

Dedicated Innovation Systems for Local Sustainability Transformations in the Global South

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Kurzzusammenfassung der Dissertation

Da sich unser globales Wirtschaftssystem einem irreversiblen Kipppunkt nähert, sind die Regierungen sowohl im Norden als auch im Süden aufgerufen, die ökologischen und sozialen Auswirkungen unserer fossilbasierten Produktions- und Konsummuster zu reduzieren. Aus neoschumpeterianischer Sicht können Innovationen dazu beitragen, einen solchen „transformatorischen Wandel“ unseres globalen Wirtschaftssystems in Richtung Nachhaltigkeit anzustoßen. Diese Dissertation postuliert, dass Innovation und der weitgehend akzeptierte theoretische Rahmen des Innovationssystems (IS) eine nützliche Heuristik für die Gestaltung wirtschaftlicher Regularien, die den Strukturwandel fördern, sind. Die Förderung der weitergehenden Ziele für nachhaltige Entwicklung (SDG) der Agenda 2030 erfordert jedoch eine analytische Perspektive, die über die IS-technologiezentrierte Logik hinausgeht und sich an die Vielfalt der lokalen Kontexte sowohl im globalen Norden als auch im Süden anpassen lässt.

Eine in dieser Arbeit vorgeschlagene Anwendung ist das Konzept des „*Dedicated Innovation System (DIS)*“ (Pyka, 2017) als ein revidierter Ansatz für den IS-Rahmen. DIS ermöglicht die Untersuchung der oft übersehenen und kontextuell einzigartigen qualitativen Dynamiken, die Innovationsprozesse in informellen und ungesicherten institutionellen lokalen Kontexten von Entwicklungsländern beeinflussen. Insbesondere konzentriert sich diese Arbeit auf die praktische Anwendung von DIS im mexikanischen lokalen Kontext. Der Fokus liegt dabei auf dem Konzept der „*Dedicated Actors (DAs)*“ um die Rolle zu untersuchen, die Systemakteure bei der Förderung von *Direktionalität, Legitimität und Verantwortung* in DIS-Nachhaltigkeitstransformationen spielen.

Diese Arbeit befasst sich mit der allgemeinen Forschungsfrage: *Wie können dezidierte Akteure (DAs) ein Engagement für Nachhaltigkeit in DISs in informellen und ungesicherten institutionellen Kontexten in Michoacán, Mexiko, einführen?* Um auf die Forschungsfrage zu antworten, werden drei Gruppen von Teilfragen untersucht: (a) *Was sind die Eigenschaften von DAs, die es ihnen ermöglichen, IS in informellen und ungesicherten institutionellen Umgebungen in Michoacán, Mexiko, nachhaltig erfolgreich zu etablieren?* (b) *Welche Rolle spielen DAs beim Aufbau kollektiver Fähigkeiten in informellen und ungesicherten institutionellen Umgebungen in Michoacán, Mexiko?* (c) *Welche lokalen Fertigkeiten lassen sich aus DIS in informellen und ungesicherten institutionellen Umgebungen in Michoacán, Mexiko generieren?*

Da der Schwerpunkt der Arbeit auf der Untersuchung innovationsgetriebener Transformationen in Richtung Nachhaltigkeit auf lokaler Ebene liegt, konzentriert sie sich auf die Analyse von Dedicated Grassroots Actors (DGAs) auf drei praktischen Fallstudien.

Ein erstes Forschungsergebnis befasst sich mit *den Merkmalen, welche DGAs definieren* und sie als Akteure des systemischen Wandels positionieren. DGAs gelten als Akteure, die aus dem "Paradox der eingebetteten Handlungsmacht" ausbrechen und institutionelle Veränderungen anstreben, die im Gegensatz zu den etablierten lokalen Überzeugungen stehen, und die "positiv" in die lokalen Institutionen eingebettet sind. Dadurch können die bestehende kulturellen Überzeugungen umgangen werden und gesellschaftliche Normen erweitert werden.

Ein zweites Ergebnis bezieht sich auf die *Rollen von DGAs* beim Aufbau kollektiver Fähigkeiten in informellen und ungesicherten institutionellen Kontexten in Michoacán, Mexiko. Drei Hauptrollen wurden identifiziert: (1) Bewusstseinsbildung: DGAs sensibilisieren die Menschen vor Ort, fördern die kritische Reflexion über Alternativen zu den wahrgenommenen realisierbaren Möglichkeiten und wecken den Wunsch, ihr Leben zu verbessern; (2) Vermittlung: DGAs spielen eine wichtige Rolle bei der Förderung der Schaffung kollektiver Fähigkeiten, indem sie Verbindungen zwischen individuellen Bedürfnissen und umfassenderen kommunalen Nachhaltigkeitszielen ermöglichen, die Beteiligung der Gemeinschaft und aktive Mitsprache koordinieren sowie den Wissensaustausch und den Erwerb von Fähigkeiten erleichtern; (3) Zusammenarbeit: DGAs spielen eine aktive Rolle bei der Erleichterung der Zusammenarbeit mit regionalen und externen Akteuren.

Ein drittes Forschungsergebnis bezieht sich auf die *Schaffung kollektiver Fähigkeiten* in informellen und ungesicherten institutionellen Kontexten in Michoacán, Mexiko. Es wurde beobachtet, dass ein allgemeines Gefühl von kollektiver Ungerechtigkeit innerhalb dieser institutionellen Umgebungen lokale Gemeinschaften ermutigt, kollektive Strategien zu entwickeln, um Ungerechtigkeiten zu reduzieren, die durch äußere Bedingungen verursacht werden. Die lokalen Gemeinschaften aus den Fallstudien neigten dazu, Resilienzfähigkeiten zu entwickeln, um Armutsfällen, Gewalt und mangelnder sozialer Mobilisierung zu begegnen. Obwohl die Schaffung kollektiver Fähigkeiten ursprünglich durch Fragen im Zusammenhang mit wirtschaftlichen und sozialen Faktoren ausgelöst wurde, die in ungesicherten und informellen Kontexten im Allgemeinen als hohe Priorität angesehen und gewertet werden, haben diese Fähigkeiten auch dazu beigetragen, Umweltherausforderungen zu bewältigen, die lokale Gemeinschaften betreffen (bspw. klimatische Veränderungen, Verlust der biologischen Vielfalt, Entwaldung usw.).

Summary of the dissertation

As our global economic system draws closer to an irreversible breaking point, governments from both the North and South countries are called upon to reduce the environmental and social impacts of our fossil-based production and consumption patterns. From a neo-Schumpeterian view, innovation can prove instrumental in triggering such “*transformational change*” of our global economic system towards sustainability. This thesis posits that innovation and the largely endorsed theoretical framework of *innovation system (IS)* give a useful heuristic for the design of the economic policies that foster structural change. However, the promotion of the broader Sustainable Development Goals (SDG) of the 2030 Agenda requires an analytical lens that extends beyond IS technology-centric logic and adapts to respond to the variety of local contexts in both the Global North and South.

An application put forward by this thesis is that of the concept of “*Dedicated Innovation System (DIS)*” (Pyka, A., 2017a) as a revised approach to IS framework. DIS allows for the study of the often-overlooked and contextually unique qualitative dynamics that influence innovation processes in the informal and insecure institutional local contexts of developing countries. Specifically, this work focuses on DIS practical application in the Mexican local context. It builds upon the concept of “*Dedicated Actors (DAs)*” to examine the roles that system actors play in fostering *directionality, legitimacy, and responsibility* in DIS sustainability transformations.

This thesis addresses the overall research question: *How can Dedicated Actors (DAs) introduce a commitment to sustainability in DISs in informal and insecure institutional settings in Michoacán, Mexico?* To respond to the research question, three sets of sub-questions are explored: (a) *what are the characteristics of DAs that allow them to direct IS towards sustainable outcomes in informal and insecure institutional settings in Michoacán, Mexico;* (b) *what is the role of DAs in the building of collective capabilities in informal and insecure institutional settings in Michoacán, Mexico?* and (c) *what are the local capabilities that result from DIS in informal and insecure institutional settings in Michoacán, Mexico?*

As the focus of the thesis has been the study of innovation-led transformations towards sustainability at the local level, the research has prioritised the analysis of Dedicated Grassroots Actors (DGAs) through three practical case studies.

