring me, giving me a computer, supporting me, sitting me in front of the computer, cooking with me and for me, having coffee breaks, motivating me, and sharing feedback. But above all, I thank you all for being there.

After all, writing is a collaborative process.

## Abstract

In the midst of rapid urban digital development, rural areas are dragged by this development impulse. Both areas do not have the same conditions, instruments, behaviors, demographics nor market opportunities to follow each other. The result is a worrying urban-rural divide that besides being digital, has consequences in the analog reality, even more worrying are they in the context of climate change effects and, for instance, a pandemic. Collaborative Business Models emerge as an opportunity to incentivize ICTs markets to digitalize some rural areas' economic activities. Nevertheless, as shown in this research, topics so intertwined with society and environment, such as agriculture and rural development, require other approaches besides solely urban, technological and business oriented. It requires the involvement of the people from rural areas.

This thesis explores a European Union project, COMMECT, that aims at bridging the urban-rural digital divide with the implementation of Collaborative Business Models in five Living Labs across Europe. Through a series of interviews with Living Lab technical leaders and a semi-systematic Literature Review, this research explores how these Living Labs could better organize to address rural development beyond a mere market-driven digitalization.

Ultimately, urban and rural areas are unclear definitions, with even more blurred boundaries in the age of ICTs. In that sense, the work you are about to read corresponds to the field of Smart Urban Digitalization and engages with the discussions across the urban-rural spectrum. It uses the axes of technology, market and society to articulate a different understanding of urban-rural dichotomies, and states that they must not be addressed with the same ideals that set them apart in the first place.

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*"Los frutos de la tierra (Fruits of the Earth)". Frida Kahlo, 1938.*

## 1. Introduction

### 1.1. Background

In recent decades the European Commission has gathered significant efforts to reshape agriculture -one of the oldest human activities- to face the challenges of climate change and harness the potential of the digital age (Barabanova & Krzysztofowicz, 2023). There has surged a myriad of political tools to promote the adoption of green technologies in rural areas, mostly in line with European Union's priorities of green and digital transitions to shape a sustainable future (Muench et al., 2022). Examples of these efforts are the European Green Deal, the Farm to Fork strategies, the Europe Fit for the Digital Age, and the Common Agricultural Policy (CAP) (Barabanova & Krzysztofowicz, 2023).

Rural areas are vulnerable to sustainability (social, economic and environmental) challenges related to climate change. These areas depend heavily on natural resources, thus environment degradation and the food security targets' pressures of a growing population are aggravating effects for rural areas (Barabanova & Krzysztofowicz, 2023). Rural communities are particularly confronted with demographic shifts, land use changes and risk of poverty (Barabanova &

Krzysztofowicz, 2023). Generally speaking younger generations prefer to migrate to nearby cities, and as the city grows, it demands space previously available for rural activities (Barabanova & Krzysztofowicz, 2023).

Moreover, it is well acknowledged that rural areas experience limited access to information, a contrasting difference seen between rural and urban areas (Aker, Ghosh, & Burrell, 2016; Feurich, Kourilova, Pelucha, & Kasabov, 2024; Nakasone & Torero, 2016; Rijswijk et al., 2021; Salemink, Strijker, & Bosworth, 2017). This disparity accentuates the analog vulnerabilities such as gender inequalities, restricted access to education, and worsening climate change effects among others (Aker et al., 2016). The lack of Digital connectivity access in rural areas in contrast with urban areas is called the *urban-rural digital divide* (Keniston & Kumar, 2004; Salemink et al., 2017).

Bridging the urban-rural digital divide is crucial for rural areas and agriculture mainly due to the promises that it entails (Barabanova & Krzysztofowicz, 2023; Gilsing, Oukes, Szijjártó, & Kerstens, 2023; Luxembourg Institute of Science and Technology (LIST), 2022; Salemink et al., 2017). On one hand the implementation of digital technologies promises a more efficient and sustainable production (Barabanova & Krzysztofowicz, 2023). On the other, digital connectivity also claims to improve quality of life, economic prosperity and balance the analog disparities (Barabanova & Krzysztofowicz, 2023).

## **1.2. Problem statement**

Sonnino (2009) and Wiskerke (2015) argue that food provisioning has been neglected from urban studies, policies and planning while critiquing the production impetus to meet food security goals. Additionally, in the light of how urban areas are and will be increasingly important to the future of humanity, urban areas are shaped with technology-driven (technocratic), economic and efficiency notions (referred to in this thesis as “biases”) (Caprotti, 2018). In other words, the urban biases feed the food production narrative by adding the “smart”, “profitable” and “efficient” adjectives to it. These conditions create a melting pot of misleading ideals for rural digital development plans that might head to not only increasing environmental challenges, and technological disadvantages for rural areas, but to eventually miss the ultimate goal of ensuring food security.

The core problem is that despite technological, economic, and political advancements, there is no guarantee that digital technologies and connectivity will fulfill their promises for rural areas and agriculture. This is because rural technological implementations follow urban-led agendas with the rationale of pervasive connectivity without consideration of rural needs (Salemink et al., 2017). Urban technological dogmas are transferred into rural realities,

implementing with them the same -but accentuated- challenges which urban areas are generally victim from (Salemink et al., 2017). For this reason, European initiatives that are highly reliant on technological implementations to reshape agriculture should be supported additional considerations in order to escape the biases' traps.

In their literature review on unequal ICT availability, adoption, and use in rural areas, Salemink et al. (2017) point out that “the basis of a lack of digital connectivity in rural areas lies in the market for telecommunications”. Privatization policies together with the market mechanism of supply and demand, discouraged telecommunication investments in rural areas. Rural areas are high-cost markets compared to urban areas as they require more physical, practical technological implementations, referred to as the *connectivity domain*, as well as more sociological and behavioral characteristics, referred to as the *inclusion domain* (Salemink et al., 2017). This offset as initial conditions to develop rural digital businesses, keeps rural areas in a perpetual disadvantage in the digital race as “rural areas need to grow faster than urban areas in order for economic cohesion to take place” (Salemink et al., 2017).

### 1.3. Research aim

According to Keniston and Kumar (2004), the market-related nature of the urban-rural digital divide resulted in a self-confirming prophecy, where the assumption of no market opportunity became a fact. Within the inclusion and connectivity domains, there are indeed great challenges for deploying Information and Communication Technologies (ICTs) in rural and remote areas due to low profitability deriving from specific market conditions such as language, digital knowledge, data costs, use-cases, and nonstandard devices (Aker et al., 2016; Keniston & Kumar, 2004; Salemink et al., 2017). Nonetheless, as much as the market's forces might be both cause and reinforcer of the urban-rural digital divide, the gap lies in not relying solely on market mechanisms for breaking this cycle.

Given the fixation that urban-led development agendas in rural areas have with technocratic rationale (Caprotti, 2018; Wiskerke, 2015) and the strong market-related nature of the urban-rural digital divide (Salemink et al., 2017) There is a need for:

- 1) A different way to implement technology in rural areas. Rijswijk et al. (2021) warns about the differences among *digitalisation*, *digitisation* and *digital transformation/transition* with the intention to avoid reinforcing systems which are (considered) unsustainable (social, economic and environmentally) and in favor of powerful directives. Digitisation can be understood as a conversion of information from analog to digital form (Autio, 2017). Differently, digitalization is more about how the

digitisation of certain processes integrates with sociotechnical processes of institutions (Tilson, Lyytinen, & Sørensen, 2010). On the contrary, Digital transformations/transitions in the rural context could enable the design of strategies for agriculture and rural areas, considering socio-economic conditions influencing and influenced by digitalisation and digitisation(Rijswijk et al., 2021).

- 2) A different way of modeling businesses in rural areas that better understand information and complementary market failures in a given context (Aker et al., 2016). As shown in Figure 1 the alternative way of business modeling involves a *market interference* strategy to integrate connectivity and inclusion domains, ensuring that rural communities and telecommunication companies regulate that integration together (Salemink et al., 2017). In this context, the Service-Dominant Business Model (SDBM) logic becomes highly relevant, as it repositions the customer as a co-creator rather than a passive recipient. (Turetken, Grefen, Gilsing, & Adali, 2018). The SDBM logic could function as the market interference that allows for the integration of connectivity and inclusion research domains. Namely, by addressing the market-related foundations of the urban-rural digital and by providing the space for communities and telecommunications to co-create called *Space for interaction* (De Koning, Puerari, Mulder, & Loorbach, 2018).

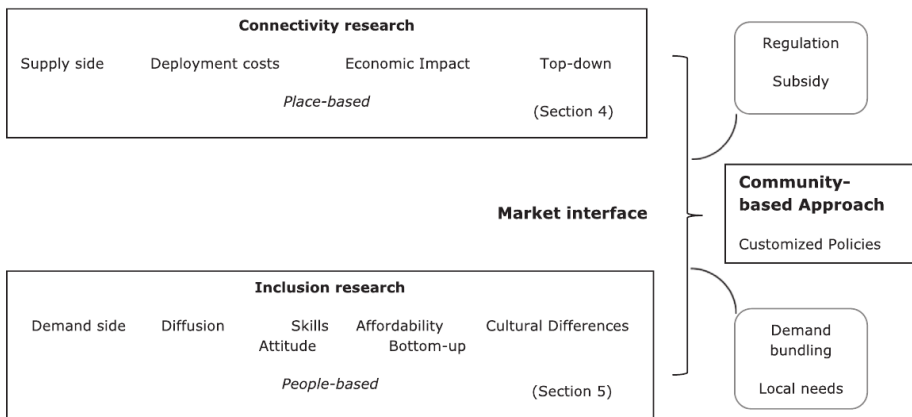


Figure 1. Salemink et al. (2017) call for an integrative research agenda between connectivity and inclusion research domains at a community scale.

These shifts concern rural communities, businesses developers in rural areas, technological innovators, policy makers and the natural environment. The implementation of ICT solutions in rural areas help farmers and communities foster economic independence by broadening their marketing opportunities,

contributing to socio-economic sustainability (Stojanova et al., 2022). Additionally, digitally connectivity can bridge literacy and knowledge gaps, mitigating the disadvantages that rural communities face in climate change adaptation and broader socio-economic adversities (Nakasone & Torero, 2016). Farmers, communities, rangers, and other potential ICTs end-users in rural and remote areas play a pivotal role in shaping the value proposition -as they are the ones directly experiencing the challenges and opportunities for markets to flourish, and most importantly, are the ones vulnerable to the effects of the digital division.

## **1.4. Research questions**

Given these points, the research questions for this thesis depart from the critique of how the urban-dominant, technocratic and production biases placed the market mechanism as only “solutions” to achieve food security in face of climate change challenges in rural areas. However, this thesis also seeks to move beyond these biases by integrating the connectivity and inclusion domains with the so-called market interference, at the time of recognizing how relevant digital technologies have come to reshape one of the oldest human activities.

To do that, this thesis examines the project Bridging the digital divide and addressing the needs of Rural Communities with Cost-effective and Environmental-Friendly Connectivity Solutions (COMNECT) (LIST, 2022). A Horizon Europe-funded initiative aiming to bridge the urban-rural digital divide through connectivity solutions and collaborative business models implemented in five Living Labs (LLs). COMNECT as a case study offers a fertile soil (literally and metaphorically speaking) to explore how market mechanisms, technological deployments, and stakeholder participation play a role in the so-called rural digital development. By using the frameworks of Service-Dominant Business Models (SDBM), and Design-enabled Participatory City Making, this thesis seeks to critically assess whether such initiatives can move beyond market-driven digitalization to foster more inclusive, local relevance, and sustainable forms of rural digital development.

Therefore, the main and secondary research questions are:

## **How could COMMECT's LLs better organize to address rural development beyond market-driven digitalization?**

- i. What does literature say to better explain how the SDBM logic, Digital Transitions and Participatory Design can address rural development beyond a market-driven approach?
- ii. What is the role of the COMMECT project within the European agenda for rural digital development?
- iii. What are the requirements for Interaction from the point of view of COMMECT's LL technical partners?

### **1.5. Scope**

I expect these research questions serve to mobilize, to add the “how to?”, to the stimulating and intriguing publication of Barabanova and Krzysztofowicz (2023) for the European Commission. They state that “adopting digital technologies should not be seen as the ultimate goal in itself. Instead, a directed digital transition that supports social challenges is necessary through responsible innovation that anticipates the intended and unintended impacts of digital technologies” (Barabanova & Krzysztofowicz, 2023).

This thesis proposes to aim at achieving digital transitions for rural and remote areas instead of digitisation and digitalisation strategies. It seeks to include the socio-technical systems surrounding the implementations and adoption of digital technologies, accounting for the interaction among the agricultural sector, the environment, technologies, innovation, organizations, communities, and stakeholders (Barabanova & Krzysztofowicz, 2023). Rural and remote areas in general face challenges like demographic changes, high risk of poverty, lack of access to basic services such as health, education and transport are among them (Barabanova & Krzysztofowicz, 2023). A comprehensive approach of digital technologies -that account for these challenges could help rural and remote areas, as well as agricultural and environmental preservation sectors existing in them, to strengthen their socio-economic and environmental resilience (Barabanova & Krzysztofowicz, 2023).



*“El hombre controlador del universo (Man Controller of the Universe)”*. Diego Rivera, 1934.

## 2. Conceptual and theoretical framework

### Introduction

As stated earlier, in the context of rural digital development, bridging the urban-rural digital divide is regarded as one of the most important priorities in European development agendas for rural areas and the agricultural sector (Barabanova & Krzysztofowicz, 2023). Nevertheless, addressing the priority of bridging the urban-rural digital divide equals addressing only a fraction of the technological challenges in rural areas. Salemink et al. (2017) explain this by categorizing two mayor strands on rural digital development research; connectivity domain and inclusion domain. Expecting that the market interference could bring them together in benefit of rural digital development (Salemink et al., 2017).

### 2.1. The connectivity domain and its statements

The connectivity research domain focuses on material inequalities such as telecommunication markets, the technical and material requirements for connectivity, economic development and policies and regulations (Salemink et al., 2017). The urban-rural digital divide is defined in this domain as “a lack of connectivity as the comparatively disadvantaged state of connectivity of places and regions [(rural and remote areas)], in respect to the overall connectivity status and developments in the surrounding context [(urban areas)]”(Salemink et al., 2017). Knowing that the urban-rural digital divide refers to the disadvantage state of connectivity in terms of telecommunication markets, technical and material requirements, economic development, policies and regulations, unveils two key statements.

### **i. The first key statement**

The first key statement is that the boundaries, reach, scope, goals and metrics are declared by the actors and conditions of the areas related to the connectivity domain. In other words, addressing the urban-rural digital divide is as much addressed as there are telecommunication markets opportunities or disadvantages, technical and material enablers or constraints. It depends on the state of economic development, policies and regulations of the regions.

Within the connectivity domain, research explains that one of the reasons for rural areas to remain digitally underserved regions, is the lack of appealing markets under the excuse of being high-cost markets compared to urban areas (Salemink et al., 2017). This is an unfair comparison because urban areas already count with physical and behavioral requirements, for technological deployment and management, that creates a barrier for rural areas to enter into the market (Salemink et al., 2017).

In consequence, rural areas experience what James Hite (1997) calls a *rural penalty*, where rural inhabitants pay the socio-economic and environmental price of living in rural areas. Leading to the paradox that although “rural communities [while being the] most in need of improved digital connectivity to compensate for their remoteness, [...] they are [the] least connected and included” (Salemink et al., 2017).

Moreover, rural areas cannot be expected to follow the same digital development patterns as their urban counterparts. Urban-centered agendas (whether political, economic or technological) tend to lead development agendas at paces that rural areas are not prepared to follow. As Salemink et al. (2017) argue, digital development is urban-led despite both areas are constituted differently, with contrasting conditions and requirements that make it insufficient for rural development agendas, political and market, to simply react to technological trends.

### **ii. The second key statement**

The second key statement is that the dominant understanding of bridging the urban-rural digital divide appears to be rather a digitalisation or digitisation strategy than a digital transition strategy. Digitisation can be understood as a conversion of information from analog to digital form (Autio, 2017). Similarly, digitalization is more about how the digitisation of certain processes integrates with sociotechnical processes of institutions (Tilson et al., 2010).

As seen earlier, digital development in rural areas cannot be limited to deploying the latest urban-led technological trend, as this is a free-market strategy based on

the unfair assumption of equal opportunities between urban and rural regions. Digital technologies have ‘unknown and unseen impacts’ (Klerkx, Jakku, & Labarthe, 2019) in society only clear when carried out in practice. As the work of Rijswijk (2021) suggests, special cares should be taken in agricultural and rural ‘innovations’, as it has been addressed by several authors that digital technologies could rather reinforce the inequalities underlying the urban-rural digital divide.

Therefore, the concept of digital transition was introduced, as it encompasses the use of digital technologies, but integrating the complexity of its impacts in society, either positive or negative (Vial, 2019). Instead of focusing solely on technological development, rural digital transitions are presented as an opportunity to avoid reinforcing the urban-rural digital divide. Digital transitions can benefit from using the inertia of agricultural and rural ‘innovation’ to account for the socio-economic and environmental impacts of technology (Barabanova & Krzysztofowicz, 2023; Rijswijk et al., 2021).

### **2.1.1 Unveiling the statements**

Up to now I have introduced the idea that bridging the urban-rural digital divide is just one task for rural digital development strategies and belongs to the connectivity domain. This domain deals with the market-related nature of the urban-rural digital divide, its connections to urban-led development agendas, and the differences among digitisation, digitalisation and digital transitions. Implicitly, this discussion prompts the reader to question to which strategy are the European Commission’s priorities aligned, an issue that will become increasingly pertinent in the analysis that follows.