A first research finding looks at the *characteristics that define DGAs* and positions them as agents of systemic change. DGAs are found to be actors that break out of the “paradox of embedded agency” because of their prior exposure to the institutional spheres that contrast local established beliefs; and that are “positively” embedded in local institutions, which allows them to circumvent existing cultural beliefs, and stretch societal norms.

A second finding of this research refers to the *roles of DGAs* in the building of collective capabilities in informal and insecure institutional settings in Michoacán, Mexico. Three main roles have been identified: (1) *conscientisation*: DGAs create awareness in local people, foster critical reflection on alternatives to perceived feasible possibilities, and inspire a desire to improve their lives; (2) *conciliation*: DGAs play a strong role in fostering the creation of collective capabilities by enabling linkages between individual needs with wider sustainability communal goals, and coordinating community participation and active voice, as well as facilitating knowledge exchange and skills acquisition; (3) *collaboration*: DGAs have an active role in facilitating collaboration with regional and external actors.

A third research finding relates to the *creation of collective capabilities* in informal and insecure settings in Michoacán, Mexico. It was observed that a general sense of collective injustice within these institutional settings encourages local communities to adopt collective strategies to resist injustices caused by external conditions. The local communities from the case studies, tended to develop resilience capabilities to face poverty traps, violence, and a lack of social mobilisation. Although the creation of collective capabilities was initially triggered by issues related to economic and social factors (that are generally viewed and valued as high priorities in insecure and informal settings), these capabilities have also served to address other environmental challenges affecting local communities (e.g. climate change, biodiversity loss, deforestation, etc.).

Declaration in lieu of an oath on independent work

according to Sec. 18(3) sentence 5 of the University of Hohenheim's Doctoral Regulations for the Faculties of Agricultural Sciences, Natural Sciences, and Business, Economics and Social Sciences

1. The dissertation submitted on the topic "*Dedicated Innovation Systems for Local Sustainability Transformations in the Global South*" is work done independently by me.
2. I only used the sources and aids listed and did not make use of any impermissible assistance from third parties. In particular, I marked all content taken word-for-word or paraphrased from other works.
3. I did not use the assistance of a commercial doctoral placement or advising agency.
4. I am aware of the importance of the declaration in lieu of oath and the criminal consequences of false or incomplete declarations in lieu of oath.

I confirm that the declaration above is correct. I declare in lieu of oath that I have declared only the truth to the best of my knowledge and have not omitted anything.

Geneva, Switzerland, 13 December 2021

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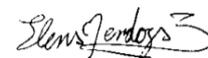
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1. Introduction

The majority of countries and regions around the world have experienced unprecedented climate events associated to global warming. According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), a United Nations (UN) body created to enhance policy making processes with the scientific assessments of climate change-related risks, global temperatures recorded over the last decade have been higher than in any other period in the last 125,000 years (IPCC, 2021).

The report stressed how we are “*unequivocally*” responsible for recent changes in the climate system, as human activity «...*has warmed the atmosphere, ocean and land*» (2021, p.5) to such an extent that some of the changes in the global sea level and ice sheets will be «...*irreversible for centuries to millennia*» (2021, p.28). Although these changes have already impacted, and will impact the lives of both present and future generations, the rapid acceleration of climate change can still be brought to a halt.

Indeed, “*human-induced climate change*” (IPCC, 2021, p. 10) represents the greatest challenge of our decade, and of our entire history. Unless greenhouse gas emissions (GHGs) are reduced considerably, we will exceed the 1.5°- 2°C threshold within this century. The surpassing of this climate threshold will result in an accelerated increase in the frequency and intensity of extreme weather events such as droughts, tropical cyclones, and heatwaves. We will also witness an extremely detrimental setback in our global efforts to advance sustainability — particularly in regards to our progress on poverty reduction, environmental conservation, and economic growth.

Path-dependency theories provide insights on the historical circumstances that have caused our current carbon lock-in, and give some hints as to the complexity of finding alternative sustainable paths. For over 200 years, global economic progress and industrialisation processes have been based upon the use of fossils as the trigger of transformative change (Hetemäki, L. et al., 2017). The greatest paradigmatic change of the 18th century, the Industrial Revolution, was sparked by fossil fuels – namely coal superseding firewood and charcoal as the main source of energy for steam locomotives. The transformational change of the mid-19th century was prompted by petroleum, when

the development of drilling technology allowed for the mass use of this fossil energy. Oil generated an accelerated economic growth, and allowed an unprecedented number of people to gain access—for the first time in their lives—to energy, motorised transport (automobiles, ships, airplanes, etc.), and heat services at relatively low private costs (MHI, 2010).

The use of fossil fuels not only prompted the emergence of new industrial sectors, but also boosted the production levels of more traditional ones, like agriculture. Fossil fuels sparked the so-called Green Revolution (GR) at a time when fast growing populations and food shortages in South Asia created a widespread belief in the need to address forthcoming episodes of famine. This general concern was generated by Malthusian overpopulation theories, which predicted global food crises as the result of arithmetic/linear increases in agricultural production falling short in the face of geometric/exponential population growth (Conway, G., 1997).

Increased agricultural production was assumed to be the answer to Zero hunger, and thus the goal of the GR. Fossils, including natural gas, oil and hydrocarbon, played a central role in the GR as the key components of fertilisers, pesticides and irrigation systems, and as the main triggers for the transformation of agricultural practices (Pfeiffer, D., 2004). Their use allowed agricultural production levels to skyrocket, and prompted accelerated economic growth in low-income countries, and in the lagging regions of emerging economies (WB, 2007b).

Although the GR indeed fostered growth, and reduced food insecurity by alleviating some two billion people from starvation (Conway, G., 1997), the revolution had some limitations. One major shortcoming was highlighted by Sen (1981), in which he referred to the previously-held, widespread policy focus on increased agricultural production, as opposed to tackling food accessibility. In Sen's words, "*starvation is the characteristic of some people not having enough food (rather than) the characteristic of there not being enough food*" (Sen, A., 1981, p. 1). e

While Sen recognised that increased agricultural productivity and economic growth were fundamental elements, he made a case for broadening the scope of food security policies. Sen stressed the importance of initiating food policies to address the

inequalities in food and income distribution, which also ensure that the benefits of economic growth are shared with the poor (FAO, 2015). A second prevalent shortcoming of the GR referred to the environmental impacts generated by the mass consumption of fossil fuels, which increased GHG historical emissions by 80 percent (OECD, 2014) and contributed to the instigation of our present climate emergency.

World leaders have already pledged to take bold and collaborative action to address climate change, and to limit global warming to 1.5 degrees C by 2030. In a landmark international accord, almost all countries became signatory to the Paris Agreement on December 2015, where they committed to reduce GHGs and to establish more sustainable production and consumption patterns, while simultaneously promoting sustainable growth and development (UN, 2018).

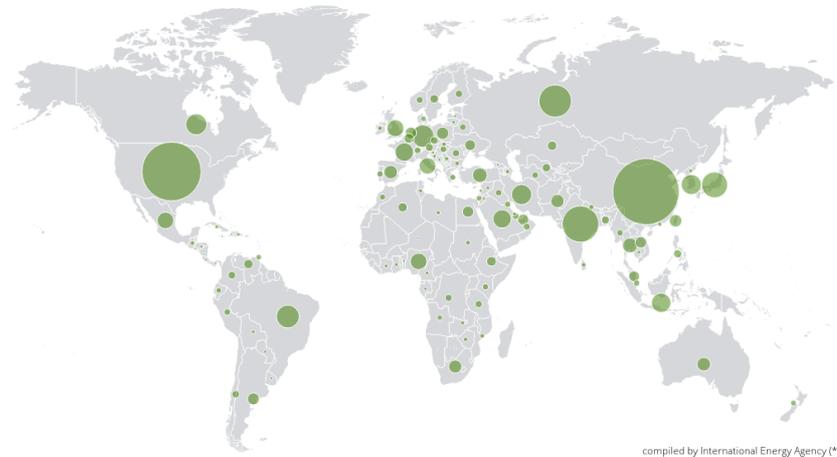
The on-the-ground delivery of the SDGs was also part of the 2030 Paris Agenda, and is being promoted through initiatives like “*Localizing the SDGs (Local2030)*”. Local2030 serves as a platform for regional and national governments, along with the private sector, civil society, and academia to share knowledge, experiences and tools for the integration of subnational contexts in framing the goals and targets of the 2030 Agenda (LOCAL2030, 2021).

Despite these global and local efforts, fossil fuels still represent more than 80 percent of our global energy consumption today —with four countries being responsible for half of our current total fossil energy consumption (namely China, the United States, India and Russia). Moreover, developing countries in Asia are projected to be the main contributors to accelerated growth, thereby being the cause of more than sixty percent of the estimated increases in energy consumption (IEA, 2017).

The growing environmental and social impacts of our fossil-based production and consumption patterns are not compatible with the 17 Sustainable Development Goals (SDG) that make up the 2030 Agenda. Time is counting down, and delivering the SDGs by 2030 will require decisive and collective action to meet systems thinking, so that systemic changes can be fostered to fight climate change and achieve our ambitions for sustainability.

Figure 1.

World Energy Consumption (2015)



Note: This figure illustrates the global energy consumption per country. The countries with the highest energy consumption (namely China, the United States, India and Russia) are depicted with a big green dot. Reprinted from *2017 Energy Balance*, by the International Energy Agency (IEA) Atlas of Energy (<http://energyatlas.iea.org/#!/tellmap/-1002896040/1>).

Fostering this “*transformational change*” in our global economic system to a sustainability-based focus is a complex - but possible - task under Neo-Schumpeterian thinking. According to this approach, the main source for any systemic economic transformation is innovation (*and in particular technological innovation*) (Hanusch, H. and Pyka, A., 2007), which has been responsible for all five major historical socioeconomic transformations (1. “*the Industrial Revolution*” (in 1771); 2. the “*Age of Steam and Railways*” (1829–1870s); 3. the “*Age of Steel, Electricity and Heavy Engineering*” (1875–1910’s), 4. the “*Age of Oil, Automobiles and Mass Production*” (1908–1970’s); and 5. the “*Age of Information and Telecommunications*” (since the 1970’s) (Perez, C., 2007, p. 5).

Despite the relevance of technological innovation, this thesis argues that technology (alone) cannot solve the current stalemate situation of our global economic system, as the global challenges faced by humanity today (e.g. *climate change and nature degradation, inequalities, urbanisation, rapid population growth and technological upheavals* (UN Economist Network, 2020, p. 2)) are systemic, rather than technical. As

each challenge is systematically intertwined with the other, a technology-centric innovation approach with a focus on sparking economic growth through increases in productivity and competitiveness, will be insufficient to solve today's global crises. Rather, due to their underlying contestation, complexity and uncertainty (Hofstetter, D., 2019), modern human challenges must be addressed through system level change.

- **Problem statement and research questions**

Our global economic system is at a social and environmental breaking point (Hofstetter, D., 2019); humanity is closer than ever before to an irreversible climate precipice, which will bring severe economic, social and environmental impacts down upon us all — especially the poor and most vulnerable. Governments in both the North and South must be called upon to join forces to foster a transformation in our global economic system towards sustainability.

Innovation can be a key tool for delivering on the 2030 Agenda, however, there is a need to rethink the largely endorsed theoretical framework of innovation system (IS). IS analytical tools should address the complex and interdependent dynamics of sustainable development across a variety of contexts. The framework should integrate qualitative lenses that allow for the analysis of innovation processes in different institutional contexts in both the Global South, and at the local level.

Based on this problem statement, this thesis supports the use of “*Dedicated Innovation Systems (DIS)*” concept as a revised version of IS, and focuses on its practical application in the Mexican local context. It suggests the concept of “*Dedicated Actors (DAs)*” as an integral part of DIS, and aims to address the overall research question: *How can Dedicated Actors (DAs) introduce a commitment to sustainability in DISs in informal and insecure institutional settings in Michoacán, Mexico?* To respond to the research question, three sets of sub-questions have been developed and are explored in the empirical chapters: (a) *what are the characteristics of DAs that allow them to direct IS towards sustainable outcomes in informal and insecure institutional settings in Michoacán, Mexico;* (b) *what is the role of DAs in the building of collective capabilities in informal and insecure institutional settings in Michoacán, Mexico?* and (c) *what are the local capabilities that result from DIS in informal and insecure institutional settings in Michoacán, Mexico?*

- **Outline of the thesis**

Chapter 2– Sustainability policy paradigms

This chapter provides the foundation of this thesis with a general introduction to sustainability policy paradigms. It first revisits the eco-retreat and sustainable capital policy paradigms, before presenting different narratives under the sustainable capital, including circular economy (CE), green economy (GE), bioeconomy (BE) and knowledge-based bioeconomy (KBBE). The chapter concludes by elaborating upon the KBBE paths in Latin America -specifically in the informal and insecure institutional settings in Michoacán, Mexico. These research themes are then analysed in the empirical part of the thesis.

Chapter 3–Sustainability transformations through Dedicated Innovation Systems (DIS)

One fundamental proposition of the thesis is that the concept of Dedicated Innovation Systems (DIS) constitutes a practical and heuristic approach to the study of transformative change aspired to in the 2030 Agenda, in that it provides greater space for the incorporation of “*dedicated*” interventions in innovation systems (IS). DIS concept broadens the systems of innovation approach to incorporate directionality, legitimacy, and responsibility, which represent the three cross-cutting and practical dimensions of systems of innovation that allow it to normatively address sustainability transformations. A central concept of this chapter refers to dedicated actors (DAs). Along with enabling thinking, the DAs concept builds upon the idea of actors being “*responsible*” for the introduction of “*dedicated*” efforts towards sustainability (Schaile, M., Urmetzer, S. Ehrenberger, M. et al., 2020) through networked interventions within an IS. The chapter builds on the “*polycentric environmental governance*” approach to describe two different types of DAs: “*dedicated state actors (DSAs)*” and “*dedicated grassroots actors (DGAs)*”.

Chapter 4– Methodology and research design

This chapter presents the methodological tools that guided the research. It outlines some of the ontological and epistemological considerations of the research, and details the systematic-combining approach followed in the thesis. The chapter then presents the data collection methods employed in the thesis, including interviews, participant observations, and documentary evidence, followed by a brief description of the

analytical procedures. The chapter concludes with a discussion of the main methodological challenges faced by the research, as well as the strategies used in the thesis to address these limitations.

Chapter 5– Overview of case studies

This chapter provides a synopsis of the three case studies that were investigated in the thesis, namely: 1) Local security councils addressing violence and forest deforestation from the avocado industry in Tancítaro; 2) Ejido Verde: regenerating forests through social and financial Innovation; 3) Red Tsiri: an experience of social innovation for sustainable local food systems. The selected case studies are in line with the pathways identified for the development of the KBBE in Latin America and the Caribbean (LAC), and are based in Michoacán, Mexico.

Chapter 6. Applying the 3C-Model for Grassroots-led Development (GLD) in case study analysis

In this chapter, the 3C-model for GLD is adapted for the analysis of the characteristics of GDAs, and their role in building the collective capabilities for a dedication to sustainability in DIS in the informal and insecure settings in Michoacán. The chapter also explores the collective capabilities developed by the local people in the case studies.

Chapter 7-Discussion and conclusion

This chapter concludes the thesis with a summary of the main research findings, which are then linked to the overall research question of the thesis. The main contributions of the research are presented next, followed by plausible policy recommendations, and suggestions for future research agendas.

2. Sustainability policy paradigms

The integration of sustainability into international policy agendas often results in competing, and sometimes overlapping, policy approaches that arise from the different understandings and responses to the philosophical and theoretical question of “*what is sustainability*” (Hartmann, D., 2014). Essentially, there are two main viewpoints in the ever-evolving discourse on sustainability or “*sustainable development*,” each promoting different futures for global production systems, and each derived from different intellectual strands and economic theories.

2.1 Eco-retreat policy paradigm

On the one end of the spectrum, there is the “*eco-retreat*” policy position (Hausknost, D. et al. , 2017), which is closely related to concepts as *degrowth*, *abstinence and downscaling*. This position arises from Georgescu-Roegen’s work (1971), which presented an inherent connection between economic activity and the degradation of natural resources (Correia, J., 2015). The eco-retreat narrative gained momentum in 1972, when the principle of “*zero growth*” appeared in the international policy scene as part of the report “*The Limits to Growth*,” produced by the Club of Rome.

The eco-retreat policy narrative is derived from Neoclassical theories, in which economic growth is explained in quantitative terms, and through capital accumulation (Pyka, A., 2017b). According to Solow’s Neoclassical growth theory, which describes growth as a function of three inputs: labour, capital, and “residual” technological factors, once a stationary state is reached, capitalistic economic systems cannot grow unless an external technological shock is produced (Avendaño, L. and Fortuno, J., 2013). Following a similar logic, the eco-retreat policy narrative projects that there is no room for the conservation of resources, because economic systems cannot *endogenously* manage technological change, and thus foster change towards sustainability (Pyka, A., 2017b). Hence, eco-retreat narratives sustain that the only path towards sustainability is through political and economic structures that reduce the patterns of production and consumption in industrialised countries.