Within the connectivity domain, these two key statements intentionally resemble two out of three frameworks used in this thesis that will serve to both dismantle and expand the understanding of the urban-rural digital divide. Additionally, they help articulate what Mason (2002) calls an *ontological perspective*, tracking the constituents of the researched phenomena. In line with (Snyder, 2019; Torraco, 2005) they also help to combine perspectives, provide an overview of the knowledge base, and re-conceptualize the foundation of the topic. This exploration aims to uncover the broader implications of rural digital development, and to show how these frameworks provide alternative insights and approaches to addressing them.

### **2.1.2 Unveiling the first key statement of connectivity domain. Bridging the urban-rural divides to achieve food security**

One of the main objectives, if not the ultimate objective, supporting the reshape of agriculture is to ensure food security for the world’s growing population in the

context of present and future climate change challenges (Barabanova & Krzysztofowicz, 2023). Nevertheless, part of the complexity of designing rural policies and market strategies to ensure food security is related to the appointment of responsibilities. Is food security an urban or rural issue?

As it has been discussed so far, technocratic urban-led agendas are not suitable to direct rural digital development, as they generally do not consider specific rural needs and result in transferring challenges to which rural areas are more vulnerable to (Salemink et al., 2017). Nevertheless, almost contradictorily, Wiskerke (2015) advocates for considering food provisioning -often regarded as rural policy- to be part of urban studies, policies and plans as it has been neglected from urban challenges.

These two ideas are not entirely opposing forces, food provisioning is not a matter of either excluding or including rural policies into urban development agendas, it is a problem of recognizing urban-rural issues belonging to dichotomic, two sharply defined, contrasting and exclusive problems (Wiskerke, 2015). Sonnino (2009) argues that the urban-rural policies dichotomy delves into three shortcomings. First, confining the study of food provisioning to rural and regional development, misses the fact that “the city is the space, place and scale where demand is greatest for food products”. Second, urban food security failure is seen as a production failure instead of an affordability, accessibility, availability and adequacy failure. Third, the role of cities as food system innovators is delayed when food policy is seen outside of urban responsibilities (Sonnino, 2009; Wiskerke, 2015).

Food security cannot be addressed without understanding this urban-rural policy divide that permeates into other kinds of dichotomies, urban-rural digital divide for instance. While urban-led agendas are prone to disregard rural needs, this is precisely the call to rather of isolating, integrating urban-rural issues as shared responsibilities.

#### **a. The production narrative**

Increasing food production is arguably a prominent narrative that permeates from the urban-led agendas to rural plans, and in its way reinforces the urban-rural dichotomies. The world is expecting to host 9.8 billion people by 2050, from which 68% (6.7 billion) are expected to inhabit urban areas (United Nations, 2019). In addition to that, the population has been changing its diet in the last decades, by increasing the amount of food consumed and changing the composition of the diets (Wiskerke, 2015). With this scenario how to feed the population of this future, is a reasonable question to ask, but not to answer with the less reasonable slogan -widely accepted- of doubling food production (Wiskerke, 2015).

Increasing food production to address food insecurity is a misleading strategy as this, first, neglects that before food security being a production goal, the right to food is about availability, accessibility, affordability and adequacy (Schutter, 2014). In other words, food insecurity is better addressed if it is more carefully understood that across and along regions there is abundance and scarcity of food, that even when available there are uneven means to access food, that not everyone can afford it, and that food has additional cultural values beyond nutritional (Schutter, 2014; Wiskerke, 2015)

Secondly, while the composition of diets has been changing in favor of animal proteins, and the kilocalories intake per capita per day increased in a global scale (Wiskerke, 2015). Increasing food production is based on the assumption that the amount of food and its composition will continue to change in the same fashion as in the last decades (Wiskerke, 2015). This leaves out of the discussion the possibility of the very much needed change of food consumption patterns, especially in urban areas and industrialized economies (Wiskerke, 2015).

Thirdly, global food production is already able to feed 10 billion people, but around 40% of food produced does not reach the consumer due to harvest, post-harvest losses and post-consumer waste (Wiskerke, 2015). In a general scale, reducing food losses could be even more important than increasing production (Wiskerke, 2015). With these three arguments, it becomes less clear how increasing food production will do anything to achieve food security.

#### **b. The urban-economic bias**

The food insecurity challenge has been stripped away from its complexity and interrelations and reduced conceptually and practically to the metrics of food production. It suffered from a “bloodless abstraction” (Buller, 2022) by the markets, where reasonable abstractions to understand a system were pushed to the extremes of being unrepresentative of the very system intended to understand.

The abstraction of food security becomes particularly dangerous, because it implies that having available, accessible, safe, affordable, nutritious, and meaningful food produce is not only of lesser importance, but a price to be paid for the sake of increasing food production. Moreover, this abstraction unveils that the goal of technological development is to increase productivity, as if technology could not enable other benefits for communities, particularly those in rural and remote areas. In his words, “when the socio-environmental sphere is not given adequate consideration, then a purely economic perspective misses the mark by a mile” (Caprotti, 2018).

When Caprotti (2018) -in his work about technology and human needs- elaborates about the biases in plans and visions for future cities, this food

production narrative could fall into what he calls an *urban-economic bias*. This bias explains that plans and visions of the future cities validate urbanities and economy to function unaltered by pressing challenges: a blind technological progress is allowed and encouraged under the banner of continued economic growth (Caprotti, 2018).

To the best of my abilities, I laid out the relationship between markets' rationale and technological development that will be complete after explaining the second key statement of the connectivity domain in research related to technology (digital transitions). To summarize the first key statement about the markets, it has been discussed that the markets rationale from urban areas governs the food production narrative for rural development and it is responsible for the perpetuation of urban-rural dichotomies, such as political and digital. This food production narrative is result of an abstraction to address food insecurity from urban-led and economic agendas, entailing that the major contribution of technology development is increasing production. With this information, the introduction of the SDBM framework is timely, as it allows for a more comprehensive understanding of its relevance to this thesis.

### **c. Service-Dominant Business Models (SDBMs)**

A business model is a way in which an organization generates value (Turetken et al., 2018). Similarly, Collaborative Business Models (CBMs) are ways to generate value following the Service-Dominant Business Model (SDBM) logic; emphasizing their collaborative approach (also referred as network-centered), contrasting with the company-centered perspective ruling the conventional business model (Turetken et al., 2018). I will focus on highlighting the SDBM characteristics and reasoning behind it.

The core elements of SDBMs are how the perception of value shifted from goods-dominant to service-dominant, and how that shift calls for a network-centric approach in businesses (Turetken et al., 2018). Customers are solving their market needs by the value products deliver to them, not by the product itself. In that sense, the service-dominant shift happens when the products become the container of their solutions, having value when they are used, this is called *value-in-use* (Turetken et al., 2018).

Then, If the value is 'activated' when the product is in use, then the un-used lifespan of the product -or other values that the same product delivers for that matter- are open to new markets, new costumers (Turetken et al., 2018). Here is where the network-centric approach comes in play when designing business models; to co-create services that deliver different kinds of value to different kinds of stakeholders (Turetken et al., 2018).

To summarize, this network-centric approach leads to a *check-list* to define SDBMs (Turetken et al., 2018):

- ✓ A broader definition of value. Different stakeholders cherish different things, and value has a widespread meaning according to the use each stakeholder gives to a specified product.
- ✓ Creation of a value network. Opening multilateral channels of communication across stakeholders and moving away from the traditional analogy of *value chain*. *Value network* emerges, where the value does not follow a single top-down direction, with a beginning and end, but rather follows multidirectional ways and does not necessarily end with the product's lifespan.
- ✓ Redefines the role of the end-user as a stakeholder that, theoretically, has a say in designing their own service (again, contained in a product). End-users are one of several 'activators' of the value-in-use.
- ✓ Focuses more on the processes for creating value across the network. With a service-dominant perspective, contrary to concentrating it on one end of the chain as a goods-dominant perspective would do.

As part of the research of Turetken et al. (2018), their objective was to develop a Service-Dominant Business Model Radar (SDBM/R), which is a visual "representation of the way in which a network of organizations, including the providers and customer, co-creates a value for the customer through a solution-oriented service and generates revenue and benefits for all network partners" (Turetken et al., 2018). The SDBM/R brings together the elements of the SDBM to be used in practice.

Based on the work of Turetken et al. (2018), the components of the SDBM/R shown in Figure 2 from the center outwards are:

1. Co-created value-in-use. As explained before, that instead of representing a product or a service, it is rather the value of a solution to a customer.
2. Actor value proposition and actor's roles. This is the portion of the central value-in-use that corresponds to a specific actor. It can also be understood as what the actor brings to the table.
3. Co-production activity. These are activities each actor performs to deliver the value-in-use to the customer.

4. Costs and benefits. These are monetary and non-monetary expenses and gains that the co-creation actors have in the process of achieving the value-in-use.
5. Actor. The stakeholders that -while having different responsibilities, are in theory equally considered to generate value-in-use. The different type of actors are customer (contributes to the production of value-in-use), focal organization (party that initiates the setup of the business model), core partner (contributes to the essentials of the solution), and enriching partner (enhances the solution's added value-in-use).
6. Customer experience. Is part of the outcomes of the SDBM/R that is formed by determining the components and can be expressed in text, graphically, in a story or storyboard. The objective is to specify how the customer experiences the creation and delivery of the co-created value-in-use.

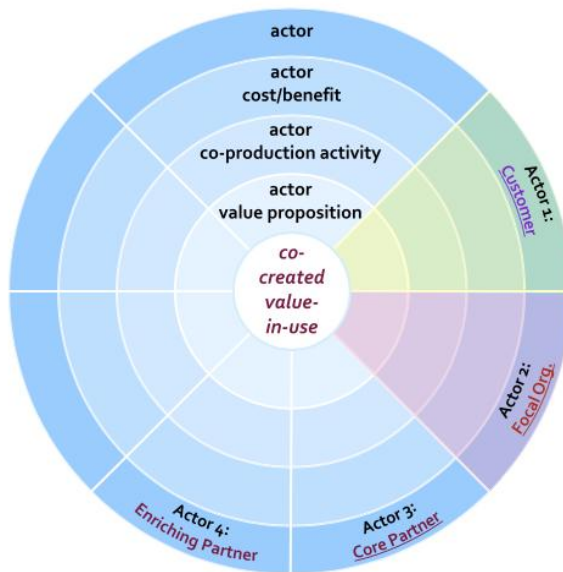


Figure 2. Service-dominant Business Model Radar by Turetken et al. (2018)

## Relevance to this thesis

The SDBM is relevant because it responds to the lack of business opportunities, which is often regarded as a key factor in causing and perpetuating the urban-rural digital divide. Unlike traditional business models focused on centralized and profit-driven approaches, SDBMs offer a collaborative approach that includes

end-user as co-creators. This approach can help rural end-users of technological applications surpass the barriers that prevent them entering the market of technologies by allowing them to gain autonomy to model solutions that better align with their needs.

Moreover, the SDBM challenges the production narrative centered in a single organization. It emphasizes the collective actions of a network to generate value and recognizes that technology delivers different values for different stakeholders. This shift encourages stakeholders to move beyond a purely *productivity-driven* perspective—read also *urban-economic bias*—and towards more inclusive (from the inclusion domain in rural digital development research) and contextual technological implementations.

Regarding the production narrative passed from urban-led agendas to the food security challenge, SDBM supports that the goal should not necessarily be to produce more food but rather to rethink how food can be made more accessible, affordable, adequate, and available to people, in other words; SDBM logic helps to gather and recognize a broader spectrum of values in food production. This shift in perspective acknowledges that rural and urban areas should both play a role in shaping food security strategies, rather than being constrained by an outdated model that assumes production alone solves the issue.

Moreover, SDBM logic helps frame the discussion of whether food security is an urban or rural problem. By incorporating multiple stakeholders into decision-making processes, it implicitly argues that food security is a shared responsibility rather than an issue that belongs to one domain or the other. However, this raises further questions: Who is invited to participate in these decisions? Who determines who gets a seat at the table? And more fundamentally, is there even a table for inclusive discussions in the first place?

These questions emphasize the need for structural change in decision-making processes, ensuring that digital transitions and technological applications in agriculture are not just dictated by urban-led agendas but instead co-created with rural communities, whose voices and expertise are critical in shaping sustainable solutions.

### **2.1.3 Unveiling the second key statement of connectivity domain. Promises and pitfalls of technology for agriculture**

As has been explained, one of the objectives of rural digital development is related to the distribution of technologies that facilitate digital connectivity for rural and remote areas. These technologies can take the form of internet of things (IoT), big data, augmented reality (AR), robotics, sensors, 3D printing, system integration, artificial intelligence (AI), machine learning, digital twins and

blockchain among others (Klerkx et al., 2019). The term of ICTs (Information and Communication Technologies) refers to those technologies (generally internet-enabled) that capacitate for communications for people and organizations to occur (Food and Agriculture Organization of the United Nations (FAO), 2024). In this sense, wireless networks, cell phones, computers, software, middleware and other devices and services that allow users to access, retrieve, store, transmit and manipulate information in a digital form are also considered part of the realm of ICTs (FAO, 2024).

These technologies have economic impact in rural areas from an agricultural perspective - borrowing the term from Aker et al. (2016) these technologies deliver both “promises (and pitfalls) for agriculture”. Digital technologies promise a more efficient production of food and biomaterials (Barabanova & Krzysztofowicz, 2023; Nakasone & Torero, 2016). The digitalization (defined in the firsts paragraphs of this chapter) of agriculture uses data such as, location, weather, behavior, consumption, energy use, and prices, provided by ICTs to monitor animals, soil, water, plants and humans (Klerkx et al., 2019). Such meticulous management of resources can derive in the increase of agricultural production, farm profitability, and job opportunities (Nakasone & Torero, 2016). On a larger scale, digitalization of agriculture is expected to optimize agricultural production systems, value chains, and food systems (Klerkx et al., 2019).

However, while several authors agree that the economic - or market-related-promises of digitalization of agriculture are very well mapped (Klerkx et al., 2019; Nakasone & Torero, 2016; Rijswijk et al., 2021; Saleminck et al., 2017), each of them pursue to unveil other impacts beyond economical. The challenge of digitalizing agriculture, of bringing connectivity to rural areas, does not rely solely on the already challenging deployment of digital technology - though this deployment can be supported by the SDBM rationale. For instance, ICTs have the potential to increase farmers’ access to public and private information, farmers’ knowledge of financial services and political tools, (Aker et al., 2016), and in rural areas in developing countries to increase wellbeing and food security (Nakasone & Torero, 2016). According to Barabanova & Krzysztofowicz (2023) digital connectivity is a key element to improve quality of life and ensure geographically balanced development. ICTs can have impacts on farmer’s identity, skills, knowledge, civil and political power, ownership, privacy, and ethics (Klerkx et al., 2019).

Within ICTs, there is special attention to cellular phones for being considered a primary development opportunity for rural and remote areas (Nakasone & Torero, 2016). These devices have stronger and more immediate effect on rural and remote communities. Their use allow to reduce loneliness in elderly people in rich countries (Kilpeläinen & Seppänen, 2014). The use of cellular phones constitutes a significant step -and groundings- to bridge the urban-rural digital

divide. in a more general scale (Nakasone & Torero, 2016) due to their already somewhat wide acceptance, and relative simplicity (Aker et al., 2016).

Nonetheless, as Rijswijk et al. (2021) state, digital development has pitfalls, its own winners and losers. In the light of rapid digital development, groups such as rural children, rural youth, rural women, older people, rural patients, workers and teleworkers living in rural areas are more vulnerable to digital and social exclusion (Saleminck et al., 2017). Without mentioning the environment as a silent player, sponsor and spectator of this digital race. This thesis focuses on rural digital development and, surprisingly or not, the environment health has been found only in measures of mitigation, monitoring, management (Barabanova & Krzysztofowicz, 2023) and livestock welfare (Klerkx et al., 2019).

### **a. The efficiency imperative**

I would like to recover the idea of how rural areas are dragged by urban development agendas and add to what we now know about how market-centric rationale leads rural digital development. Caprotti (2018) suggests that plans and visions for future cities have too many hopes placed on technology as a means to transform governments, corporations and other sorts of institutions into frictionless systems with continuous and rapid flows of goods, capital and knowledge. According to Buller (2022) warns that this emphasis on efficiency often comes at expenses of justice, distributional concerns, durability and simplifications. The expectations for technology to digitalize the institutions of future cities are pushed by an *urban-efficiency bias* (Caprotti, 2018) that, regardless of their proved potential to increase the speed of production flows, the tracks of this digitalization are built over justice and equality fertile soils (Buller, 2022).

Praising efficiency as a priority, condition and objective of digital development entails that, on one hand, those who participate in this acceleration are needed, included, considered, and protected (Caprotti, 2018). On the other hand, those who do not, the inefficient ones, the less able, the poor, the elderly or those who live outside the urban networks, are left behind, secluded, and seen as targets of control and political oppression (Caprotti, 2018). In the context of the urban-rural dichotomies, this gains the more profound meaning that political and digital divides punish rurality, remoteness and agriculture by pushing them away of the urban-efficient domains but bringing them back to respond to a market-centered call. The winners and losers of this digital race are also determined by how efficient they can be.

From the definition of digitalization and digitisation, digitalization strategies for rural areas imply strategies that seek for a conversion of information from analog to digital integrated into sociotechnical process of rural institutions (Autio, 2017;

Tilson et al., 2010). Limiting these rural strategies solely to the deployment of technologies in rural areas means neglecting the benefits that technological advancements can bring to rural communities outside the *urban-economic* and *urban-efficiency* visions.

### **b. The urban-efficiency bias**

The problem with the efficiency imperative is that from an economic perspective, efficiency does not imply an effective outcome; precondition of social justice and equality (Buller, 2022). In other words, the concerns for rural digital development are misdirected to increase the speed of information, capital and products flows with technology. Instead of addressing rural needs for the so-called *inefficient*. The scope of technology should be directed to level the analog vulnerabilities that vulnerable groups are already facing. In this way technology, by seeking effectiveness rather than efficiency, can strive to be fair, and result in equitable outcomes.

This is where the concept of digital transitions becomes relevant, as a reaction against the efficiency vision of digitalization. Digital transitions could integrate visions of justice, equality or inclusion for rural areas. They need to take into considerations socio-economic conditions to avoid reinforcing the systems supporting the urban-rural digital divide (Rijswijk et al., 2021). Digital transitions could address social challenges by anticipating the unforeseen impacts of digitalization (Barabanova & Krzysztofowicz, 2023).

In conclusion, while digital technologies offer significant promises for rural agriculture, they also bring pitfalls shaped by an urban-efficiency bias. To truly benefit rural areas, digital transitions—not just digitalization—must be prioritized to promote equitable, inclusive, and context-sensitive development.

### **c. The Multilevel Perspective framework**

The Multilevel Perspective (MLP) framework (Geels, 2012) could be useful to visualize a way to escape the an efficiency imperative. That as seen above, prioritizes technological deployment and productivity over fairness and inclusion. By embracing digital transitions, which inherently consider socio-technical systems and broader impacts, we can prioritize effectiveness (fair and equitable outcomes) over mere efficiency.

The MLP states that transitions follow non-linear processes, product of the interactions of the development of three analytical levels: niches, regimes and landscape as showed in Figure 3 (Geels, 2012).

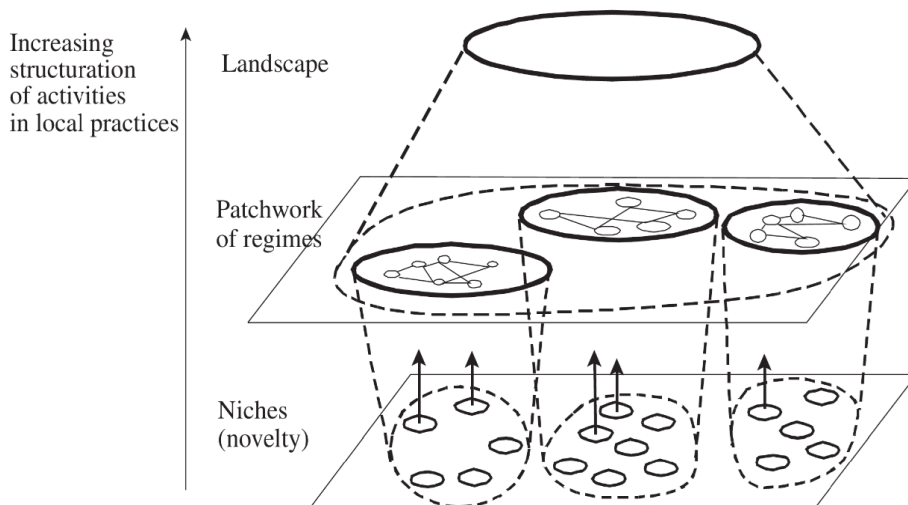


Figure 3. Three analytical levels of the MLP (Geels, 2012).

The Niche level are “protected spaces” where innovations emerge. In this level three social processes occur for innovation: (1) *Learning processes* that highlight imperfections of technology, organization issues, demands, infrastructure requirements, (2) Articulation and adjustment of *expectations and visions* that guide innovation activities and attract attention from external actors, and (3) *Social networks* building that expands the social base of innovations (Geels, 2012). For the purpose of this thesis Niches can be, for instance; companies, Living Labs, small community networks and institutions. The enablers for Niches to gain momentum are the stabilization of *learning processes*, the widely acceptance of *visions and expectations*, and the growth of *social networks* (Geels, 2012).

The Patchwork of regimes level represents the structure behind activities, refers to intangible rules where actors coordinate activities and draw concrete actions (Geels, 2012). The innovation in this level is ruled by (1) *lock-in mechanisms* that are dominant rules that maintain the status-quo and (2) *trends* that enclose the innovation into a defined path (Geels, 2012). These factors are not to be controlled directly but rather evidence of alterations at the niche level. This thesis addresses socio-technical regimes (social norms and technical structures) that are shaped by the relationships between actors, institutions and technology, more concretely; different systems such as ICTs infrastructure, technological developments, agricultural practices, policies, negotiations, regulations,

knowledge, power and organizational structures, and routines among other systems.

The Landscape level influences the niche and regime levels. It is the metaphorical and literal landscape that we are part of (Geels, 2012). Here are macro-trends that change slowly with and with no direct influence from the regime level. In this thesis a landscape can be understood as the spatial structures; the spatial characteristics that identify and differentiate urban and rural areas from one another, such as the natural environment or spatial distribution of the community. Additional examples are the social values and other cultural beliefs that are beyond the control of individual actors, such as generational disposition to adopt new technologies and practices, or collective perception of agricultural labors.

The way the three levels interact among each other to unfold a transition involves a niche innovation that gains momentum through the internal dynamics of learning processes, expectations and visions, and social networks. The landscape creates pressure on the regime destabilizing the latter and creating opportunities for niches innovation to penetrate the regime (Geels, 2012).

In their framework of how transitions develop, Geels and Schot (2007) recognize that there are different ways for them to unfold. Intuitively, transitions could be either top-down or bottom-up orchestrated. Nevertheless, transitions are not resistance-free linear processes that go from one level to another, nor are they exclusively monodirectional. They are rather defined by the combination of timing and nature of their multi-level interactions, resulting in four type of transition pathways (transformation, reconfiguration, technological substitution, and de-alignment and re-alignment) (Geels & Schot, 2007). In this sense, neither strong niche-innovations or landscape pressures alone are sufficient to trigger sociotechnical transitions. There should be an alignment across all three levels (niche, regime and landscape), between readiness of the innovation (timing) and kind (nature) of the interaction across levels (Geels & Schot, 2007).

### **Relevance to this thesis**

The MLP framework is particularly relevant for this thesis because it reinforces the idea that relying solely on the deployment of technology in rural areas is insufficient to achieve meaningful change (Aker et al., 2016; Caprotti, 2018; Rijswijk et al., 2021; Salemink et al., 2017). While such deployments may influence niche innovations and possibly some elements of the regime, they are unlikely to transform the landscape—in this case, agriculture and its socio-economic and environmental conditions. Without addressing these broader dynamics, digital interventions risk falling short of delivering lasting transitions (Caprotti, 2018).

To achieve a true digital transition, it is essential to consider not just the technology itself, but the socio-technical systems surrounding it (Caprotti, 2018). Digital transitions require alignment across all three levels of the MLP framework, ensuring that niche innovations (e.g., ICTs for rural areas) are not shadowed by regime dynamics (e.g., *urban-economic and urban-efficiency biases*) and are instead supporting shifts in the broader landscape (e.g., agriculture's integration of fairness, sustainability, and inclusion).

So far, I have discussed two key statements related to the connectivity domain in rural digital development research. They stem from my interpretation of the reasons and implications of prioritizing technological development in rural areas. These statements are supported by two of the three biases outlined by Caprotti (2018) in plans and visions for future cities. While these key statements focus on the connectivity domain, it is important to acknowledge the inclusion domain, which remains to be explored in this thesis.

## **2.2. The inclusion domain**

The inclusion domain research focuses on the adoption of ICTs leaning on topics such as; diffusion of technology, digital inequalities, and digital inclusion policies (Salemink et al., 2017). This domain explains how new technologies and innovations are spread across rural areas. For instance, lack of financial resources, unemployment, low educational levels and conservative attitudes are considered barriers to ICTs adoption (Salemink et al., 2017).

### **2.2.1 The Human-centered approach**

The fact that new technology is transferred from urban to rural areas creates a skewed view on rural digital adoption. Urban demographics, characterized by higher education levels, higher incomes, and industries that drive innovation, often dictate the design and deployment of technologies in rural areas (Salemink et al., 2017). This urban-centric approach neglects the distinct needs and conditions of rural and remote areas, such as unique demographics, industries, environmental factors, and limited connectivity. Despite these obstacles, rural communities are more likely to adopt new technologies when they recognize tangible benefits for their everyday lives (Salemink et al., 2017). Meaning that one of the most important roles to overcome these barriers, policies and technologies should be tailored to rural contexts, addressing the specific challenges faced by rural communities.

From a macro perspective, the inclusion domain highlights how demographic factors such as age, education, gender, and income shape the relationship between individuals and ICTs (Salemink et al., 2017). However, the relative importance of these factors remains inconclusive. From a micro perspective, vulnerable

groups—such as rural children, youth, older adults, patients, and remote workers—are particularly susceptible to digital and social exclusion due to rapid digital developments (Salemink et al., 2017).

The human-centered approach in this thesis derives from the acknowledgment that empowering these individuals requires improving their skills and addressing underlying socio-economic conditions, which serve as the foundation for meaningful technology adoption (Aker et al., 2016; Salemink et al., 2017). Merely providing technology, as emphasized in the connectivity research domain, is insufficient to promote digital inclusion. Instead, technological applications could integrate participatory approaches that empower rural communities to integrate these tools into their everyday practices.

Here, the human-centered approach is the result of adopting different ideas. The emphasis on human needs is addressed at Caprotti's (2018) critique of the technological biases embedded in visions for future cities, where he argues that basic human need should be placed "at the center of thinking and planning for future cities". It also harnesses principles of design that by deconstructing the meaning of problems and solutions, invite to shift toward a human-centered design to reframe what is the role of designers as problem solvers (De Koning et al., 2018).

#### **a. The technocratic bias**

According to Caprotti (2018), there is an overreliance on highly technical and economic frameworks for addressing urban and global challenges, reducing cities to machines to be fixed with technical solutions. Issues such as climate change, resource scarcity, socio-economic inequalities, and environmental degradation are seen as inefficiencies to be resolved through engineering and planning, neglecting the human and social dimensions of these challenges (Caprotti, 2018).

This technocratic approach also permeates rural development, which is often guided by urban-led agendas. These agendas view rural areas through the lens of technical and economic goals, disregarding the broader social and environmental contexts in which rural communities exist. Caprotti (2018) argues that envisioning future cities—and by extension, rural areas—requires placing human needs at the center of thinking and planning for cities of the future.

#### **b. The role of participation**

To ensure that technological development serves the people rather than markets, it is essential to adopt participatory frameworks that prioritize human needs. The Participatory City-Making framework (De Koning et al., 2018), for example, provides a physical and conceptual space where communities can design their

environments. This platform empowers people to articulate their needs and shape the technologies and policies that impact their lives.

When applied to rural digital development, participatory frameworks operationalize the inclusion domain by ensuring that technology is designed with and for the people. They challenge the dominant rationale that technology exists solely for market development and instead advocate for its role in improving human well-being. These frameworks approach the solutions from an environmental- and human-centered concern, as it integrates social, cultural, and environmental considerations into the development and deployment of technologies (De Koning et al., 2018).

### **c. Design-enabled Participatory City Making**

In their study, de Koning et al.(2018) seek to untangle the tensions in participatory city making, defined as “the processes in which government, entrepreneurs and citizens co-create new solutions for urban challenges”. In the process of doing so, they merge, a MLP analysis to place the city as the space for transitions, with design as a research method to bring an interrelated designer-user perspective. The area where the tensions of participatory city making untangle is defined as the *Space of interaction* (De Koning et al., 2018).

#### **MLP’s contribution to the framework**

The MLP contributes by framing cities as the places where transitions occur and by explaining how these transitions develop. De Koning et al.(2018) identify disruptive initiatives emerging at the niche level, from citizens and civil servants as drivers of urban transitions. Although these initiatives do not follow traditional policy and planning processes, they have proven to provide a starting point for exploring possible transitions in urban systems and urban governance (De Koning et al., 2018).

The role of individuals at the niche level is particularly important because they act within governmental, community, or corporate structures seeking more inclusive, creative, and diverse ways to develop the city (De Koning et al., 2018). The relevance of transitions is tracked down to citizen-level, the core component of actors in a niche. Thus, individuals are the frontrunners of transitions that create pressure within their own structures that eventually can lead to a disruption in the regime their niche is part of (De Koning et al., 2018). These niches can affect and are affected by the dominant regime, which is seen as the institutionalized systems of urban policy and planning (De Koning et al., 2018). Citizens engage with these semi and privatized services and governing systems through the exercise of voting and tax contributions (De Koning et al., 2018).

The transition from traditional top-down urban planning to participatory city-making, where citizens become active contributors to city development, presents several advantages. Increased participation in innovation processes has been shown to result in greater commitment to future innovation, with users displaying higher satisfaction and engagement due to solutions being better adapted to their needs (De Koning et al., 2018).

### **Design's contribution to the framework**

The value of design is evident in how its role has shifted and been integrated into this framework. Design practices evolved outside the conventional fields of design, from dealing with signs and things, to dealing with actions and thoughts. It went beyond shaping products and towards situating the design efforts in functions (De Koning et al., 2018). In an effort to move away from the traditional form-function dichotomy, and top-down approaches, design now accounts for the diversity of designers, practices and institutions (De Koning et al., 2018)

De Koning et al. (2018) shed light to two aspects of this shift:

1. The reconstruction of the identity of designers. The designer can appear in different configurations and amounts, i.e. end-user(s) can become designers of their own solutions.
2. The expansion of the role of designers. From the traditional perspective of the designers as problem solvers and form-givers. The tasks of designers can be redefined as enablers and facilitators of spaces and tools from where other actors can co-create.

The framework focuses on analyzing and identifying five areas of interaction for participatory city making shown in Figure 4. (1) Internal way of working of the local government; (2) internal way of working of the initiatives; (3) participatory or external way of working of the government; (4) participatory or external way of working of the initiatives; and (5) the space of interaction -where collaboration and co-creation takes place (De Koning et al., 2018).

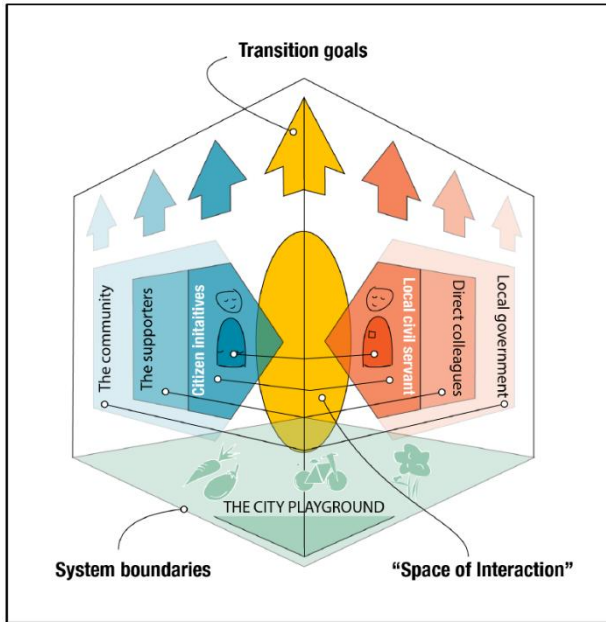


Figure 4. From two different perspectives, each stakeholder aim at a shared transition goal using a Space for interaction to co-create their solutions. Each stakeholder is supported by their own processes, involved within the same system's boundaries. Diagram from: (De Koning et al., 2018).

## Relevance to this thesis

This framework dismantles the complexity of urban transitions by focusing on their most elemental component: the citizen. Since citizens are tangible, actionable actors, engaging them directly provides a practical way to sense the direction of transitions. This emphasizes the need for platforms (spaces for interaction) that enable citizen participation, as they are key to sense and direct transitions.

The design-driven approach of this framework reinforces the argument that end-user involvement is essential for innovations -in this case digital innovations- to be successfully adopted and integrated into their everyday practices. The value of co-creation in participatory design is strongly aligned with the logic of Service-Dominant Business Models (SDBMs). Both emphasizing collaborative value creation and end-user involvement.

From an MLP perspective, while De Koning et al. (2018) apply this framework to urban settings, this thesis extends the logic to rural and remote areas. Although rural development is often shaped by urban-led agendas, this research does not aim to entirely separate rural and urban digital strategies. Instead, it recognizes

shared responsibilities and mutual influences between both spaces. The same transition pathways that have been effective in urban contexts can be adapted to frame rural and remote areas as spaces for digital transition.

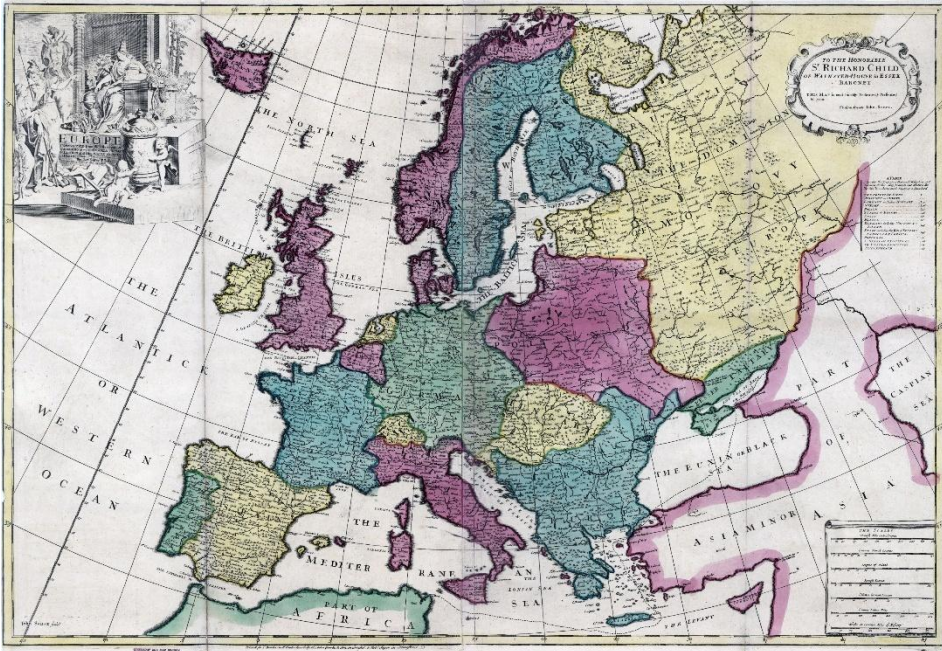
Design-enabled participatory city making explains how the collaborative value of design has a role in allowing stakeholders' interaction to achieve a transition goal. Reframing it from a different perspective; the collaborative characteristics of SDBMs have a role in designing a rural digital transition to bridge the urban-rural inequalities. Additionally Design-enabled participatory city making framework plays a role in the research methodology, as it was used to construct the interview protocol (Appendix A).