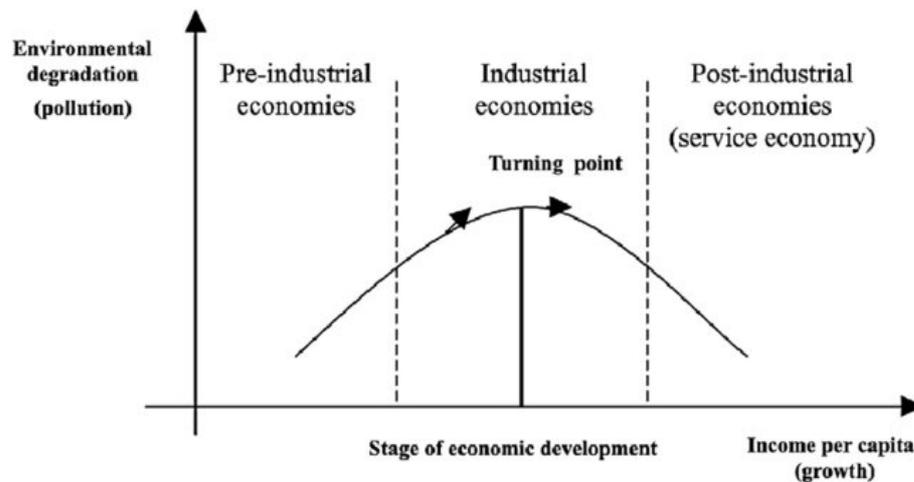
A contrasting narrative to the eco-retreat paradigm refers to the “*sustainable capital*” policy approach (Hausknost, D. et al. , 2017), which, instead of advancing the reduction of our production and consumption patterns, argues for growth that is sustainable and does not cause natural resources degradation, nor broader environmental impacts (UNEP, 2011a). Under this approach, the Environmental Kuznets Curve (EKC) (See Figure 2) is often cited to make a case for decoupling, or the positive environmental impacts that are automatically generated by growth in the long run (Azar, C.; Holmberg, J. and Karlsson, S., 2002).

This “automatic” process of decoupling in EKC claims to be the result of: (1) *smarter consumption and production patterns* generated on the one side from consumers with

better awareness of the environmental costs of goods, and on the other, from businesses willing to adapt their production models to markets for environmentally friendly products (Inglehart, R., 1977); (2) *policies that promote environmental protection* thanks to stronger institutions that integrate environmental externalities and enforce environmental regulations; and (3) *innovative technologies* that foster the transition to sustainability (Stamm, A., 2009).

Figure 2.

Environmental Kuznets Curve



Note: The graph illustrates an inverted U-shaped relationship between economic growth in terms of per capita income and various indicators of environmental degradation. Reprinted from “*Empirical tests and policy analysis of environmental degradation at different stages of economic development*”, by Panayotou, T., 1993, *World Employment Programme Research Working Paper WEP2-22/WP 238*, as cited in “*Macroeconomic conditions in the U.S. and congressional voting on environmental policy: 1970-2008*”, by Tanger et al., 2011, p. 1110

Real world research has been broadly conducted to empirically test the EKC, and the results have pointed to different conclusions, with some studies finding that the presumed “turning point” simply does not exist, while others suggest that for the turning point to occur, income per capita needs to be very high. Despite the different findings, there is a general agreement on the pressing nature of climate change. We cannot afford to risk waiting until economic growth automatically begins to have a positive effect on the environment. Policy action is urgently required to tackle the global sustainability issues of our production and consumption systems (Stamm, A., 2009).

2.2 Sustainable capital policy paradigm

The “*sustainable capital*” narrative has featured throughout the development policy agenda since the launch of the ground-breaking Brundtland Report, “*Our Common Future*,” in 1987 (Correia, J., 2015), which referred to “sustainable development” as ‘*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*’ (World Commission on Environment and Development, 1987, p. 41). Since then, there have been numerous documents that ratify consensus among global decision-makers on the strong interconnections between the economic, social and environmental dimensions of development (e.g. The Rio Declaration on Environment and Development (1992), Johannesburg Declaration on Sustainable Development (2002), The Future We Want (Earth Summit 2012), and UN’s 2030 Agenda for Sustainable Development (2015)).

The sustainable capital policy approach is rooted in a neo-Schumpeterian rationality; where innovation, technological change, and entrepreneurship act as key factors in the transformation of economic systems. In contrast to the “*eco-retreat*” policy position, neo-Schumpeterian theories do not perceive de-growth as the only possible path to sustainable development, due to what Schumpeter describes as “*creative destruction*.” Creative destruction processes happen when a pioneering innovation disrupts a previous dominant paradigm, and new technologies become associated with new institutions and social behaviours that generate wealth and changes in economic models.

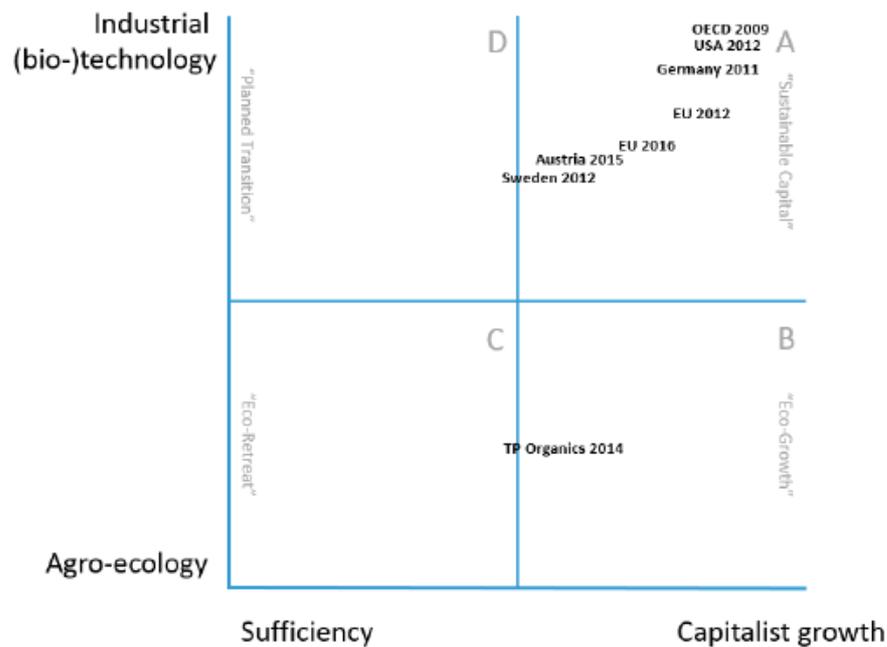
In contrast to Neoclassical theories, which simply explained technological innovation as a “*residual technological factor*”, Schumpeter expanded upon the triggers for these ground-breaking innovations (Kaup, F., 2015) beyond the analysis R&D investments and the efficient allocation of factors of production (labour and capital). The neo-Schumpeterian theoretical approach explains technological innovation as a result of a dynamic and interactive knowledge generation process, depicted by “uncertainty” and “bounded rationality” (Lundvall, 1998; Nelson, 1994) that leads to systemic change.

Prevailing sustainability policy narratives are increasingly associated with neo-Schumpeterian theories and the sustainable capital approach. A recent study conducted by Hausknot et al. (2017) confirms this tendency. The study involved use of multiple

data sources, and allowed to identify a vast divergence among the findings in official policy papers, and the actual narratives supported by stakeholders during consultations. The results of the study can be summarised in Figure 3, which shows a concentration of actors on quadrant (A) sustainable capital (Hausknost, D. et al. , 2017).

Figure 3.

Position of selected policy papers within the techno-political option space



Note. The graph illustrates four quadrants of the techno-political option space, namely (A) Sustainable Capital; (B) Eco-Growth; (C) Eco-Retreat; and (D) Planned Transition. These quadrants result from a two-dimensional option space: the technological dimension (agro-ecology and industrial bio-technology) and the political-economic dimension (sufficiency and capitalist growth). Reprinted from “*A Transition to Which Bioeconomy? An Exploration of Diverging Techno-Political Choices*” by Hausknost et al., 2017, p. 22

Under the sustainable capital paradigm, three concepts are broadly promoted by both policy makers and academia as key sustainability avenues to free economies from fossil fuels: *circular economy (CE)*, *green economy (GE)*, and *bioeconomy/ knowledge-based bioeconomy (BE/ KBBE)*. Although the concepts are interconnected, with a common overarching sustainability goal, they foster different strategies for transforming economies towards sustainable paths (D'Amato, D. et al., 2017).

- **Circular Economy (CE)**

The Circular economy (CE) approach promotes the transformation of our economic system through sustainable consumption and production patterns. The core idea behind CE is to reduce the environmental impact of our economy by rethinking the way in which industries produce, and citizens consume.

The concept has become popular among academia, industry and policy makers around the globe as an alternative to our current linear production systems. The origin of the concept was studied by Korhonen et al. (2017), who conducted an extended literature review of key concepts used to point out features closely related to the CE concept (e.g. “industrial ecology,” “cleaner production product-service systems,” “eco-efficiency,” “cradle-to-cradle design,” and many others).

Today there is still no singular definition of CE, but the general concept involves an economic space “*where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized*” (Carus, M., 2017, p. 25). In the CE, consumers are expected to play an active and varied role in enabling the circulation of products by engaging in reusing, repairing, and/or the recycling of products (Geissdoerfer, M. et al., 2017). Manufacturers on their side, are encouraged to rethink their linear modes of production by 1) increasing the efficiency of their manufacturing process and reducing waste, GHGs emissions, energy and the use of resources in general, and 2) extending the “product life cycle,” through the design of products that can be used multiple times or reused in other production cycles when they reach the end of their life are not disposed of as waste.

Innovation, and particularly digital technology, is argued to play a fundamental role in fostering the transformation to a CE, as it is a key enabler of waste reduction processes (e.g. through de-materialisation and virtualisation of production processes) and facilitates efficiency gains in production processes (e.g. by increasing transparency and feedback-driven intelligence) (Ellen Macarthur Foundation, 2017).

- **Green Economy (GE)**

Although the green economy (GE) concept was used for the first time more than 30 years ago (Barbier, E., Pearce, D. and Markandya, A., 1989), it was not until 2012 at the UN Conference on Sustainable Development in Rio de Janeiro that the concept became part of world leaders' policy discourse, as an economy “... *that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities.*” This definition of GE recognises the systemic nature of environmental challenges (Green Economy Coalition, 2019), in contrast to the CE that is limited to promotion of circularity through mere engineering fixes, and involves all three dimensions of sustainability (economic, environmental and social).

The concept of GE is often used interchangeably with “green growth,” so as to highlight that supporting the social environmental foundations of an economy translates into economic growth. Today, the GE is promoted by the UN System through the “Partnership for Action on Green Economy (PAGE),” which arose from the Rio+20 Declaration as a coordinated effort of five different UN agencies — the UN Environment Programme (UNEP), the International Labour Organization (ILO), the United Nations Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO), and the United Nations Institute for Training and Research (UNITAR), engaged in fostering the GE. PAGE aims to promote both sustainable development and the 2030 Agenda by helping countries to reduce poverty, create jobs, promote social inclusion and equity, environmental conservation and sustainable growth (PAGE, 2020).

Innovation and clean technologies are a key facet of the GE agenda; in fact UNEP promotes green growth through investing in five critical areas: 1) renewable energy technologies, for example wind, solar, geothermal and biomass technologies; 2) sustainable transport technologies, for instance, hybrid vehicles, high-speed rail and bus rapid transit systems; 3) nature-based infrastructure, including safeguarding freshwaters, forests, soils and coral reefs; 4) sustainable agriculture, including organic production; and 5) energy efficiency in old and new buildings (UNEP, 2009, p. 1).

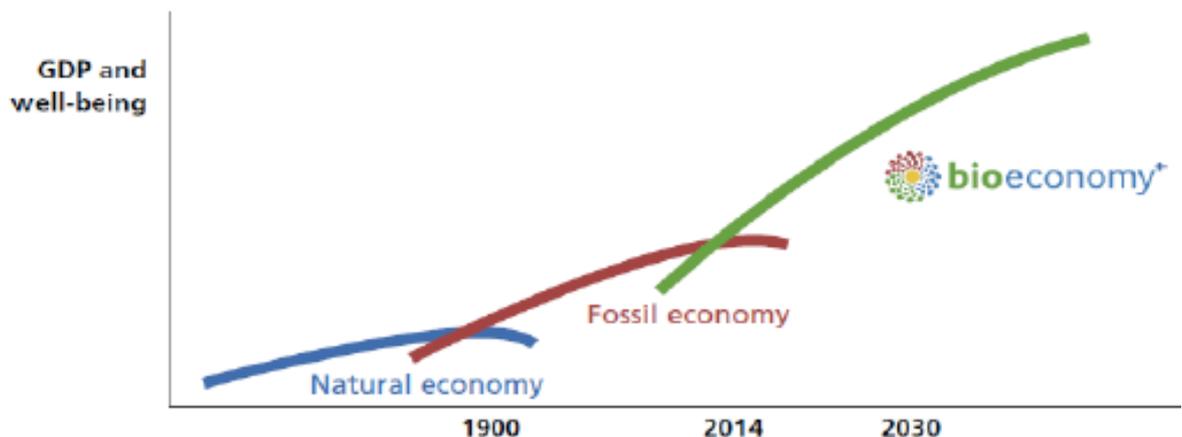
- Bioeconomy (BE)

The Bioeconomy (BE) is another sustainability term analysed in this thesis as an avenue for unlocking economies from fossil fuels (see Figure 4). Although the BE has gained a certain level of global endorsement, its conceptual framing is still a matter of international, national and regional discussion in the policy and scientific arenas (Schmid, O., Padel, S. and Levidow, L., 2012). The concept was first used by Jiri Zeman in the late 1960s to express the reliance of almost all economic activities on biological bases (Bonaiuti, M., 2014). Nicholas Georgescu-Roegen took up Zeman's concept in the 1970s, and used it to explain economic systems theories under the principles of physics and biology.

Although Georgescu-Roegen did not use the terms *degrowth*, *eco-retreat*, *abstinence*, or *downscaling*, he did link the BE concept to the notion that “*unlimited growth is not compatible with the basic laws of nature*” (Bonaiuti, M., 2014, p. 54). According to him, agricultural and industrial production levels cannot grow indefinitely, as the energy and material foundations on which they are based will face irreversible entropic degradation (Schriefl, E. et al., 2008).

Figure 4.

Bioeconomy as a sustainability avenue for unlocking economies from fossil fuels



Note: The graph presents Bioeconomy as the next wave of economy. Reprinted from “The Finish Bioeconomy Strategy” by the Finnish Ministry of Employment and the Economy, 2014, p.5

In 1997 R. Martinez and J. Enriquez presented some insightful work on the potential of both biological sciences and biotechnology in transforming industrial production processes (Birner, R., 2018). In particular, the authors analysed how innovations in the field of genomics could play a role in restructuring our entire economic system (Enríquez, J., 1998). Although Martinez and Enriquez did not use the term BE, their contributions made a case for the concept to be used under the sustainable capital narrative, for which innovations can support growth while creating positive environmental and social impacts.

While the BE concept has been widely discussed among the scientific community over the last decades, the term has only recently gained momentum in the policy arena. Typically, two terms are used interchangeably across policy discourse: bioeconomy (BE) and bio-based economy (BBE). However, the BE concept is broader than BBE; where the BBE only refers to non-food products (e.g. bioenergy, bio-based pharmaceuticals and chemicals, materials and others) (IEA Bioenergy Task 42, 2014), the BE includes both food and non-food products (FAO, 2016).

As an example, the European Commission's (EC) current policy discourse does not make a clear-cut distinction among the above concepts (Viaggi, D. et al. , 2012). In earlier years (2006, 2011 and 2012), EC's concept of BE referred to «*the sustainable, eco-efficient transformation of renewable biological resources into food, energy and other industrial products*» (DG Research, 2006, p. 2); «*the sustainable production and conversion of biomass, for a range of food, health, fibre and industrial products and energy*» (EPSO, 2011, p. 5); or «*the bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy*» (European Commission, 2012b, p. 5). As it can be observed, all earlier definitions included both food and non-food products as part of BE. However, the latest use of the BE concept by the EC refers to food waste only as input to other sectors: «*bioeconomy' means an economy using biological resources from the land and sea as well as waste, including food wastes, as inputs to industry and energy production. It also covers the use of bio-based processes to green industries* (European Commission, 2012a, p. 1).