### **Conclusion of Conceptual and theoretical framework**

To conclude, in the context of rural digital development, Service-Dominant Business Models (SDBMs) can serve as a form of market interference that bridges the connectivity and inclusion domains. SDBMs address the market-related barriers that perpetuate the urban-rural digital divide while simultaneously challenging the production biases imposed by urban-led agendas on rural contexts. This is supported with the shift from digitalization, which focuses on technological deployment, towards digital transitions, that seek to encompass the broader complexity of how technology impacts society.

Both SDBMs and digital transitions emphasize co-creation, contextual solutions, and the need to address underlying analog challenges that shape the adoption and impact of rural digital technologies. Additionally, participatory approaches foster inclusion, ensuring that vulnerable groups affected by digital exclusion and other urban-rural dichotomies are involved in shaping their solutions.

Moreover, as explained by the MLP framework, instead of pushing either top-down or bottom-up niche-driven innovations, it is about balancing the readiness of the innovation and the type of interaction among niche, regime and landscape levels. LLs can profit from the windows of opportunity created when their technological innovations are “ready” and when regime and landscape levels are fertile ground for them to be developed as from niche to regime levels. These strategies not only enhance acceptance and adoption of technologies within rural markets but also empower individuals -the fundamental unit of communities- to become agents of transition pathways. Enabling communities to co-design digital solutions ensures they are fair, inclusive, sustainable, and meaningful—ultimately leading to more resilient and equitable rural digital development.



“Map of Europe”. John Senex, 1719.

### 3. Case study

#### Introduction

The theoretical framework chapter outlined the urban-rural digital divide and biases in rural digital development. There was also the opportunity to introduce SDBMs, the differences between digital transitions and digitalization and digitization, the MLP analysis and the need for participatory approaches. This chapter provides a tangible context by examining how rural digital development is carried out in Europe and how business models, governance structures, and technology adoption shape rural connectivity initiatives.

To illustrate this, I focus on the COMNECT project, a Horizon Europe-funded initiative designed to bridge the urban-rural digital divide. This case study allows for a deeper analysis of the effects of participatory approaches to unfold digital transitions that could bridge urban-rural disparities beyond connectivity alone.

This chapter situates theoretical discussions on SDBM, digital transitions, and participation into a real-world case study. It highlights the potential and limitations of COMNECT project using CBMs in rural digital development and raises

critical questions about how participatory models can drive more inclusive and sustainable transitions.

It is worth noting that the development of this thesis' empirical research occurred over course of seven months at TNO's (Dutch Organization for Applied Scientific Research) headquarters in The Hague. I joined the team responsible for developing the Business Model Reference Framework for COMMECT and assisting Living Labs in creating their Collaborative Business Models (CBMs). This team also conducted socio-economic and environmental impact assessments for the Living Labs. Given TNO's role as a key player in the development of CBMs for the Living Labs, I was in the ideal environment to conduct my research. This position provided me with ample resources, support, contacts, and information, greatly beneficial for the research.

### **3.1. Rural digital development in Europe**

The European Union has pushed forward two major developments; green and digital transitions (Muench et al., 2022). In the context of European agriculture this means efforts to use digital technologies to help agricultural and rural communities become more sustainable and strengthen their resilience against climate change effects, and the pressures of feeding a growing population (Barabanova & Krzysztofowicz, 2023).

The overarching European Union's policy strategy is the European Green Deal, with the objective of transforming Europe into a clean and circular economy, to become the first climate-neutral continent by 2050 (European Commission, 2024e). Within the European Green Deal, the agricultural sector plays a key role, for its inherent relationships between society and the environment. European agriculture is supported by the Common Agricultural Policy (CAP) which is a set of national and global standards for safety, security of supply, nutrition and quality of food (European Commission, 2024a).

The CAP incorporates into its general and specific objectives the modernization of agriculture and rural areas through innovation and digitalization of its processes across areas such as financial, environmental, food and health (Barabanova & Krzysztofowicz, 2023). It also highlights the need for the latest farming methods and market developments (European Commission, 2024d). The CAP is regarded as an effort towards sustainable food systems that delivers environmental and social benefits, and offers a fairer economy while ensuring food affordability and availability (European Commission, 2024a).

The current CAP (2023-27) supports farmers and rural stakeholders of 27 European Union countries through their respective CAP Strategic (national) Plans

(European Commission, 2024d). These plans are at the same time linked to contribute to goals of the European Green Deal, Farm to Fork Strategy and Biodiversity Strategy (European Commission, 2024d). Farm to Fork Strategy for 2030 aims to create a fair, healthy, and sustainable food system by reducing the environmental footprint of food production, mitigating climate change, reversing biodiversity loss, and ensuring food security and public health (European Commission, 2024c). While the Biodiversity Strategy for 2030 is a comprehensive plan to protect nature and reverse ecosystem degradation. It seeks to establish a larger network of protected areas, restore degraded ecosystems, and implement measures to address global biodiversity challenges (European Commission, 2024b).

While these policies aim to preserve the environment and ensure a sustainable European food system, they tend to emphasize a production narrative, an efficiency imperative, and a technocratic perspective. On one hand the CAP promotes financial support for the digitalization of agriculture through financial, knowledge exchange, and information dissemination support (European Commission, 2024d). On the other hand the CAP contribute to Rural Development Plans (RDs) by the European Agricultural Fund for Rural Development (EAFRD) where one of its priorities is “promoting social inclusion, poverty reduction and economic development in rural areas” (European Commission, 2023). This raises questions about whether these European policies align with digital transitions or just digitalization strategies.

### **3.2. The COMTECT project**

Knowing that a key aspect of the CAP is fostering digitalization in agriculture to enhance efficiency and sustainability (European Commission, 2024d). The objectives of COMTECT align with the CAP's emphasis on digitalization. By improving connectivity in rural areas, COMTECT facilitates the adoption of digital tools and technologies in agriculture, hence contributing to the CAP's goals of sustainable and efficient farming practices.

The COMTECT project is a great example of how to address the market-related nature of the urban-rural digital divide discussed in the Theoretical Framework. COMTECT is a project funded by the Horizon Europe program (EU's key funding program for research and innovation) that seeks to “bridge the urban-rural digital divide and address the need of rural communities with cost-effective and environmental-friendly connectivity solutions” (Luxembourg Institute of Science and Technology (LIST), 2024). The way of doing it is by setting up five Living Labs (LLs) in rural and remote areas across Europe to bring different actors to the creation of Collaborative Business Models (CBMs) to support technological implementations for agriculture and forestry (LIST, 2024). The aim is to determine how to meet coverage and capacity demands of different communities with an end-user-centered approach, and offer the end-users the Decision-Making

Support Tool (DST) to support the digitalization of the agricultural sector (LIST, 2024).

In addition to that, COMMECT's impact is expected to improve and optimize agricultural practices such as transportation, use of pesticides and water, and yields to contribute to the reduction of greenhouse gases (GHG) emissions (LIST, 2024). This will be reflected and considered in their internal socio-economic and environmental impact assessments of the proposed technological solution. Moreover, COMMECT's main 4 objectives touch on (LIST, 2024):

- (1) Empowering rural and remote communities and train them toward digitalization.
- (2) Increasing competitiveness of rural communities and give them access to new services and business opportunities.
- (3) Facilitating decision-making in the selection of the most appropriate Internet connectivity.
- (4) Contributing to climate change mitigation and increasing resilience and sustainability of rural communities, which highlights the project's integral approach to bridge the urban-rural digital divide.

### **3.3. The Living Labs**

The learnings from the variety of Living Labs are key to decide the most appropriate connectivity solution based on the technical requirements, and socio-economic and environmental conditions (LIST, 2024). The five Living Labs are described as follows (LIST, 2024):

1. Living Lab Luxemburg. Seeks to integrate Remote Sensing (RS) and Internet of Things (IoT) technologies to support winegrowers with control and prediction of diseases and droughts, irrigation, and fertilization of their vineyards.
2. Living Lab Norway. Aims at integrating RS and IoT technologies to collect real-time data help forests managers monitor forests' health, optimize operations and ensure sustainable forestry practices.
3. Living Lab Denmark. Focuses on adopting communication technologies such as public and private 5G, and WiFi 6 to assist livestock farmers and transporters optimize loading/unloading of animals, and real-time transportation monitoring.
4. Living Lab Turkey. Focuses on integrating communication technologies such as near band IoT (NB-IoT), 5G, WiFi and enhanced machine-type communication (eMTC) to help olive farmers increase yield and quality of the product by informing them about the best time to control pests and diseases.

5. Living Lab Serbia. Aims at adopting communication technologies such as edge gateways, Long Range Wide Area Network (LoRaWAN) and 5G to help farmers and environmental protectors automate irrigation of their crops and to monitor soil and weather conditions to ensure sustainable agriculture and preservation of natural environment.

One of the key supporting elements of these living labs to ensure ICTs implementations with the collaboration of different stakeholders is the design of Collaborative Business Model (CBMs). The Living Labs' development is crucial for most of COMMECT's objectives and, consequently, so is the creation of innovative business models supporting the Living Labs, that can help decision makers improve rural connectivity.

### **3.4. Collaborative Business Models**

The relevance of CBMs in the Living Labs falls in the right place regarding bridging the urban-rural digital divide with the implementation of ICTs. They address the market-related nature of the urban-rural digital divide proposing a new collaborative characteristic and having a service-dominant logic, extensively explained in the Theoretical Framework of this thesis (Jonker et al., 2020; Turetken et al., 2018) In short, CBMs in this thesis can be understood as the representations that each LLs has of the SDBM/R (Figure 2)

When CBMs focus on ICTs, the logic behind them aligns with the way ICTs deliver value to end-users; as a service (Turetken et al., 2018). The collaborative approach and service orientation of these business models are key for ICTs solutions to not only be adopted by the end-user, but also to surpass the market challenges to bridge this urban-rural disparity and move towards a more comprehensive integration of ICTs within Living Lab communities. Therefore, the importance of creating CBMs in a participatory way that enables this comprehensive integration cannot be overstated.

Based on the five Living Labs, TNO developed a business model reference framework to support the design of CBMs for connectivity solutions in rural and remote areas. The reference framework consists on seven categories (showed in Table 1) that define the CBMs (Gilsing et al., 2023).The framework acknowledges the need of a strong participatory approach, specific to CBMs, that involves the end-user in the value-creation process (Gilsing et al., 2023).

Type of stakeholder	Connectivity solutions	Purpose of solution	Access to data	Investment structure	Types of values to consider by end-users	Means of value capture by providers
End-users (households, farmers, rangers, schools, public services)	5G Connectivity Platforms	Data sharing solution	End-users	Individual investment by end-user	Connectivity / digital inclusion	Value capture through need for services / compliance
Telecom operators	Local 5G Private Networks	Data analytics solution	Shared responsibility	Collective investment by end-users	Reduced emissions / increased sustainability	Value capture through data collected
Service provider / platform provider	IoT and Edge Computing Solutions	Data collection solution	Rights at the provider	Investment by association or cooperative	Reduced inputs needed	Provisioning of new services
Government bodies (local governments, municipalities, ministries)	AI and Network Automation			Investments by government body	Data-driven insights / improved decision making	Payment for connectivity solution
Investors				Investments by private organization	Provisioning of new services	Expanding market segment
Cooperatives, Associations					Productivity / efficiency	Increased social and environmental well-being
(Rural) Infrastructure Provider / technology provider					Reduced costs	
Value chain stakeholders (operator, retailer, contractor)					Value through compliance	
Regulator, certifier, insurance					Improved safety	
Knowledge institutes					Improved competitive position (reputation, brand)	
					Increased ease-of-use / technology adoption	

Table 2. Reference Business Model framework done by TNO to support the design of LLs' CBMs (Gilsing et al., 2023).

### 3.5. Contextualizing the case study. Strengths and limitations of COMMECT

#### Strengths

The COMMECT project shows great potential to exemplify how the SDBM logic-materialized in the LLs' CBMs- can serve as the market interference needed to bridge the connectivity and inclusion domains. The strengths of COMMECT project are:

- Focuses on rural and remote areas. The contrast in technologically underserved and well-served areas result in divides determined by their spatial distribution; urban-rural disparities (Townsend, Sathiaseelan, Fairhurst, & Wallace, 2013). The COMMECT project tackles this rural penalty (Hite, 1997) with improved connectivity to compensate for their remoteness and potentially bridge urban-rural disparities (Salemink et al., 2017).
- Addresses the market's mistakes. Deals with the lack of market incentives for ICTs businesses in rural and remote areas pointed out by (Salemink et al., 2017). It aligns with (Aker et al., 2016) warnings that ICTs for agricultural initiatives should aim to understand the information and market failures before their implementation. This could mean that the business models that support rural digital implementations, guarantee the economic viability of the technology in the regions.
- Adopts the participatory approach. Involves end-user as co-creator of their solutions, suggestion found in SDBM logic and design-enabled participatory city making by (Turetken et al., 2018) and (De Koning et al., 2018) respectively.
  - Uses Living Lab methodology. The nature of this methodology has shown qualities that allows to position the end-user as both, co-creator and expert informer at the same time (Dell'Era & Landoni, 2014). In the context of technological implementations in rural areas can lead to harness the potential of existing technologies or to the exploration of opportunities new technologies (Dell'Era & Landoni, 2014).
- Considers agricultural needs. As an effect of the participatory approach, the COMMECT project apparently avoids implementing urban-led development agendas into the agricultural sector. The project seeks that the creation of CBMs springs from the collaboration and participation of local stakeholders involved in agricultural activities of their regions (Gilsing et al., 2023; Luxembourg Institute of Science and Technology (LIST), 2024). Moreover, it acknowledges that broadband connectivity is a need for the sustainability of rural communities and that it has the

potential to “improve their lives” in short- and long-term(Luxembourg Institute of Science and Technology (LIST), 2022).

- Incorporates socio-economic and environmental impact assessments. As an effort to promote sustainability in the initiative, the reference business model framework (Table 1) acknowledges that contributing towards social and environmental impact is a type of value stakeholders might be interested in (Gilsing et al., 2023).
- Recognizes different types of value. As seen in the 6<sup>th</sup> column of Table 1, the project moves away of the oversimplification of value creation by and for single stakeholders, toward a more complex generation of value through a network of actors(Turetken et al., 2018). Value then takes different forms for each stakeholder involved, broadening the perspective of the impact of ICTs for agriculture.
- Focuses on the use of ICTs. In the attempt to bridge the urban-rural digital divide, the project heavily relies on the implementation of new technologies for agriculture. It aims at the digitalization of the agricultural sector by integrating , for instance, non-Terrestrial Networks with terrestrial cellular XG networks, and low-cost Internet of Things (IoT), and Artificial Intelligence (AI), and Edge and Network Automation to reduce energy consumption at connectivity and computing level (Gilsing et al., 2023).

## **Limitations**

Nevertheless, while the COMMECT project claims to bridge the urban-rural digital divide through the digitalization of the agricultural sector, this focus remains primarily on the connectivity domain (Gilsing et al., 2023). Emphasizing technological infrastructure and business-oriented processes rather than a holistic approach for technological adoption for rural digital development (Salemink et al., 2017). As much as this might be a valid approach for structuring ICT-driven initiatives, in the context of rural digital development, and especially considering how the role of technology has permeated in our lives (Salemink et al., 2017), this approach falls into the cracks of the biases outlined in the theoretical framework chapter of this thesis.

## **The production narrative and the urban-economic bias**

This project reflects a market-driven logic, where technological innovation is primarily intended to enhance connectivity and economic competitiveness rather than to improve the overall quality of life for rural communities. COMMECT aligns with the dominant food production narrative, which assumes that increasing agricultural yields and optimizing resource use will lead to food security (Schutter, 2014; Sonnino, 2009; Wisserke, 2015). Food security is not just a mat-

ter of production. Schutter (2014) highlights that availability, accessibility, affordability, and adequacy are the real challenges. Simply producing more food does not make it more accessible to those who need it.

The project's language and objectives indicate a focus on optimizing productivity through digital connectivity and decision support tools. Rural and remote dwellers were consistently referred to as *end-users* and *customers* rather than to as individuals with diverse social, cultural, and economic roles (Luxembourg Institute of Science and Technology (LIST), 2022). For the objectives, COMMECT outlines four of them: (1) empowering rural and remote communities and train them toward digitalization; (2) increasing competitiveness of rural communities and give them access to new services and business opportunities; (3) facilitating decision-making in the selection of the most appropriate Internet connectivity; and (4) contributing to climate change mitigation and increase resilience and sustainability of rural communities (Luxembourg Institute of Science and Technology (LIST), 2022).

The objectives of the project are rightfully delimiting their scope within the boundaries of digital connectivity, sustainability and business domains. Nevertheless, they fall short of explicitly considering how these technological interventions will support equitable food distribution or improve affordability. They do not engage with the broader structural challenges that define food insecurity beyond food production, leaving a gap between digital implementation and the broader social objective of food security. Technologies could be designed to enhance accessibility, affordability, or local food sovereignty. COMMECT primarily frames ICTs as tools for optimization but could benefit from framing them as tools for social equity in food systems. The setbacks for COMMECT failing to challenge the root causes of food insecurity, could lead to reinforce the urban-led assumption that food security is a production issue rather than an inequality and injustice issue (Buller, 2022). This leads to the second bias.