Although there is indeed a general consensus among academia and policy makers on the utility of CE, GE and BE concepts to address the urgent need for transforming our global economic system towards sustainability, there is still no common understanding on each of the concepts, and how they foster different sustainability paths (D'Amato, D. et al., 2017).

On the one hand, CE and GE promote sustainable paths that do not diverge completely from the use of fossil fuels. To be specific, the main focus of the CE is on fostering eco-efficient production processes and the re-valorisation of waste and raw materials (including fossil fuels), while GE furthers the transition to a low-carbon sustainable future in a way that is fair, efficient, and socially inclusive (Monge, A., 2015).

On the other hand, the BE narrative entails a total replacement of fossil fuels with biologically-based alternatives. Far from being contradictory, the BE approach advances both CE and GE in the sense that it provides alternatives to the recycling of biomass from nature-based sectors within the CE, and for reducing the demand for fossil carbon while advancing the three dimensions of sustainable development in the GE. However, the BE represents a real avenue for completely disentangling economies from fossil fuels, and for transforming the structure of industrial sectors.

2.3 Knowledge Based Bioeconomy (KBBE)

In this paper, BE, along with the Knowledge-Based Bio-Economy (KBBE), are explored as leading sustainable avenues to diversify from fossil fuels, and move towards a sustainable, low-carbon economy. As a result of the interconnected nature of our global crises, KBBE has gained momentum as a comprehensive approach to humanity's most pressing challenges, including climate change, biodiversity loss, fossil resource dependence, and food security (FAO, 2016).

The KBBE is a semantic hybrid of knowledge-based economy (KBE) and bioeconomy (BE) (CREPE, 2011), and is defined as “*life sciences and biotechnology knowledge converging with other technologies to transform into new, sustainable, eco-efficient and competitive products*” (Cologne Paper, 2007, p. 2).

As the BE concept was addressed earlier in this paper, this section shall focus on the analysis of the KBE —a notion closely linked to other narratives, such as the *information society, the learning economy, and the creative economy*. The KBE is promoted as a key driver of competitiveness by the Organisation for Economic Co-operation and Development (OECD), the World Bank (WB) and the European Commission (EC) and many other international organisations like the International Monetary Fund (IMF), the World Trade Organization (WTO), the World Bank, the World Intellectual Property Organization (WIPO), and the various agencies of the United Nations (UNCTAD, UNSESCO, UNECE, ECLAC, etc.).

The long list of KBE definitions intersects on a concept that involves an economy reliant on efficient innovation system; institutional frameworks that incentivise the production, distribution and use of knowledge, along with the formation of an educated and skilled labour force, and investments, within a top-notch information infrastructure (Eurostat, 2005; OECD, 1996; WB, 2007). The KBE is generally measured through indicators including expenditures in research and development (R & D), the employment of engineers and technical personnel in science and technology (Eurostat, 2017), patents, and international balances of payments for technology (OECD, 1996).

Although relevant, this notion of KBE centres on science and technology systems as the only and main producers of new knowledge. When the KBE is adapted to developing contexts, the concept is limited in several ways, for example: 1) technology transfer implies that there are already existing technological capabilities in place, which is not always the case in developing countries; 2) some technologies that support the effective decoupling of environmental impacts from economic growth are not available on a large scale; and 3) traditional technology transfer is dependent on externally imposed knowledge and technologies (Stamm, A., 2009).

In general, the greatest limitation of this concept is its tendency to relate KBE to (only) the most technologically-advanced economies (Boulding, K., 1996), which excludes the Global South and does not fully capture the complex, dynamic nature of knowledge development and acquisition (Sum, N. and Jessop, B., 2013). The understanding of knowledge in a global context requires rethinking the economic fundamentals of

“...what is valued as knowledge and who determines the value of that knowledge”
(Roberts, J., 2009, p. 298).

Knowledge has always contributed to human activities and production. However, the way we now understand the concept of knowledge differs from the days when knowledge simply related to the use of information. Today, knowledge is conceived as something economically valuable. This commodification of knowledge originates from the industrial revolution. In the pre-industrial age, the value of knowledge was limited to elites, or “islands” of S&T knowledge; the industrial revolution brought about a major break-up of these islands. As knowledge was no longer outside the economic and commercial sphere (Soete, L., 2007), it was absorbed as a factor of production, taking the form of capital (such as patents, copyrights, software) or labour (such as skills, ability, creativity) (Kim, H., 2007).

The commodification of knowledge is paradoxical in many ways, for example, there is an eminent contradiction between the collective nature of knowledge generation and its private embodiment. Although knowledge is collectively produced and is not scarce, the KBE causes it to remain private and “artificially” scarce, due to its commodification in either capital or labour forms (Jessop, B., 2006). This contradiction is not in a position to be addressed by that which created it – the market-driven KBE framework.

A second contradiction refers to the value of knowledge, which cannot always be estimated in economic terms. A purely market-led approach is too narrow in so far as the subjective characteristics of the knowledge derived from social and cultural relationships are not considered (Fuchs, C., 2009). While perhaps of no upfront market value, knowledge-based resources have tacit social, cultural, and historical value.

In contrast to economically valuable and codified knowledge, tacit knowledge is not easy to transfer, due to it being rooted in local social and cultural contexts. Extracting tacit knowledge from its social and cultural contexts threatens the preservation of existing knowledge-based resources, as well as the generation of future “reserves” (Turcotte, J., 2016).

In this paper, it is argued that the value of knowledge cannot be defined merely in economic terms, but that local, non-commercial and non-patentable knowledge (Kahangwa, G., 2017) resulting from social, cultural, and historical values must be considered. This broader definition of knowledge creates space to study alternative systems of knowledge production in the Global South, while complementing the analysis of scientific knowledge produced by universities and government laboratories in the Global North.

Various forms of knowledge lead to “*active inclusion*,” that is, “*..giving rights, voice, capabilities and incentives for the excluded to become active participants in processes of development and innovation* (Johnson, B. and Andersen, A., 2012, p. 8). This is the kind of KBE that should be fostered: one that embraces the value of different sources of knowledge to enhance sustainable and inclusive development. This revised KBE concept acknowledges that markets fail to integrate the value of social, cultural and historical relationships as important (non-market-based) factors in the production of various types of knowledge in developing countries.

Considering that the KBBE is a semantic hybrid of KBE and BE, this paper defines KBBE as the “*various types of knowledge converging to unlock our economies from fossil fuels and transform our global economic system towards sustainable economic, social and environmental paths.*”

This thesis elaborates on the above KBBE concept by studying its application in the Global South, and thus analyses the application of the concept in developing countries in Latin America. It then expands upon its concrete application at local level contexts, namely the case of Michoacán, Mexico.

- KBBE in Latin America

In Latin America (LA), BE and KBBE concepts are often used interchangeably. Although no singular common regional definition exists, the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) describes KBBE as an economy that leverages knowledge and technologies for the production and consumption of goods and services derived from the transformation of biological resources (ECLAC, 2017).

The concept has not received the same policy attention that it has in Europe, and a holistic regional approach towards KBBE is still missing. Nevertheless, some LA countries have actively advanced policy strategies for the development of relevant bio sectors (See Figure 5). Among the leading countries in the region are Brazil and Argentina, which aim to foster the bioenergy sector and the use of genetically modified crops; whereas Colombia and Uruguay have made significant progress in the bioprospecting sector (German Bioeconomy Council, 2018).

On its face, the LAC region possesses comparative advantages for building KBBE in terms of agricultural land availability (with 50 percent of its lands being classified as having agricultural potential), biodiversity endowment (seven of the nineteen LAC countries are considered to be “mega diverse” in terms of biodiversity), and water assets (30 percent of the planet’s fresh water) (Trigo, E. et al., 2014). Because of these favourable endowments of natural resources, LA countries position themselves as suppliers of biological resources. However, this narrow approach to KBBE can only exacerbate inequalities among knowledge provider countries (in the Global North), and biomass suppliers (in the Global South) (Saviotti, P., 2017).

Figure 5.