### **The efficiency imperative and the urban-efficiency bias**

The project's emphasis on economic sustainability and market viability demonstrates a strong alignment with the efficiency imperative, which assumes that business and efficiency should be the primary drivers of rural digital development.

COMMECT promises business models to ensure the long-term sustainability of its ICT solutions (Gilsing et al., 2023). However the possible pitfalls of the unforeseen effects and potential retrieval of technology are not addressed (Aker et al., 2016; Rijswijk et al., 2021) These models fail to explain what would happen if there were not enough profits - if they were ineffective-, will they be abandoned, leaving rural communities without long-term support?

In the business model reference framework shown in Table 1 there is space that accounts for different kinds of value (Gilsing et al., 2023). Nevertheless, it falls short of acknowledging how are the technologies, for instance, supporting to increase long term resilience in rural areas, beyond market-driven productivity gains, improving access to services such as healthcare, education or emergency responses. In general, it fails to address the broader urban-rural inequalities. This could be explained by the fixation with strategies for digitalization rather than for digital transitions.

Instead of prioritizing efficiency of technologies, COMMECT could benefit from prioritizing its effectiveness; precondition of social justice and equality (Buller, 2022). That is to encompass in the design of CBMs other kinds of value that technologies could deliver to the communities that help bridge urban-rural divides. Moreover, by shifting the perspective from digitalization to digital transitions, visions of justice and equality could be integrated. In this way, COMMECT could avoid reinforcing the same urban-rural disparities it seeks to eliminate.

### **The role of participation and the technocratic bias**

COMMECT replicates the urban-led assumption that technology is a condition for rural development. Which is partially true as seen in the theoretical framework, but misses questioning whether technology alone can address deeper socio-economic disparities. The project does not clarify how will introducing more and more complex technology inherently improve rural livelihoods. Moreover, it does not assess whether local knowledge systems and existing practices could be strengthened instead.

This resembles the illustration that Nakasone and Torero (2016) made on the relevance of cellular phones. Which are already showing influence on rural digital development and are still to show their greater effects (Nakasone & Torero, 2016). COMMECT focuses on educating farmers on how to use new digital tools, but does not assess whether these new technologies—especially at their current level of complexity—are filling a gap for rural digital development that could not be filled with other, simpler, more accessible, more familiar technology. Like -for instance- cellular phones.

Moreover, even if new technologies are successfully implemented in rural areas, the inclusion domain invites to raise critical questions about the long-term relationship between communities and these technologies. Who will own them? Who will maintain them? Will they create dependencies on external expertise, further limiting local control over technological development?

Even in a scenario where digitalization occurs successfully in rural areas, urban areas continue advancing at faster rates (Salemink et al., 2017). This raises a fundamental contradiction: if rural areas must accelerate development just to catch up, the urban-rural gap may never actually be bridged. Instead of chasing urban technological advancements, a more critical question should be asked: What are urban areas doing to slow the pace of technological development to allow rural and remote areas to level the digital race? If rural areas can never truly compete in this race, then why place rural and remote areas at a digital race they are going to lose? The pressure for newer, faster, bigger, more productive, and more efficient technologies in rural areas risks being a futile exercise, consuming resources without addressing the root causes of urban-rural disparities.

This exemplifies the technocratic bias, where modern challenges are viewed primarily as technical problems to be solved with more technology, rather than as complex socio-economic systems with unexplored opportunities for alternative solutions. Instead of seeing rural development as a “broken machine” that can be fixed with technology, we should recognize it as a “black box” filled with opportunities that requires more than just digital tools to thrive (Caprotti, 2018).

### **Conclusion of Case study**

One possible line of action to escape the biases of plans and visions for the future suggests shifting from a technology-centered approach to a human-centered approach (Caprotti, 2018). This means to place human needs at the core and foundations to envision the future for urban and rural areas (Caprotti, 2018). The human-centered approach should be on one hand detailed, and place-specific but adaptable to broader agendas, while on the other hand understand how the context -either geographical, cultural, historical, or economic- shapes human needs (Caprotti, 2018).

Building on top of the strengths of COMMECT project to use Living Labs to understand different contexts while responding to the broader project’s agenda. The proposal for this thesis is to take a human-centered approach by assessing the state of a Space for interaction and participation in the Living Labs of the COMMECT project (De Koning et al., 2018). This could ensure that rural inhabitants have a space to expose their needs beyond the market view and meet solutions that are practical, relevant, and effective in bridging urban-rural disparities.



*“La ofrenda (The Offering)”*. Saturnino Herrán, 1913.

## 4. Methodology

### Introduction

This chapter explains the methodology used to assess how the Living Labs (LLs) in COMMECT could better organize to address challenges beyond market-driven digitalization. This research explores the idea that a well-defined Space for interaction—where stakeholders actively participate in shaping technological solutions—can serve as a key enabler of digital transitions in rural and remote areas.

To research this, I used a semi-systematic literature review and semi-structured interviews with Living Lab leaders (technical partners). The literature review provided the foundations to build the theoretical framework and interviews. The interviews were designed to assess the state of a Space for interaction -where multiple stakeholders co-create solutions- in COMMECT’s LLs(De Koning et al., 2018).

This evaluation seeks to give two insights of CBMs in COMMECT. How CBMs genuinely engage local stakeholders in decision-making processes to address challenges arising from the urban-rural digital divide. By doing so, the evidence

speaks about how CBMs follow a user-centered approach, enabling end-user-driven technological adoption. On the contrary this evaluation can reveal whether CBMs merely position end-users as consumers of pre-designed technological solutions, demonstrating the reinforcement of market-led digitalization.

The methodology follows ethical research standards, adhering to the Human Research Ethics Committee (HREC) guidelines of Delft University of Technology (TU Delft), as well as internal data protection policies from TNO and Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute). Ethical considerations include an Informed Consent for interviewees, a Data Management Plan, and a Risk Assessment and Mitigation plan to ensure participant confidentiality and data security throughout the research process.

## **Main divisions**

By dissecting the main research question of **“How could COMMECT’s LLs better organize to address rural development beyond market-driven digitalization?”**. Several sub-questions arose. Nevertheless, the overarching two main categories respond to the “what” and “how” of the main research question.

### **4.1. Semi-systematic literature review**

Responding to the “what” component required to understand what is the studied phenomena, its constituents and how they relate to delve into the problem statement (Mason, 2002). For this purpose, a brief semi-systematic literature review was conducted to help understand the urban-rural digital divide. This type of research method was useful to answer the first secondary research question because the main purpose was not to cover an extensive and rigorous research of everything related to the societal impact of ICTs in rural and remote areas, but to understand how the topic has progressed over time (Snyder, 2019; Torraco, 2005). Since the research on urban-rural digital divide is rather mature, this type of literature review is helpful to overview the knowledge base and re-conceptualize the theoretical foundation of the topic, to identify the components and relationships and to serve as foundation for the interviews (Snyder, 2019).

The work of (Salemink et al., 2017) contributed on finding that the urban-rural digital divide was result of a particular interaction among its main components related to markets, technology, and society, providing the main taxonomy of this thesis into the connectivity and inclusion domains intensively used.

The concepts of SDBM logic and Digital Transitions emerged as a response to better articulate the three components causing the urban-rural digital divide. SDBM logic was found on the theory grounding the COMMECT project. The focus on businesses and technology of the SDBM is predominant in authors like

(Aker et al., 2016; Gilsing et al., 2023; Stojanova et al., 2022; Turetken et al., 2018). After researching about the relationships between technology and society for rural development, Digital Transition concept came from state-of-the-art academic discussions about social sciences on agriculture's digitalization, especially from literature from (Barabanova & Krzysztofowicz, 2023; Klerkx et al., 2019; Rijswijk et al., 2021; Salemink et al., 2017), focusing on the impacts technology has on society.

In a more general scope the work of (Caprotti, 2018) and (Wiskerke, 2015) served as basis to add the urban perspective to the topic, as the former analyzes the influence urban agendas have on technological development, while the latter analyzes the influence urban agendas have on food systems. The texts of (Buller, 2022) and (Goldstein, 2018) were particularly helpful to form a sound understanding about the paths that green entrepreneurship has been taking with the introduction of technologies. The brief semi-systematic literature review can be found in this thesis under the name of Theoretical Framework.

A particular literature material was consulted to guide the structure of this thesis, such as the chapters by (Cope, 2010; Healey & Healey, 2010; Longhurst, 2010) belonging to the same book and the papers of (Snyder, 2019; Torraco, 2005). In a similar way, I relied on the publications of (Mason, 2002; Moses & Knutsen, 2007) to understand the fundamentals of metaphysics, namely, what is knowledge?, what is knowledge made of?, and how do we acquire knowledge? This helped me to articulate what this research is about and where do I stand in the topic I am researching.

## **4.2. Semi-structured interviews**

The “how” component was assisted with desk research in addition with semi-structured interviews. The desk research entailed finding a framework that explains ways in which stakeholders organize to address issues in their communities. This helps to identify if and/or to what extend social challenges related to the urban-rural digital divide are/could be addressed by the CBMs found in the COMMECT's LLs proposals. The framework in question is the one of (De Koning et al., 2018) that is at the same time supported by the MLP framework by (Geels, 2011).

The flexibility of semi-structured interviews allows to explore topics that might have passed unnoticed on preliminary research, and to “understand how individual people experience and make sense of their own [projects]” (Longhurst, 2010). This form of interview has a determined component but still ensures the interviewee explores other angles of the topics (Longhurst, 2010).

## **Formulating questions**

In accordance with (De Koning et al., 2018) I built an interview protocol that sought to understand the “issues [(requirements)] for participation from the point of view of the interviewees”. The interview protocol elicited information from Living Lab leaders by a list of questions that covered the topics: (1) Objectives and motivations as stakeholders, (2) Collaboration and Participation practices, (3) Organization and Structure of the Living Lab, (4) Challenges in the Living Lab, (5) Problems and resistance in participation, and (6) The story line of the Living Lab (De Koning et al., 2018).

Prior to the interviews, I researched the specific Living Labs status, so that the first minutes of the hourly session were spent in the comfortable task of corroborating facts, aligning the initial knowledge of the Living Lab. The major divisions of the interview protocol adhered to the six aforementioned topics, with primary and secondary questions. Often, after the first minutes dedicated to fact-checking, the interviewee proceeded to fill gaps in my knowledge that led the conversation to the prepared topics of the interview protocol (Appendix A), thus, during the interviews I ensured the topics were covered following the rhythm of the meeting.

The design-enabled methodology for Participatory City Making originally complemented the interviews with a set of workshops and explored the stakeholders involved in the “process of co-creat[ing] new solutions for urban challenges” (De Koning et al., 2018). While the interviews with the end-users and the workshops were highly encouraged, knowing the possibilities and limitations of this research, the interviews of the Living Lab leaders/Technical Partners remained the focus.

## **Selecting participants and location**

The interviewees are selected from the Business Models of the Living Labs, based on their familiarity with the research topic (Longhurst, 2010). The SDBM/R follows four main stakeholder’s distinction: focal organization, customer, core partner, enriching partner (Turetken et al., 2018). Nevertheless, I interviewed Living Lab leaders, also referred as Technical Partners, using the design-enabled participatory city making framework by De Koning et al. (2018) as inspiration, in conformity to COMMECT project’s documentation (Gilsing et al., 2023), and to ensure some degree of confidentiality and anonymity.

There were five interviewees (Table 2) from four different Living Labs, meaning there was one Living Lab with two interviewees (Luxemburg) and one with no interviewee (Norway). Therefore, the interview protocol was adapted for technical partners ensuring consistency across the interviews. The interviews were conducted between 24th May and 5th June 2024.

<b>Living Lab</b>	<b>Interviewee</b>
Luxemburg 1	Technical partner
Luxemburg 2	Technical partner / End-user
Denmark	Technical partner
Turkey	Technical partner
Serbia	Technical partner

Table 2 List of Living Lab interviewees.

Interviews took place online since interviewees are in four different countries across Europe, respective to their Living Labs. The interviews were recorded with Microsoft Teams' inbuilt features, allowing me, the interviewer, to focus on the interaction, topics, quality of the intervention, and note taking (Longhurst, 2010).

### **Transcribing data and coding**

The interviews' recordings were listened after completion to improve the way they are conducted, and the transcription was coded as soon as possible after conducting them to capture the tone of the conversation (Longhurst, 2010). The transcription of the interviews is done with Microsoft Word features and corroborated by me matching audio and transcript with Atlas.ti.

There are two type of codes used, first-level descriptive codes composes by in-vivo codes, and second-order analytic codes that are a rational interpretation of an excerpt (Cope, 2010). In the coding process, the set of codes is generated in an abductive way, a hybrid between deductive and inductive coding: having an initial set of codes derived from literature and theories, but also open to find new codes related to findings or hypothesis from the interviews' transcripts (Cope, 2010). The coding process was accompanied by note-taking.

The interviews' coding followed a two-step process:

- 1) Find categories and patterns. The first step is about getting an overview of the transcript to understand it. To achieve this, the coding process followed the next coding categories explained in the code-book found at the Appendix B:
  - a. Structural coding. Outlining themes covered in the interview protocol.
  - b. In-vivo codes. A type of descriptive code using literal words from the speaker as codes.

- c. Codes from the literature review by Salemink et al. (2017).
- d. Pattern identification at the basic level of coding: conditions, interactions among actors, strategies and tactics, and consequences (Cope, 2010).
- e. Value codes. Descriptive codes explaining the worldviews, attitudes and beliefs of the speaker. Analytic codes that involve a humane interpretation of the tone of the conversation (Cope, 2010).

After the first interview was coded, new patterns emerged that forced a revision of the research questions, literature, theories and objectives of this research. These patterns appeared to have overlapped meanings with pre-existing codes that indicated how the same empirical evidence could also be explained, either in more detail or from other perspectives from other frameworks. Within the pre-existing codes detailed in Appendix B, the codes related to organization and structure of the Living Labs from design-enabled participatory city making framework by De Koning et al. (2018), are also related to interactions among the actors from Denzin, N. & Strauss, A. (1988) recommendations.

2) Find themes. The second step consisted of a more in-depth coding process to cluster codes in themes that allowed to reshape the research question and finding similarities across the transcripts.

From looping back to the researched material, similar and complementary codes emerged. The work of De Koning et al. (2018) overlapped with components from the SDBM/R (Turetken et al., 2018); objectives and motivation with costs and benefits categories, and storyline of the initiative with customer experience categories. Additionally, there were commonalities between MLP theory by (Geels, 2011) and both, Denzin, N. & Strauss', A. (1988) recommendations and design-enabled participatory city making by De Koning et al. (2018). Therefore, the themes of SDBM and MLP were added to the codebook (Appendix B):

- a SDBM. Elements of the SDBM/R: agreed value-in-use, actor value proposition and actors' roles, co-production activity, actor's cost & benefits, stakeholder involved, customer experience.
- b. MLP. The three analytical levels of landscape, regime and niche.

### **Ethical considerations**

This research adheres to the ethical standards set by the Human Research Ethics Committee (HREC) at TU Delft. The HREC is responsible for ensuring that research involving human participants is conducted in accordance with principles of integrity, safety, and respect. Its role in this thesis was to evaluate the ethical

implications of my research methods, assess potential risks, and ensure that participants' rights, well-being, and privacy were safeguarded. By following HREC guidelines, this study meets institutional and international ethical research standards.

Additionally, I complied with internal data protection regulations from TNO, as stipulated in my internship agreement with the company. Furthermore, under the governance of Wageningen University and TU Delft, the AMS Institute required the development of a Data Management Plan, which outlines the procedures for secure data collection, storage, and sharing in accordance with institutional policies.

As part of the ethical approval process, I prepared an Informed Consent form, which serves as a fundamental agreement between myself and the interviewees. The Informed Consent process ensures transparency by clearly informing participants about their role in the research, the scope of their participation, and any potential risks involved. It explicitly states how their physical, emotional, and reputational security will be protected, ensuring that their participation is voluntary and based on a well-informed decision.

Furthermore, a Risk Assessment and Mitigation Plan was made for the purpose of identifying, evaluating, and addressing potential risks associated with the research. It outlines preventive measures and response strategies to minimize any ethical, privacy, or safety concerns that may arise during the study.

By integrating these ethical safeguards and following the protocols established by HREC, TNO, and AMS Institute, this research ensures compliance with ethical best practices, participant protection, and data security throughout the study.

### **Conclusion of Methodology**

By coding and analysing interview data, this study explores the extent to which the possibility of a Space for interaction in COMMECT's CBMs can enable digital transitions instead of mere technological deployment. The results presented in the next chapter will provide insights into the layers and degree to which the theory outlined in the theoretical framework manifests within the Living Labs. These findings will further clarify whether COMMECT promotes digital transitions or reinforce existing urban-rural inequalities.



*“Alegoría de la construcción (Allegory of Construction)”*. Saturnino Herrán, 1910.

## 5. Results and Analysis

### Introduction

This chapter presents the findings and analysis of the COMMECT project’s Collaborative Business Models (CBMs) and their potential to support digital transitions in rural and remote areas.

Building on the theoretical and contextual foundations established in the previous chapters, this analysis evaluates how participation, co-creation, and decision-making processes within COMMECT’s Living Labs shape the adoption of ICT solutions. It examines whether the current structure of CBMs enables a shift from market-driven digitalization to more inclusive, user-driven digital transitions—or if it reinforces urban-led technological biases.