Bioeconomy- related Policy Strategies in Latin America



Country*	Perspective	Document Name
Argentina	Holistic Bioeconomy Development	"Bioeconomía Argentina" (2017) "Plan Provincial de Bioeconomía" (2016)
	Regional Bioeconomy Development	"Argentina Innovadora 2020" (2012)
	Research & Innovation	
Brazil	Research & Innovation	"Estratégia Nacional de Ciência, Tecnologia e Inovação 2016 – 2019" (2016)
	Bioenergy	"Plano Decenal de Expansão de Energia 2023" (2014)
	High-Tech	"PAISS" (2012)
	Green Economy	"Biotechnology Strategy" (2007)

Colombia	High-Tech	"Política para el Desarrollo Commercial de la Biotecnología a partir del Uso Sostenible de la Biodiversidad" (2011)
Mexico	Bioenergy	"Estrategía Intersecretarial de los Bioenergéticos" (2009)
Paraguay	High-Tech	"Política y Programa Nacional de Biotecnología Agropecuaria y Forestal del Parauay" (2011)
Uruguay	High-Tech	"Plan Sectorial de Biotecnología 2011–2020" (2012) "Uruguay Agro inteligente 2010–2015" (2010)

Note: The chart presents a summary of the main policy strategies in Latin America related to Bioeconomy. Adapted from “*Bioeconomy Policy (Part III) Update Report of National Strategies around the World*” by the German Bioeconomy Council, 2018, p.25.

The transition towards sustainability in LA should involve the exploration of different KBBE trajectories that adjust to the variety of institutional settings and local sociocultural structures for the delivery of the SDGs, thus becoming a source of GHG emissions reduction, poverty reduction, and job creation at the local level.

As part of the activities of the LAC-UE project (ALCUE-KBBE), “Towards a Latin America & Caribbean Knowledge Based Bio-Economy (KBBE) in partnership with Europe,” six pathways for the development of the KBBE in Latin America and the Caribbean (LAC) are identified and promoted, namely:

(i) *Biodiversity resources utilisation*: this KBBE path centres on the recognition of the expertise and knowledge of indigenous communities for the valorisation of different types of biodiversity. It involves the use of native species for food and feed; the use of knowledge and innovation for the discovery of new applications of biodiversity as new industrial feedstocks, or as new ingredients in pharmaceuticals, phytotherapeutics, cosmetics, and other sectors (Trigo, E. et al., 2014).

The valorisation of biodiversity supports in situ conservation practices in LA countries. In Mexico for example, there are a large number of projects working alongside indigenous communities for the conservation of agrobiodiversity. In Venezuela, the historical and cultural value of the *gave cocui* in Sierra de Falcón is being preserved through programmes that promote and support the sustainable development of its

derivative products, such as alcoholic spirits, and crafts made from the fibers (Pisón, A. and Bentancur, M., 2014).

The health sector is also a beneficiary of the valorisation of biodiversity, as a large percentage of new medicines stem from native plants, and around 80 percent of the world population still uses traditional medicines (WHO, 2002). There is a large number of documented cases on of research collaborations that have resulted in the development of new medicines from native plants. One regional example is the successful partnership between the National Biodiversity Institute of Costa Rica (INBio) and the Korean Research Institute for Biosciences and Biotechnology (KRIBB), who collaborated on a treatment for allergies and asthma derived from the mabolo tree, found in the Conservation Area of Osa, in Costa Rica (Sasson, A. and Malpica, C., 2017).

(ii) *Agriculture eco-intensification* is presented as an alternative to current agricultural practices, and is an important avenue for the development of the KBBE in LA. It consists of reducing fossil-based agricultural inputs (e.g. fertilisers, pesticides, and others), while maintaining regular productivity levels (Trigo, E. et al., 2014).

There are many strategies already underway in the region that are based on agriculture eco-intensification. Some examples include that in the Ixcán region in Guatemala, where soil fertility was restored through intercropping techniques, such as the cultivation of corn crop with the Inga tree (*Inga edulis*), a legume capable of restoring soil fertility. In the Andean Region of Peru, integrated pest management allowed farmers to counteract the damage of pests, and achieve certified organic potatoes to sell. In the dry Colombian Caribbean, a mixed organic fertiliser based on nitrogen-fixing bacteria has helped to increase the fodder supply for feeding dairy cattle that had previously been affected by soil deterioration and weather conditions. In Brazil and Paraguay, farmers reduced their application of herbicides by using green manures and biological pest control techniques, which increased the organic matter content of soils and reduced weed infestation (Pisón, A. and Bentancur, M., 2014).

(iii) *Biotechnology applications*: biotechnology is part of the KBBE, and refers to the use of biological systems for the development of products, tools and processes that can be applied across various industries. Some of these applications include genetically

modified (GMO) crops and seeds/plants, improvements to animal reproduction, industrial tissue culture, and many others (Trigo, E. et al., 2014).

In Latin America so far, the most widespread application of biotechnology has focused on GMOs, with Brazil, Argentina, Paraguay and Uruguay among the top 10 countries in the world cultivating with biotech crops. Moreover, many regional projects have been instigated to develop GMOs, such as the Biotecsojasur project, which aims to detect useful genes for improving soybeans, the main export product of the Southern Common Market (MERCOSUR for its Spanish initials) (Pisón, A. and Bentancur, M., 2014). The Ibero-American Programme for Science and Technology for Development (CYTED) (involving Argentina, Brazil, Mexico, and Spain) sequenced the genome of the Mesoamerican common bean (*Phaseolus vulgaris*), while the International Potato Center (CIP) in Lima, Peru, analysed 400 clones of indigenous potatoes (Sasson, A. and Malpica, C., 2017).

(iv) Biorefineries and bioproducts can offer an alternative path for the energy sector, and for the regional development of the KBBE; the main focus being on the substitution of fossil fuels by bio-based alternatives, such as biogas, biodiesel, and ethanol (Trigo, E. et al., 2014). Some LA countries are already global leaders in this sector, such as Brazil, which is the world's second-biggest producer of ethanol; Colombia is the fourth-largest producer of palm oil in the world, and the first in the region, while Argentina, controls just over 50 percent of global biodiesel exports.

Although this KBBE path provides alternatives to low carbon value-added activities in the region, there are still food security concerns linked to the use of agricultural resources for fuel production. Some industry players have already developed strategies to address such concerns, for example, in 2006 the Clayuca Corporation implemented an ongoing R&D programme that aims to establish a technology platform to process hydrated bioethanol using different crops (e.g. cassava, sweet potato and sweet sorghum), at the level of small, rural communities. The purpose of the programme is to assist the company in moving away from a monoculture for bioethanol production, to create local jobs while reducing impact on food security. (Sasson, A. and Malpica, C., 2017).

(v) *Value chain efficiency improvements*: Agriculture value chains in LA in particular have the potential to reduce postharvest losses and create market opportunities for bio-based products. One central remark under this sustainability avenue refers to the sustainability of bio-based products, which, despite representing a low carbon option, still runs the possibility of resource overuse – which can be a constraint, as in conventional consumption and production models (Trigo, E. et al., 2014).

(vi) *Ecosystem services* are considered an alternative path for KBBE in LA, and involves all the provisions that we receive directly from nature, such as water and food, along with indirect benefits like carbon storage and climate regulation, waste-water treatment, recreation, and tourism (TEEB, 2018).

In the framework of the KBBE in LA, eco-tourism strategies, water management pricing and carbon credit systems are some of the avenues for the development of the ecosystem services path (Trigo, E. et al., 2014). A relevant example in the region is Costa Rica: a country that has actively invested in both nature conservation (25 percent of its territory is protected and 12 percent is comprised of national parks and reserves) and the development of the ecotourism sector (e.g. bird watching, volcano climbing and kayaking) (Gouvea, R., 2004))

Although relevant, the aforementioned six paths should only represent entry points for the development of KBBE in the LA region. Within LA countries, and even among different regions of the same country, there are variations in natural resources endowments, as well as in economic and social contexts. Thus, the KBBE cannot proclaim to be a unique path towards sustainability (Pisón, A. and Bentancur, M., 2014). Opportunities for KBBE should be explored on a case by case basis, taking into consideration the diversity of local contexts.

In the next section, the potential for KBBE in informal and insecure settings in Michoacán, Mexico is analysed. This institutional setting has been selected as there is little literature on the opportunities for KBBE within informal and insecure contexts, due to a lack of quantitative data and the associated challenges of integrating qualitative elements in IS framework.

This thesis aims to provide new insights on the particularities of local innovation processes in informal and insecure settings in Mexico, and contribute to broadening the application of DIS theoretical framework.