Through interview analysis, coding, and thematic categorization, this chapter highlights how stakeholders perceive and engage with ICT solutions, the degree to which participatory frameworks influence decision-making, and the extent to

which CBMs facilitate long-term socio-technical benefits beyond market efficiencies. The results contribute to a deeper understanding of the role of human-centered approaches in shaping equitable digital transitions, identifying both opportunities and challenges within the COMNECT project.

By analysing these (code) categories, this chapter aims to determine the role of SDBMs in fostering digital transitions and to identify strategies for improving participatory engagement in rural digital development.

## 5.1. About the quality of the interview

As part of the structural coding suggested by Cope (2010), I made a frequency table grouped by the six topics of the interview protocol. The purpose of this was to first, know whether the topics were covered and how relevant were they per interviewee.

	Transcript LL Turkey quo=179	Transcript LL Denmark quo=104	Transcript LL Luxemburg 1 quo=85	Transcript LL Luxemburg 2 quo=125	Transcript LL Serbia quo=91	Totals
Objectives and Motivations	18	15	6	12	10	61
Collaboration and Participation Practices	45	28	33	48	38	192
Organization and Structure of the Living Lab	4	5	4	8	3	24
Problems and Resistances	7	3	9	9	10	38
Challenges	15	16	3	9	8	51
Storyline of the initiative	14	11	14	13	8	60
<b>Totals</b>	<b>103</b>	<b>78</b>	<b>69</b>	<b>99</b>	<b>77</b>	<b>424</b>

Table 3. Frequency table of quotes per topic of interview protocol per interviewee. Total quotes in the upper row will be bigger than the total count in the lower row because there are quotes that did not fall into the categories for the interview protocol.

From Table 3 can be seen that all the topics were addressed in the interviews with a predominant attention to “Collaboration and Participation Practices”. This might come as an obvious observation, but it also speaks about the strong, and intended interest in understanding how stakeholders interact within and outside their organizations. It also notable a pattern where, besides the second topic (Collaboration and Participation Practices), other topics such as “Organization and structure of Living Labs”, and “Problems and Resistances” were the least discussed topics. The topics covered followed similar relevance per interview, meaning the interviews were conducted coherently and structured.

It is worth noting that for the presented results and analysis, the information derived from the interview with the interviewee from Living Lab Luxemburg 2 will not be used as I did not receive consent to do it for this purpose.

## 5.2. About the content of the interviews

### Objectives and motivations:

The overlapping codes were similar with co-created value in use and costs and benefits. In general, providing rural areas with digital connectivity solutions remained a prominent objective and motivation for interviewees. They saw how by delivering digital connectivity as a co-created value-in-use to their end-users, they could: reduce costs of production, preserve the environment, foster strong relationships with stakeholders, broaden market perspectives, optimize water usage, maximize yields and optimize operation times. Some remarkable quotes that exemplify how objectives and motivations from the design-enabled participatory city making framework is intertwined with collaborative business models are the following.

“There are rich farmers and every day they're increasing, and they are doing it more professional but when you look at the average of Turkey. Who works on olive trees is not rich, are poor guys or [have] less [income] than the average. [...] The main OpEx [(operating expense)] in their income for producing table olives or olive oil from their olive trees, is the chemical which is used for this this pest. [...] if they recognize the problem on some part of the garden, they use chemicals to all gardens, not partially. [They also use chemicals] if one of the farmer recognized that there are some pests and neighbors also start to use the chemicals. But in our solution the agriculture engineers analyze this data, the sensor data, and they say that instead of using the chemicals for all Valley, all village, [they should use it] only on some portion of it. So for the end-user using less chemicals, ([and]because the chemical's based on the prices from U.S. dollar) [...] their expenses are less.

The second benefit of reducing chemicals is. When they are using it on the trees, there may be one-week or two-weeks disease, but when they use chemicals, it falls down to the soil. So they pollute the soil also. If you use less chemicals instead, the pollution of the soil is less.” (Interviewee Living Lab Turkey)

From this excerpt we can note that the identified main objective with their connectivity solution is to reduce the use of chemicals that deteriorates the soil quality and puts economic pressure to the already economically pressured farmer. So the objective of this stakeholder is, yes to deploy a digital connectivity solution, but also to alleviate socio-economic and environmental constraints to olive's farming. Here, the value-in-use of the digital connectivity solution becomes tangible and relevant not in the deployment of the technological solution but in how it brings value to the end-user. This is a great example to recall from the theory, how the SDBM logic behind the CBM stakeholders try to solve end-user's needs

by the value products deliver to them, not by the product itself, in that sense the technological solution becomes the container of their solution, not the solution itself.

A similar approach to value-in-use as an objective and motivation comes from other stakeholders, such as the following quotes from other interviewees working with Living Lab Luxembourg.

“I would say [the main objective is] that viticulture becomes, in general agriculture, but also viticulture, (which is a bit more challenging due to the permanent cultivation. You cannot adapt quickly to, for example, climate change) more resilient by providing services [...] to different stakeholders, more resilient to the effects of climate change, which is for example, the increased pressure of diseases and to provide different tools to take the advantages of also digital information. For example, to make the viticulture more resilient. Also let's say, maybe, more sustainable. That you have tools to, for example, spray on the right moment, not too much, not too little to avoid losing your yield, but also for example, not to spray more than you need; to put irrigation exactly on the right time, at the right place to not lose water, but also to keep your yield.” (Interviewee Living Lab Luxembourg 1)

We can see from the quote above, that their objective goes beyond delivering a digital connectivity solution, it is mostly in favour of the end-users, farmers, and for the viticulture and agricultural sector. Using the terminology from the theory, one can say that in the light of their constraints, such as climate change effects, increased pressure of diseases, water shortage, that they are innovating, they are working to deliver technological solutions from the niche level, to be concrete and useful to the viticulture and agriculture sector, to the regime level.

A more careful analysis of this topic sheds light on the fact that these objectives and motivations fall at the same time into the connectivity and inclusion domains (Salemink et al., 2017). On one hand the connectivity domain is represented when they highlighted that they want to reduce costs of production, broaden market perspectives, optimize water usage, maximize yields and optimize operations times. On the other hand, they are keen on preserving the environment and fostering stronger relationships with stakeholders, which is a sign of the inclusion domain.

To summarize, the objectives and motivations from the Living Labs show that they understand that their digital connectivity solution is not the main objective of the Living Lab, but to help “activate” the value they contain for the end-user and stakeholders involved. To do that, there are costs and benefits associated with it that are not solely monetary, such as time, learning goals, strong relationships with other stakeholders, and better soil quality. The objectives and motivations

are to disrupt the regime level, the way agricultural practices have been developing until now, starting from a niche innovation, introducing digital connectivity solutions to help solve end-user needs, all of this while being constrained by the landscape conditions of climate change and the challenges derived for lack of connectivity in rural and remote areas (urban-rural digital divide).

### **Collaboration and participation practices**

Overall, there are two major findings. One about the type and process of relationships stakeholders foster with end-users and other stakeholders. This is related to the awareness of the societal challenges of the end-user. The second is about the practices that make a good participation and collaboration.

Starting from the first one. There is not a definite guide the interviewees follow to effectively interact with other stakeholders and end-users. Nevertheless, it seems that workshops are the preferred setup (followed by research proposals) where stakeholders and end-users can convey to interact and discuss additional topics than the workshops. In addition to that they also use SMS, calls, e-mails, networks outside COMMECT and their job, co-workers' network, cafés, interviews, to exchange knowledge with stakeholders and end-users. There are differences between when interviewees interact with members outside their organization and when they do it inside their organization but not striking differences. One thing that caught my attention is how the Living Lab interviewee from Denmark keeps a more distant relationship with end-users and stakeholders compared with the other four interviewees.

Interviewer: “Have you talked to them about any other kind of, let's say, challenges or difficulties that they have embraced? not specifically related to their job, but also related to other kind of social challenges that they might experience?”

Interviewee: “No. The only thing is that they are farmers' trading companies, hauling companies. They all have one thing in common and that is efficiency and cost efficiency. So it is workload efficiency, It is cost efficiency in all processes, and that is actually what we have heard. If we just want to generalize it. But if you look at a more social, economic point of view, we did not ask much about the social part of it.

What happened is that based on some press release that we made from the transport center and from the living lab, was that we got some feedback, companies were writing to us and said it was a very good idea to improve the connectivity on the farms. Because, there were companies that are selling systems to the farmers where they need connectivity, they need to transmit data and the farmer need to receive some correction

[...]

When we started the living lab. We did not know much, to be honest. It was by talking to stakeholders that we figured out that there were these needs of connectivity solutions.” (Interviewee Living Lab Denmark)

One can see that the perception he has from end-user’s needs comes from an indirect source and that perception of the efficiency need does not appear to be linked to have a societal relevance. The interviewee also mentioned how they are new to the topic of connectivity on the farms. This is contrasting with other interviewees, especially when they use words such as “family” and “friends” to explain their relationship with stakeholders and end-users, and that demonstrate previous experience to COMMECT project of working with farmers. See for example the following quote:

“[...]the olive sectors is like a big family because everyone needs from other partners. For example, if the farmers don’t produce a good olive product; the olive oil producers or table olive to eat. It [the relationship] is also degraded. So everyone needs others and what I see from workshop is that everyone respects to each other because it's like a chain [...] one chain is broken, the other, the partners, or the other stakeholders also suffer. It [is not the case that] only one change and one part of stakeholders suffer and the other continue the business. Unfortunately, no, one part of chain is broken. All is broken.” (Interviewee Living Lab Turkey)

Here we can see that the interviewee from Living Lab Turkey understands participation with other stakeholders as a chain that to remain operational, the problems that harm one stakeholder in one part of the chain, should be supported by other stakeholders from other areas. Another interviewee also made a similar remark.

“We had some, let's say, a few years of experience in talking with the farmers and defining their needs, different type of farmers dealing with different type of production. So at the beginning of this project, we also did some interviews and we had the workshop where we talked to the farmers and trying to better understand the their needs, their requirements and the problems they're facing with the end to understand in which part of those problems we can help and how, with digital solutions, move forward in improving their production.

[...]

We constantly have some collaboration and discussions with the farmers, so that is like ongoing process. You know, and after having several discussions, you're something like, It's hard to say friends, but something like that. Someone that you can call anytime to ask for something related to the project.” (Interviewee Living Lab Serbia)

The interviewee from Living Lab Serbia showed that their experience in the field made them able to understand and approach stakeholders and end-user needs. The

interviewee also expressed to have developed a strong and close relationship with them to the point of being available to support them in topics related to the project. This can explain why the interviewee from Living Lab Denmark has a more distant relationship with end-users. From these two Living Labs we can see how they show a deeper understanding of end-users' needs, that again, can be linked to the closer relationship they have with them or to the previous experience that Living Lab Denmark lacks of.

The second major finding is a collection of factors that form good relationships across stakeholders and end-users. Based on the Living Lab interviewees' responses, good relationships with stakeholders and end-users are based on respect among each other, trust to share their agendas, active involvement in workshops, demonstrate interest in participation, knowledge related with the topic, previous involvement experience with the end-user, and, coincidental enough, the spatial distribution of the Living Lab and culture where it develops might have a role in it. Interviewees from Living Lab Luxemburg expressed how being in a small area was easier for them to form relationships with new and existing networks.

“I know them very well because Luxemburg is very small, and you can know practically most of them at one time. So, I call them by phone or I write an e-mail and I meet them in some training or in some workshop we organize in the frame of other projects.” (Interviewee Living Lab Luxemburg)

“[...] we have very close collaboration with [stakeholder] and they know all of them because it's a small community. It's not a huge region, it's tiny. So they also know which wine growers are interested in new technology and active, and also the bigger ones are of course more interested” (Interviewee Living Lab Luxemburg)

To summarize how collaboration and participation practices develop. Collaboration and participation practices are related to stakeholders and the niche where the innovation is happening, in this case the Living Labs. This theoretical concept is confirmed with these interviews. Collaboration and participation practices have channels that vary from each Living Lab but the most prominent ways to interact are by workshops and sharing networks through informal social ties and intermediary connections. It is notorious how strong relationships are based on a set of factors such as trust, interest, familiarity, and respect, but is also determined by experience and knowledge. Finally, the degree of awareness of end-user and stakeholders' needs is related to how strong and close the interaction they have among each other.

## Organization and structure of the Living Labs

The purpose of this category is to know how the Living Lab is structured in terms of the decision-making processes. This can provide information about governance, resource allocation, stakeholder interactions, and the level of autonomy that LLs have in shaping their initiatives. This gives insights into the degree of freedom of LLs to experiment, adapt, and respond to local needs while also considering the influence of European and governmental policies that frame their operations.

The decision-making process and level of autonomy of the LL depends on their focus. LLs' interviewees with a theoretical focus structure their processes to reach the construction of a sound research proposal. Two interesting quotes that exemplify and elaborate this, come from interviewees from Living Lab Turkey and Denmark

“Yes I am free. I am free to develop the idea on some tier A-level and implement or write a project proposal. So, we have some priorities, yes. The idea generation or its effect in pure research [then, there] will be no issue. But if the [idea has]effects on the regulations or policies on our sales, of course I need to take permission from related department. Not permission, but I share my ideas “(Interviewee Living Lab Turkey)

“I cannot make a decision without a project proposal. So, the first step for making anything new.is to team up with the stakeholders. Make a consortium, and then apply for funding. Then, this research application is, of course, comprising all the tasks that each of the stakeholders or partners have to perform but everything is based on the research proposals. But I can make my personal decision to say that I want to go for this[(meant ‘any’)] particular research proposal. At large I write [with] freedom to choose consortium, project proposals and so on.” (Interviewee Living Lab Denmark)

From these two interviewees is clear that the research proposal is an important milestone to reach. These two interviewees declared to be in researcher positions at their institutions, this fact clarifies that the structure and freedom of the LL's stakeholders could be (partially) determined by the type of stakeholder involved. Their organization and structure remain more hierarchical because they seek the approval of their own institutions followed by the approval of the COMECT consortium.

The research proposal is an early inflection point in the LLs development. While researchers are obliged to navigate through and across the research proposal, they also declared to be free and autonomous to decide the specific topic they want to address within the overarching project. Selecting the topic should be a strategic

choice because the topic determines the stakeholder in the project, and in turn, the stakeholders determine the solid groundings for a research proposal to be accepted by the COMMECT board.

Ultimately then, the topic determines the proposal strength, which raises questions about the decisive factors to develop technologies in rural areas. This can be shown in the following excerpts from the interviews with technical partners from Living Lab Luxemburg and Serbia.

“So we have regular meetings. We designed them, of course, jointly because we are also depending on each other. But we have the special situation that [a] direct colleague is [also a] coordinator of the entire project. So sometimes also she takes decisions or is involved in the decision process. [...] Usually, we exchange interactively and decide jointly what's the best way and when to do it. [...] The other partners depend on the topic, of course. When it's about image acquisition, of course we decide together with [the relevant stakeholder] what's the best way, when to go, and how to progress. We have a meeting and just define the best way jointly.” (Interviewee Living Lab Luxemburg)

“[We] are agronomist. So, we help in that part and also we collaborate with farmers regarding this topic. When it is about installation of devices and when to do that, how to do that, it is again like mutual, with our expertise with the one from our partner company that is providing the mobile generators and farmers because everything should be adjusted with their activities at the fields, and with the weather conditions.” (Interviewee Living Lab Serbia)

These excerpts also shed light on how stakeholders are involved in specific tasks of the project depending on their expertise. This can be an indication that not all stakeholders are involved in everything at the same time but rather involved as it is more relevant to the maturity of the project.

On the other hand, there are stakeholders with a more practical focus. While they perceive themselves free in the way they carry out their activities, they also identify that they are constrained by weather conditions and farmers' availability (see “Problems, resistances and challenges”). An indicator for farmers' availability appears to be their attendance to workshops organized by the LLs, highlighting also the trust and familiarity farmers have to the institutes.

“We are working with the field on the field, you know, practical. I mean it's interesting if some researchers are very high and very developed, but we have to focus, for me, in the meeting. The one [thing] I try to focus all the time is how useful it is for the wine growers. Could they use it after three years of the project, or maybe in the in the follow up project? And so it's the aim for [the institute (the interviewee is working for)] that we

stay on the field and on the vineyards and not too high in the research world.” (Interviewee Living Lab Luxemburg)

This practical approach speaks about an informal, yet effective way of including end-users and deciding about the implementation of new technology in the project for the benefit of the farmers. Via existing networks, farmers and researchers appear to have more channels, feedback flows and closer interactions. In this kind of approach, LL leaders seek to draw attention and interest from the farmers (the ones that will use the technological implementation) to participate in workshops, build trust for the project and institutions, and provide feedback.

To summarize, the interviewees perceive themselves in a free (and somewhat controlled) environment that allows them to pursue their desired track for the projects. They also identify that their freedom and decision-making process are on one hand determined by the realization of the proposal and on the other more inclined towards the involvement of farmers. From the interviews it is unclear to derive which factor weights more in deciding, which is the most relevant technological implementation, the one that could potentially bring a solid research proposal or the one that involves more the farmers in its implementation?

In any case, the interdependency is evident. From a top-down, more theoretical perspective, LL leaders need involvement from other stakeholders of the project that can contribute to building a solid proposal. From a bottom-up perspective, more practical approach, the involvement of farmers is needed since they would be the hosts of the technological development in their farms, and eventually, would trust the initiative.

### **Problems, resistances and challenges**

This category is composed by two separate code categories in the Codebook (Appendix B). Problems and Resistances code category amasses codes belonging to situations and scenarios where there was a difficulty to apply the technological solution for the LLs. At the same time, Challenges category gathers the tasks needed to overcome those problems and resistances. Knowing this, the reading comes more naturally when the problems and resistances are immediately linked to a task to overcome them.

After analysing the interviewees’ responses, the central problem seems to be that farmers are not perceiving, and LLs leaders not showcasing enough, the benefits that the new technologies bring to either of them. The consequences of this can be seen in the lack of motivation of farmers to attend to workshops, and to migrate their current harvesting techniques to the proposed ones. In addition to that, other stakeholders were hesitant to join the project when the benefits were not settled in a channel of trust among them.

The central problem has been identified to have four different roots.

#### I) The state of the data

Interviewees expressed problems regarding the complexity of raw data processing. Raw data is generated on the fields either by weather stations, specific sensors or over the fields which is the case of satellite images. This raw data needs to be processed to have relevance to the end-users, to the farmers. The problem is that the data processing requires time that in some cases misses the relevance for farmers. In others it seems rather abstract information with a lack of actionable insights. Below are some interviews' extracts that illustrate this.

“We always try to sell a product, a hardware without analysing it and it's unsuccessful. By the end of the project, we try to exploit the results with a new service. But at the end. It's not like just an update, it's just doesn't fit because the farmer doesn't understand or doesn't care which technology are you using. And they are right by the way. Is it a network Iot, TNTC 5G-4G1G? It doesn't matter. They are with the phone They see on the phone. ‘Ah, I need to use chemical, or there is a weak rain. It may be damaging’. You need to say directly to use fertilizers on your soil. The chemical is missing, so you need to give just direct message, the end of the result of your analysts” (Interviewee Living Lab Turkey)

“One example is that we had installed a weather station and then they asked to have access to the data, which was not possible because we don't have access to the weather stations. We first needed to prepare the data and send it to this company who was calculating the disease severity and this took rather long, and for them of course this is difficult. I mean, research process is rather slow now and if you install the weather station, for them, it's difficult to understand that the next week they cannot see the data.” (Interviewee Living Lab Luxemburg)

“[...] data analysis is something that they don't have time to do, they don't have time to calculate, to spend like hours on analysis and that's why they are going outside, doing everything based on their experience.” (Interviewee Living Lab Serbia)

The challenge created by the delay on the raw data processing, is to process and distribute relevant data to the end-user through an appropriate channel, and it is linked to the second root of the main problem.

#### II) The state of the project

The second root is that since some projects are in the development phase, results at this stage are rather abstract. Without actionable steps, farmers miss the bene-

fits of the new technology. This, in addition to the busy agenda of multiple stakeholders and farmers, hampers farmer's motivation to attend regularly to workshops, an important participation space, as expressed by the Interviewee from Living Lab Luxemburg 1.

“They are so busy with their daily work. It's not always easy to motivate them for a workshop or something else where they don't see the direct profit out of it now, which is a bit of development phase.

[...]

I think this is a bit in general a challenge that you need a certain time until everything is installed and running smoothly and so on. And when you have the momentum of installation and contact, then it takes 2 to 3 months, and then this might become a bit difficult to keep them on board.” (Interviewee Living Lab Luxemburg)

The challenge is to motivate farmers to assist the workshops and involve them in the project regardless of the degree of completion of the end-product, to keep them engaged without constant and immediate feedback from the devices' measurements. They are doing that by contacting them individually by mail or via existing network or approaching them in bigger events where they are more likely to assist. The goal is to show partial results and showcase alternative immediate benefits for farmers to be engaged in early stages of the project.

### III) Type of responsibility

The third root is that for farmers, unlike for Living Lab leaders, attending to workshops means an additional responsibility outside their regular job-related activities. While farmers are aware of the new technologies' benefits, the fact that they are not getting any remuneration from assisting the workshops, and the lack of tangible results, makes it unclear how exactly the farmers are profiting from this participation.

“[...] No but, more criticism, which is, I think valid, is that winegrowers said ‘we are always involved when the project started already, but we also spent time and we are not paid for this’. So I think in general, if we have a workshop together, then they are there for 2-3 hours, but this time of course is lost for them and if they could have a compensation for their time. when they attend...It's always that we expect that they were just waiting for us and we developed something for them, but of course it's an interaction. We develop it together with them and they also invest something. And I think this could be respected, that they are more involved as partners with some compensation for the time in the project.” (Interviewee Living Lab Luxemburg)

#### IV) Effects of technology in rural practices

The last root is a double-end pressure that one side traditional farming practices are being challenged by modern technology, whereas from the other, younger generations are reluctant to enter agriculture with traditional methods. New technologies need to prove their competence against farmer's traditional techniques. Some traditional ways of farming have become unhealthier for the soil and more expensive due to the introduction of harmful chemicals in the process. Since their farming methods are traditional and millennial, a new way of harvesting would inevitably be at a disadvantage for the lack of historical and cultural importance to the community.

With the change in weather patterns (now increased with climate change) the agricultural sector is more unpredictable, therefore less attractive for younger people, compared to a job where the income is ensured. However, the adoption of new technologies, such as advanced weather forecasting and pest and disease monitoring tools, can help enhance the sector's resilience to climate change, and potentially make it a more viable and appealing career path for younger generations. This is explained in the quote below.

“A lot of them [(farmers)] are quite old and they have problems to find new wine growers now. One reason is also that, for example this year our yield has a bad start with the late frost and it's already clear that the yield might be only can expect at least 25% less and this uncertainty also prevents maybe young younger people to go into this this business. For this sector, so I would say this could be too if you're more resilient and your income is more insured. Is for the entire sector, of course, of profit, but also might help to to attract new people and also digital tools. might attract new younger people for this sector.” (Interviewee Living Lab Luxembourg 1)

“[Nowadays] You can use the techniques from 2000 here, because still work. And it's healthy, it's not bad. But with the current technology, If you come,[...] with a new idea, there are some [farmers] that don't even use the smartphone. The challenge is, yes, they are using the chemicals [making the] harvest very expensive. The challenge is that if you come in with new solutions or new service you need to prove it. Because on the table, there is a solution. Which already works.[...]. But you need to prove that your solution is superior than the previous.” (Living Lab interviewee Turkey)

According to the interviewee from LL Turkey “farmers will believe what they see”. Thus, the challenge for the new technologies is to prove that they have tangible results on the field, that these new technologies are cheaper and less pollutant to the soil than the current ones. In addition to that there is the challenge to attract younger workforce to the agricultural sector and ease the demanding labor

for elderly people with the implementation of new technologies to, for instance, have more accurate climate forecasts or UAV imagery.

All things considered, the benefits that new technologies bring to farmers could be better perceived and displayed if either the raw data is processed faster, or LL technological partners find alternatives to bring intermediate actionable insights or benefits for farmers. Examples of this could be a remuneration scheme, a secondary and timely analysis, an educational or networking program, where farmers could see a direct benefit of involving into the project. This could delve into an increased motivation from farmers and lead to a more solid engagement and adoption of the proposed new technologies.

### **The storyline of the initiatives**

This last section outlines the general timeline of LLs as described by the interviewees. The goal is to understand how the projects evolve and how are the stakeholder involved along the stages. While LLs follow similar stages they also show differences on the degree and way stakeholders and farmers are involved.

#### **I) Identifying needs**

There were mainly two sources to define the needs from. On one hand the needs can be defined from the industry's perspective. They started developing use cases for the Living Labs by inquiring about companies' needs to implement ICTs in farms. The clear use-cases were the basis to discuss with stakeholders about the next steps. They developed a research proposal that allows for stakeholders' cooperation.

“What actually happened, based on a press release that we made from the transportation center and from the Living Lab, was that we got some feedback from companies that were actually writing to us, and said it was a very good idea to improve the connectivity on the farms. Because, there are actually companies that are selling systems to the farmers where they need connectivity, they need to transmit data and the farmer need to receive some connectivity” (Interviewee Living Lab Denmark)

On the other hand, the needs can also be defined from the farmer's perspective. Farmers are more involved in initial conversations to understand their needs, and after defining their needs, LL leaders research ways to address them. Then, they translate farmer's needs into project's requirements and match it with services that could cover those requirements. The next step is to find specific technological devices that fulfil the services.

“I'd say, first defining the needs. Then according to those needs, defining the how to address those needs. How to translate the needs into requirements, then to define the services, devices that should be installed” (Interviewee Living Lab Serbia)

## II) Developing proposals

As mentioned earlier, the research proposal is an early inflection point in the LLs development. The proposal strength determines the funding, stakeholders involved, and type of technology used. The project proposal is submitted to the COMMECT consortium to allocate and manage budget, as well as to governmental bodies and companies to define the business models and what they entail (Figure x). The project proposal includes plans, objectives, locations of the technological deployments, and the need for participation for data sharing. There are proposed synergies among governmental institutions, companies and LL leaders on establishing a data sharing network.

“in general, as a researcher writing up proposals, you have a, probably, if you're lucky, you have a success rate on 10 to 15%. So you have to deliver at least 8 research proposals to get just one of them. So there's a huge competition. When you are applying for new funding.” (Interviewee Living Lab Denmark)

“Before the installation, we involved and had already organized a meeting with the administration of [National governmental body] to explain them about the project, what we are planning, what are the locations of the weather stations and what we want to do. Then they said that we also need to compare our weather stations with their data because they don't want to integrate each and every weather station into their network when they cannot provide maintenance or they cannot guarantee the quality of the weather stations. So they were a bit hesitating to have our weather stations after the end of the project. So we tried then, to explain them what we do and offered this comparison having two weather stations next to each other.” (Interviewee Living Lab Luxemburg 1)

## III) Technical implementation

While the interviewees are considered technical partners not all of them develop the technological devices. They mostly develop the supportive systems for the technology to be developed. This means that the interviewees responsibilities vary from providing the ICTs' architecture, and maintaining the connectivity network for data transfer, to designing the business models, installing sensors on the fields, and installing devices for stable connectivity and mobile energy stations.

“We support them, their technical architecture, technical networks. So the networks carry the data. But also including me or any of the other [colleague] engineer don't understand the data produced. I saw the data by the way, the weather data, image data of the past. I couldn't understand anything. I cannot understand. We just see the data.” (Interviewee Living Lab Turkey)

“In our Living Lab in Denmark, we are not going to deliver some sort of prototype or anything to the stakeholders. We are actually providing them with business models, with the socio-economic impact assessment, and environmental impact assessment of the ideas that were generated in the very beginning of the project.” (Interviewee Living Lab Denmark)

#### IV) Data collection and Analysis

The data cycle starts when data is transferred from its generation point to the analysis partner and finishes when it is back to the end-user to take action on the fields. The installed devices measure parameters such as soil's pH, humidity, temperature, amount of fertilizer used, produce count and weight, luminosity, and in some instances is coupled with UAV imagery that provides foliage distinction. This data is helpful for farmers to determine the health of their produce and livestock to act accordingly to maintain their health or address a problem. This also helps them to have more tailored weather forecasts, and localized action strategies in case of crops or livestock diseases.

After the data is collected, it is sent to the stakeholder responsible of the analysis. Upon completion, it is sent back to end-users via SMS or mobile application paired with the installed devices. A data cycle can be completed in one or two weeks and in some cases, it takes up to one month, depending on the needs of the crop. For instance, some crops are more sensitive during flowering time and need more data cycles to receive proper care. Other crops require steady care along the year, others vary per season and when there is a pest or disease the frequency increases.

“If you install the weather station, for them [(farmers)] it's difficult to understand that the next week they cannot see the data. Now the next step is the installation and the processing of the data and sending it to the model[ing process] to this company. So this is just where we are at the moment. First, data was sent, and now it is automatically uploaded. The next step would be to show these results” (Interviewee Living Lab Luxemburg 1)

“Then, doing the installation and start gathering data. Then, after gathering data and some analysis, lots of talking with the farmers and the workshops to train them, to teach them how to use everything. Then, probably

[after] the 2nd vegetation period [we are] having some information.” (Interviewee Living Lab Serbia)

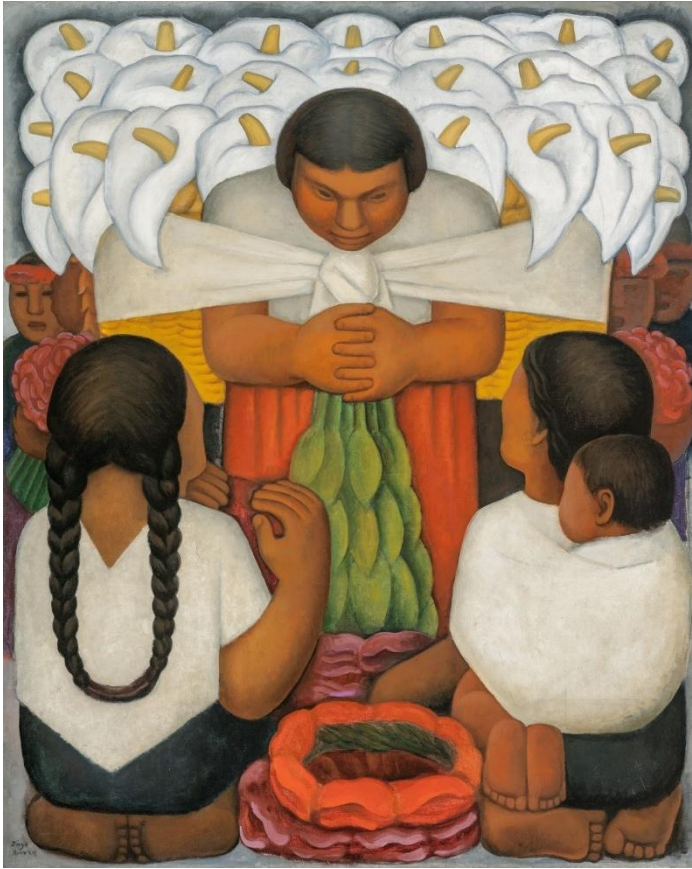
“We collect data from sensors and bring it to the [National governmental body] to process it. We distribute it to the end-user. For us the data or result analysis is like a band. But we cannot understand it.” (Interviewee Living Lab Turkey)

## V) End-user feedback

This stage focuses on involving farmers in the co-creation process through dialogue, workshops, and feedback loops. After initial data gathering and technological implementation, engaging farmers becomes essential to validate the relevance, clarity, and usefulness of the solutions. Farmer feedback informs adjustments to tools and services and helps build trust and long-term collaboration. This phase highlights how user-centered approaches contribute to refining technologies and ensuring that they align with farmers' daily practices, expectations, and long-term goals.

“We did not foresee that they would like to have a comparison [...]. If they apply a measure, for example put fertilizer on one location differently to another. To make it more homogeneous in the fields they would like to control it afterwards. If this was successful with drone images, this was something we did not see that this could be useful for them, and they wanted it. [...] What was a bit confirmed is that the last season is always the most important one, so if you want to have long term planning, it's better to have something like an inventory of all the past years and their satellite data. For example, could be useful that if you want to, do a re-planting, then you could see how was the condition the last 10 years in this vineyard. Because you always remember the last 1 or 2 years.” (Interviewee Living Lab Luxemburg 1)

This extract highlights the relevance of end-users' feedback. At the time of the interview, they already retrieved two needs and expectations thanks to the feedback received. The first one is that farmers would like to compare how homogeneous or heterogeneous their fields become when they are fertilized with different agents. The second one is that, to have long-term crop planning, with the weather stations and aerial images they could create a data log associated with timestamps, variety of the crop, quality of the product, and type and amount of fertilizer. This is for them to be able to replicate the controllable conditions for a crop that it is quite predictable in a time lapse of one or two years but if they want to replicate it in ten years then they have the log to replicate the recipe.



“*Día de las flores (Flower Day)*”. Diego Rivera, 1925.

## 6. Conclusion

Now that we, the reader and I, have reached the dusk of this thesis, I would like to recapitulate what has been discussed so far. I will start with a comprehensive understanding of the research question, unpacking it concept by concept, one at a time:

**How could COMMECT’s Living Labs (LLs) better organize to address rural development beyond market-driven digitalization?**

First, this question acknowledges that the main actors operate within the Living Labs of COMMECT, and more specifically, that the responsibility for operation largely falls on the Living Lab leaders or Technical Partners. Without denying the important role of end-users, this question highlights that, although in theory LL

leaders and end-users are considered equal stakeholders, the empirical context shows otherwise. Urban innovations are often adapted for rural settings, and this process influences the degree of involvement, responsibility, and the potential for disruptive innovation. Thus, while end-users are indeed "empowered" to act, it is ultimately the LL leaders who define the boundaries, scope, goals, and metrics of technological innovation. Furthermore, the interview protocol and research internship were developed at a more theoretical level of the COMMECT project, related mostly to Living Lab leaders. It makes more sense that it is from their point of view where I can have more meaningful insights.

Second, I focus on organization because more than development of technological solutions, LLs in COMMECT need to facilitate a space in which stakeholders can co-design. This is the Space for Interaction that in some way is conceptually represented by the Collaborative Business Models; in order to develop the CBMs it is assumed there was a Space for Interaction. The organization this research question addresses goes beyond being a condition for CBMs, it is about deconstructing the idea of who are considered designers. Instead of being a subject that will deliver a solution, they are instead a group of different stakeholders who will design their solution in a collective process. Moreover, the designer's role shifts from proposing solutions, to facilitating the emergence of a collaborative solution to multiple problems to multiple stakeholders.

Third, I intentionally chose to frame the issue in terms of rural digital development rather than urban-rural digital divide. According to the literature, the latter stays strictly and refers to the side of connectivity domain, to the technological disparity, and does not engage with the broader socio-economic landscape in which is involved. The research question brings to the table the discussion between connectivity and inclusion research domains for rural digital development. Urban-rural digital divide must be understood as one of the many urban-rural disparities, it can be an effect of some at the same time of a cause or enhancer of others. While acknowledging all stakeholders perfectly capable of performing their technological implementation, my main concern was about the awareness of how these great technologies were based on, and could contribute to, the inclusion research domain.

Fourth, I critique market-driven initiatives because, although there is a need for market interference to bridge the connectivity and inclusion domains, I invite to be careful to use a mere market-driven solution. Markets prioritize production and efficiency, but this does not necessarily align with solving structural problems like food security. It reminds me of the naïve question "why governments cannot simply print more money to eliminate poverty?". A suggestion economist would rush to dismiss since it ignores inflation and system's dynamics. But somehow in this same market mindset it does make sense to make more food to solve food insecurity without considering environment degradation and system's dynamics.

As Schutter (2014) and others have shown, food security is fundamentally a question of availability, accessibility, affordability, and adequacy, thus taking it as a mere production issue seems quite outdated and misses the mark by a mile. Moreover, market-driven approaches, focused on efficiency, often overlook efficacy: how fairly and meaningfully solutions actually serve the people they target.

Finally, considering all these points, this thesis challenges widespread digitalization strategies. These strategies lack consideration about the introduction of digital technologies' influences in their surrounding sociotechnical processes in rural areas. There is a misplaced assumption that technology can solve problems so intricately with social dynamics, in the same way a machine could be fixed. Digitalization strategies gather efficiency and production ideals to be achieved greatly with technological development. These are not only theoretically unrealistic to bridge the urban-rural digital divide but also unfeasible in the bigger scale of achieving food security in the context of increased climate change effects. Even if rural areas are fully supported to bridge the urban-rural digital divide there will always be a disparity because urban areas will inevitably continue to have faster and bigger technological advancements. In this sense, enrolling rural areas in the digital race with digitalization strategies to bridge the urban-rural digital divide, is a lost race before it starts.

## **6.1. Recommendations**

Building on the deeper understanding of the research question, the suggestion that stems to answer it, is to adopt a human-centered approach aimed at redirecting digitalization efforts towards a digital transition. A digital transition entails not only the implementation of technologies, but to include the socio-technical systems surrounding their implementations and adoption, accounting for the interaction among the agricultural sector, the environment, technologies, innovation, organizations, communities, and stakeholders (Barabanova & Krzysztofowicz, 2023).

As stated earlier, the proposed human-centered approach addressed along this thesis is based on two complementary frameworks. First, it seeks to overcome the biases stated by Caprotti (2018) embedded in the visions for future cities and secondly to adopt the Design-enabled Participatory City Making framework by De Koning et al. (2018) to allow for government, entrepreneurs and citizens co-create new solutions for their challenges.

Consequently, I offer below three axes, (or ideas) about how such digital transition is beneficial in three main areas, and seven recommendations based on the interpretation of the results through the lenses of the theoretical and conceptual framework.

- 1) **Market axis.** Alleviating the pressures for increasing food production in rural areas by focusing on the broader needs of availability, accessibility, affordability, and adequacy for food security. SDBM logic helps to gather and recognize a broader spectrum of values in food production. This shift in perspective acknowledges that rural and urban areas should both play a role in shaping food security strategies, rather than being constrained by an outdated model that assumes production alone solves the issue.
- 2) **Social axis.** Adopting an efficacy principle towards social justice and equality, instead of efficiency imperatives to increase the speed of production flows. The human-centered approach should be inclusive. This is related to the inclusion research domain and harnesses topics of diffusion of technology, digital inequalities, and policies (Salemink et al., 2017). Furthermore, it also mean to reconsider end-users, yes as their market role of end-users, but also as their role of inhabitants of rural and remote areas.
- 3) **Technological axis.** Challenging the idea that development involves the implementation of more technified practices and offering instead the opportunities of the “black box” of social participation. The human-centered approach deviates from the technological push towards a technological fit. It can act as a corrective force within the niche and regime levels, ensuring that innovations are not just technologically feasible, but socially meaningful, locally rooted, by adapting it to the realities of rural communities.

## Practical recommendations: Creating and Sustaining a Space for Interaction

- 2.2.1 **Acknowledge objectives and motivations beyond market logic.** While LL leaders acknowledged there are indeed market values derived from the technological implementations, they also considered the value that these technologies “activate”, such as timely solutions, achievable learning goals, strong relationships with other stakeholders, and better soil quality.
- 2.2.2 **Seize the existing interaction channels.** Such as workshops and informal social ties. Foster interactions based on trust, interest in the project, familiarity with the end-user, respect among stakeholders, and ponder the degree of experience and knowledge about the project.
- 2.2.3 **Adapt deliverables to LL’s structure.** Recognize if the LL has a more theoretical or practical approach. It is important to be flexible enough to reach sound deliverables or tangible results, and to know when the involvement from other stakeholders is needed. From a top-down,

more theoretical perspective, LL leaders need involvement from other stakeholders of the project that can contribute to building a solid proposal. From a bottom-up perspective, a more practical approach, the involvement of farmers is needed, since they would be the hosts of the technological development in their farms, and eventually, would trust the initiative

As seen in the theoretical framework and later in the results, more than pushing either top-down or bottom-up niche-driven innovations, it is about balancing the readiness of the innovation and the type of interaction among niche, regime and landscape levels. LLs can profit from the windows of opportunity created when their technological innovations are “ready” and when regime and landscape levels are fertile ground for them to be developed. For instance, early involvement of end-users in the co-creation process can sometimes generate distrust against technological partners, as they are asked to engage with an unfinished or evolving product. Conversely, involving end-users only after the technology is fully developed can reduce its perceived relevance and hinder adoption, as they have had little influence on its design or adaptation to their needs.

**2.2.4 Showcase timely and actionable benefits of the technology.**

Either processing the raw data faster or delivering actionable intermediary insights useful for farmers. These benefits should be according to the state of the project to motivate partners to be engaged.

**2.2.5 Recognize different economic stakes.**

Acknowledge end-users do not have the same economic responsibility as LL leaders and act accordingly. While LL leaders participate on the project as part of their job-related activities, for end-users means an additional effort that could be invested in their fields, sometimes with more tangible results. This creates an unmotivating scenario for farmers. A different kind of compensation for farmers could help keep them motivated and engaged.

**2.2.6 Balance the complexity of digitalization in rural areas.**

While advanced technological implementations can create job interest in younger generations it can also increase the digital illiteracy gap among vulnerable groups such as children, women, older adults, patients, and remote workers (Salemink et al., 2017). The adoption of technologies needs to overcome barriers for its implementation. On one hand, new technologies need to be simple and familiar to prove their competence against traditional techniques, taking advantage of simple and existing ICT devices like, for instance, cellular phones. On the other hand, new technologies need to be complex to enhance the agricultural sector’s resilience to climate change, carrying out tasks for advanced weather

forecasting and monitoring sensors, potentially making it a more viable and appealing career path for younger generations.

2.2.7 **Monitor engagement across stages.** Understand how the projects evolve and how the stakeholders are involved along the process. From the results there were identified the stages of; identifying needs, developing proposals, technical implementation, data collection and analysis and end-user feedback. While this is not a linear process it is important to understand the flow of this process, since depending on the structure of the LL, early feedback can either constipate or sooth the development of the project.

## **6.2. Reflection on the COMNECT's LLs impact in the context of rural digital development.**

Understanding how transition pathways develop makes me reflect on how truly innovative and disruptive technological innovations might never arise. Transition pathways are, generally speaking, coincidences that were ready to take windows of opportunities. A disruptive technological advancement which readiness is not aligned with the kind of pressures niche, regime, and landscape levels have among them is doomed to never see the light.

This resembles Jesse Goldstein's (2018) critique on the green capitalism discourse. Not the truly disruptive innovations are the ones that make it but the ones that allow for the economic system, the status quo, to continue working as it is. He argues the market looks for technologies that deliver "solution" without actually addressing the roots of the underlying problems that originates them in the first place. Adrienne Buller (2022) also engages with that fundamental question of what is the purpose of innovative and groundbreaking proposals if the economic imperative will inevitably delay them?

Then I naturally question the underlying excuses in which Collaborative Business Models for rural and remote areas originate. The root problem regarding food systems, as I see it after completing this thesis, is that the way the majority of urban areas are conceived as the very and only motor for development where there is no other alternative than to feed them. It resembles one of these wheels where mice run within endlessly, and when reached certain speed then it seems more tempting to keep the pace than to dare to leave.

I wonder what is the rush to focus primarily on produce more food if there are proofs from scholars that it is equally important to envision a food system that does not waste more than half of the food produced in transportation, collection, distribution and even market dynamics. There is also the need for a change in the market dynamics in the food system. When the food reaches the shelves, and it is

not sold, prepared or eaten, then economically speaking it makes more sense to throw it away, because giving it to people in need is like giving it away and that is not fair for the customers who paid for it. Is not that ironic? I reflect this after working in a warehouse and a restaurant and being marked by those jobs while doing this thesis.

Along this reflection line, in the middle of this maelstrom of technological development in rural areas, market opportunities and production incentives in rural areas. I wonder what the urban regimes are doing to decrease their speed of development. It is well documented that urban areas have technological advancements a faster rates than rural areas (Salemink et al., 2017). Then what is the purpose on following the same way of development dictated by urban areas in rural areas, if there is no way to pair them. What ultimately is happening is that actors in urban regimes are envisioning digitalization in rural areas as precursors for urban areas. That is why I am reluctant to use the words “development” and “empowerment” because apart of being quite ambiguous, they also bring with them an almost condescending connotation.

Having said that, I also question the efficacy, not the effectiveness, of creating Collaborative Business Models, or any kind of business model to solve such an intricate social issue as food insecurity. I believe it is almost a naïve thinking that we should rely on markets, let alone technological markets, to solve a social issue. I wrote earlier about the abstraction of the markets to solve problems. If with our current understanding of sustainability and economics the financial institutions have managed to come up with instruments like, for instance, carbon capture bonds. These are not only licenses that allow powerful corporations to continue damaging the environment as long as they pay the fee. They are also licenses that create entangled and convoluted markets that juggle with externalities across the world, wrongly assuming that nature, its damage and reparation is equal in all the tangents of the world. How could it be even possible that the same collective institutions, the same invisible hands could solve a social problem? Measuring how much a social issue is worth in market terms, pondering to address it if there is a market opportunity. having reparation measurements (while efficient) as ineffective as the environmental ones.

In this thesis I tried to engage with these questions and go beyond the critique with the COMNECT case study. I suggested an adjustment by bringing the human dimension at the center of the design, expecting that with that the barriers and bridges defining urban and rural areas will be of lesser importance as they are ultimately places for humans and nature. At the same time, I envision how a human-centered approach can bring market opportunities evolve beyond the typical definition of value, amassed by the few, in a bottom-up direction, disposable and concentrated in a product, but rather as a collaborative process of creation and design. The last contribution of human-centered approach that I see

is that of emancipating our systems from highly technological advancements. Detach the idea from plans and visions for the future of rural and urban areas, that production and efficiency are the only conditions for development.

There is a quote that is famously attributed to Emiliano Zapata, a farmer that became general of the revolutionary forces, somewhere in the throes of the Mexican Revolution. In defense of the rural lands and its farmers he said that “the land belongs to those who work it with their hands”. Having said what I said, written what I wrote and read what I read, I believe there must be a more careful consideration when the invisible hands of markets and technology work the lands.



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## 8. Appendices

### Appendix A

#### Interview Protocol

For Living Lab leaders/Technical Partners

#### Objectives for the interviews:

About Space for interaction

- Understand objectives and motivations for the Living Lab leaders to participate in the project.
- Investigate the ways in which Living Lab leaders participate.
- To know what their meaning is of a participatory process
- Explore the space in which Living Lab leaders interact with other stakeholders and end-users.
- Understand their perception of the appropriate moment to participate with other stakeholders and end-users.

About the urban-rural digital divide

- Explore their perception of the challenge faced.
- Investigate their considerations and understanding about the urban-rural digital divide.
- To know what their perception of the appropriate time is to use the technological applications.

#### Questions:

Get a quick overview of the Living Lab together to know that we are on the same page. Be clear about who the end-user is.

- 1) Objectives and Motivations
  - a. To my understanding, the objective of the Living Lab is \_\_\_\_\_. Are there any other objectives you have defined, envisioned or that I am missing to understand? (See if they consider the urban-rural digital divide and what are the things that they want)\*
  - b. What do you think is the main problem that you are solving here?\*
  - c. What are the benefits you bring to the community?\*
  - i. In which way that bring them benefits? \*

- d. How do you think the LL proposal helps the end-user? In their work and daily life?
  - e. How do you think these other objectives help the end-user? What do you think are other values the proposal brings and to whom?
  - f. Are you familiar with the term urban-rural digital divide?
    - i. What do you think that entails?
    - ii. Who do you think it affects and in which ways?
  - g. If you have to put in a sentence what is the main objective of your Living Lab what would it be?\*
  - h. What is your main motivation to participate in this Living Lab project?\*
  - i. What is that you get out of the collaboration?\*
  - j. How much are you willing to participate?\*
- 2) Collaboration and Participation practices
- a. When you collaborate with your colleagues within your Living Lab how do you do that?
    - i. What is the process? What do you use?
    - ii. When can you say you worked “good” with your colleagues?\*
    - iii. When can you say you worked “bad” with your colleagues?\*
    - iv. How would you say you collaborate within your company?\*
  - b. How does that change when it comes in participating with other stakeholders? Specifically with the end-user that in your case are \_\_\_\_?
    - i. What is the process? what do you use?
    - ii. When can you say you worked “good” with the end-user?
    - iii. When can you say you worked “good” with end-users/other stakeholders?\*
    - iv. When can you say you worked “bad” with end-user/other stakeholders?\*
    - v. How would you say you collaborate with the end-user/other stakeholders?\*
- 3) The organization and the structure of the Living Lab
- a. How is the Living Lab structured in terms of the decision-making process?\*
  - b. Who dictates how the resources are allocated to the Living Lab?
- 4) Challenges
- a. What are the challenges you have/had regarding participation?\*
    - i. Considering the structure of the Living Labs. What problems and resistance do you have/had in the decision-making process? (Remember to ask if it’s solved)

- 5) Problems and resistance
  - a. What are the problems you have/had when applying your ICT solution? \*
    - i. How did that affect you?
  - b. How is that a problem? What kind of resistance did you have?\*
- 6) The story line of the initiative
  - a. How could you divide the Living Lab project in stages? What is the storyline of the initiative? \*
    - i. How do you see your participation in those stages?
    - ii. How do you see end-users' participation in those stages?
- 7) Would you be willing to have another interview in case it is needed?

## Appendix B

Final version of the Codebook used for the semi-structured interview coding. SDBM and MLP themes were added after the second step of the coding process.

Theme	Category	Codes
Structural coding by Design-enabled participatory city making work of de Koning et al. (2018)	Objectives and Motivations	The perceived main problem that they are solving, benefits to the community, objectives of the LL, motivation to participate, benefits from the participation.
	Collaboration and Participation Practices	Indicators for good or bad collaboration (within the company), assessment of collaboration (within the company), Indicators for good or bad participation (with other stakeholders), assessment of participation (with other stakeholders)
	Organization and structure of the Living Labs	Decision-making process, freedom at work, interaction dynamics with other stakeholders
	Challenges	Tasks to be done to overcome a problem
	Problems and resistances	Situations and scenarios where there was a difficulty to achieve a goal.
	Storyline of the initiative	Division of LL in stages, participation of end-user in those stages
In-vivo codes	Using participants' own words as codes	
	Connectivity domain	Telecommunication markets, technologies in rural

Rural development in the digital age by Salemink et al. (2017)		areas, regional development, policy and regulations
	Inclusion domain	Diffusion of technology and innovation, Digital inequalities, Digital inclusion Policy
Key Methods in Geography. Denzin, N. & Strauss, A. (1988) recommendations found in (Cope, 2010)	Conditions	Environmental, market, social conditions
	Interactions among the actors	How interviewees engage with others, what they think of others, what others do to them ( <b>overlapped with organization and structure of the Living Labs</b> )
	Strategies and tactics	How they solved a challenge
	Consequences	The result of an event
Value codes (Cope, 2010)	Value codes	Personal beliefs, values, worldviews
Service-dominant business modelling for digital innovations or (CBM) by Turetken et al. (2018)	Co-created value-in-use	Value of a solution to a customer
	Actor value proposition and actor's roles	What actors bring to the table
	Co-production activity	Activities each actor performs
	Costs & benefits	Monetary and non-monetary expenses and gains ( <b>overlapped with objectives and motivations</b> )
	Stakeholders	Stakeholders involved
	Customer experience	How the customer experiences the creation and delivery of the co-created

		value-in-use ( <b>Overlapped with Storyline of the initiative</b> )
Multilevel Perspective (MLP) by Geels (2012)	Landscape	Environment, climate change, cultural values, urban and rural layout, macro-economic trends and political ideologies ( <b>Overlapped with Conditions</b> )
	Regime	Systems such as ICTs infrastructure, technological developments, agricultural practices, policies, negotiations, regulations, knowledge, power and organizational structures, and routines among other systems. ( <b>Overlapped with organization and structure of the Living Labs</b> )
	Niche	Companies, Living Labs, small community networks and institutions. ( <b>Overlapped collaboration and participation practices</b> )

The colors assigned to this table above depend on how much the topics serve to answer the research questions. Green categories indicate the codes corresponding to the structural coding to find Space for interaction. These have huge relevance to answer the research question for the interviews “How could COMMECT’s LLs better organize to address challenges beyond the market-driven digitalization?” and are the primary categories for analysis.

The yellow categories are kept as secondary codes because they show a direct manifestation of the theoretical frameworks in this real case. While they do not serve to answer the research question concerning the interviews, they are used to contextualize the code analysis. This two main divisions follow the recommendation by (Caprotti, 2018) to have a human-centered approach; detailed enough to understand their singularities, and general enough to understand how the context shapes these singularities.

The codes in the orange categories indicate that although they have very interesting insights of indicating towards which domain (connectivity or inclusion) the initiatives are inclined, they do not directly answer the research questions. The categories without color lost relevance for the analysis due to either the lack of relevance to the study or they were already covered under a different category.