- **KBBE in informal and insecure institutional settings in Michoacán, Mexico**

Exploring potential opportunities for the development of KBBE within a country requires a thorough understanding of the institutional setting. This involves showing an awareness of the mix of formal and informal rules that define social interactions, which largely depends on specific geographical, socio-economic, political, and cultural conditions of the country and region.

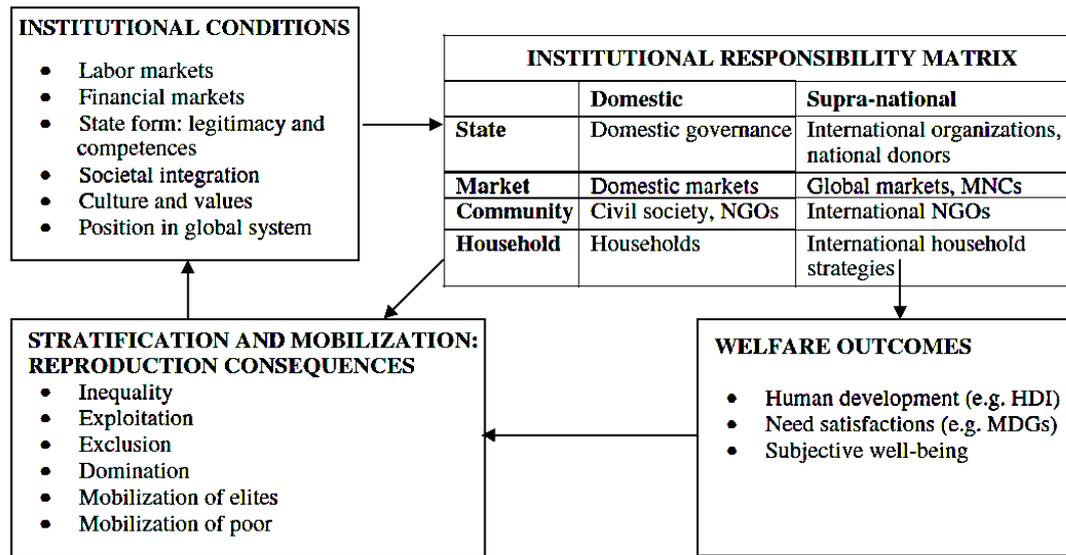
Wood and Gough (2006) studied different welfare regimes in the context of developing countries, and arrived at a practical theoretical framework that is deemed useful for the study of KBBE in informal and insecure settings in Michoacán, Mexico.

The framework is based on the study of four main interrelated components (see Figure 6) that determine the type of welfare regime:

- 1) *The institutional conditions*, which are determined by local culture and values, societal integration, the legitimacy of the state, and the role of markets.
- 2) *The institutional responsibility matrix (IRM)* refers to the conditions under which people pursue their well-being and livelihoods. It involves all actors (State, market, community, and household) at the domestic and supra-national level.
- 3) *The welfare situation of the population* is measured by the Multidimensional Poverty Index (MPI), the Human Development Index (HDI), the Sustainable Development Goals (SDGs), and others.
- 4) *The pattern of stratification and mobilisation* refers to the existing distribution of power in a society, and the range of societal inequalities.

Figure 6.

Theoretical framework for comparing welfare regimes



Note: The figure illustrates the four main components that define welfare regimes. Reprinted from “*A comparative welfare regime approach to global social policy*”, by Wood and Gough 2006, p.1701

The proposed framework compares three main types of institutional settings, namely ‘welfare’, ‘informal secure’, and ‘insecure’. Although this classification refers to STI institutional settings in developing countries, this thesis argues its usefulness in the study of the institutional settings for innovation in general (See Table 1).

‘Welfare regimes’ refer to settings where institutions are legitimate, and markets (both, labour and financial) work for all citizens. The opposite of these regimes is described by Wood and Gough (2006) as ‘informal and insecure’ institutional settings. These regimes involve a high degree of ambiguity, due to institutions being unreliable, contested and personalised. There is also a vague definition of roles: either from the state, market, community, or household. Occupying the gap in between are the so-called ‘informal secure’ settings, where informal rules prevail in the interactions among community members, the State, and even the market (as opposed to welfare regimes, where social relationships are guided by formal and legitimate rules). Finally, in ‘insecure’ settings, the prevalence of informal rules is linked to criminality and political clientelism (Ramos, M., Franco, M. and Jauregui, J., 2018).

Table 1.*The Comparative Welfare Regimes Framework*

Characteristics	Type of Welfare Regime		
	Welfare Regime	Informal Secure Regime	Informal and Insecure Regime
State form	- Legitimate	- Weak	- Weak, illegitimate and collapsed
Social relationships	- Guided by formal and legitimate rules	- Guided by informal rules	- Guided by informal rules and oppression
Source of Livelihood	- Access to formal labour market	- A collection of jobs	- A collection of jobs in conflict situations
Path dependent development	- Liberal, conservative and social democratic regimes	- Less autonomous path dependency with some regime breakdown	- Political disequilibrium and chaos

Note: This table compares the characteristics of three main types of welfare regimes (namely welfare, informal, and informal and insecure regime). Own elaboration based on Wood, G, Gough, 2006, p. 1700.

While the above framework is useful to compare the different types of institutional settings in LA contexts, it does not imply that there are three types of perfectly defined state regimes per country. Rather, Rip (2012) suggests that in each LA country there are “*pockets*” (an institutional setting co-existing within another) and “*layers*” (different contexts within the same regime) that influence the dynamics of innovation journeys in dissimilar ways. Even within the same country, different parts of the population may be exposed to contrasting institutional settings (Ramos, M., Franco, M. and Jauregui, J., 2018). Thus, it is argued that today the context for innovation in LA countries and regions exhibits a *loose scenario* with a mix of institutional settings. While many LA economies present informal secure institutional regimes, in some others -like Mexico - these coexist alongside state welfare regimes.

This complex institutional setting in LA countries mainly stems from a historical shift in the regional prevailing economic strategy. In the era of *import substitution*

industrialisation (ISI) (period from the 1950s to the 1980s known as “*Latin American structuralism*”) many LA economies had a dualised welfare regime. On the one hand, import substitution strategies advanced the emergence of welfare programmes and institutions that protected formal sector workers against unemployment risks. On the other hand, informal sector workers remained exposed to risks, with no social protection from the State (Pyka, A. and Prettnner, K., 2018). As ISI was replaced by *export-oriented industrialisation* (EOI) models, a transformation occurred in the prevailing welfare regime. The liberalisation of labour market translated into less government assistance and protection for workers. Social security schemes diminished to make way for market provisions and informal sources of support (Pyka, A. and Prettnner, K., 2018).

This complexity evident in the study of innovation processes in these pockets and/or layers of informal and insecure settings in LA, has resulted in limited research in this area thus far (Cozens, S., and Sutz, J., 2014). Most of the studies of grassroots innovation in LA take place in ‘welfare’ settings (Ramos, M., Franco, M. and Jauregui, J., 2018).

A better understanding of ‘informal secure’ and ‘insecure’ institutional settings in LA economies can contribute to the unveiling of patterns and dynamics for innovation processes applicable to these contexts, and help policy makers gain key insights underpinning the development of effective and inclusive local strategies for the transformation to sustainability.

In this thesis, the institutional setting of the state of Michoacán, Mexico, is analysed through the following four indicators: i) *welfare outcomes of the population*—measured through the Multidimensional Poverty Index; ii) *patterns of stratification and mobilisation*—explained through estimates on the Gini coefficient, income ration, and degree of social polarisation; iii) *institutional responsibility matrix*—explored by the social network perception index; and iv) *institutional framework*—analysed at the national level through the degree of social cohesion indicators, and the worldwide governance indicators (WGIs); and at the state level (Michoacán) by the Mexican Democratic Development Index (IDD-Mex) (Wood, G. and Gough, I., 2006).

i) *The welfare outcomes of the population in Mexico and Michoacán*

The welfare outcomes of the population in informal and insecure institutional settings are studied by indicators that measure the prevalence of poverty and insecurity, as well as the satisfaction of the needs of the population. Some relevant indexes include the Human Development Index (HDI), the Inequality-adjusted Human Development Index (IHDI), the Gender Development Index (GDI), the Gender Inequality Index (GII), and the Multidimensional Poverty Index (MPI) (Wood G., 2003) (Wood, G. and Gough, I., 2006).

The indexes above reflect a change in the way we understand poverty. In the past, the broad comprehension of poverty involved a lack of income or consumption. However, Sen's capability approach has brought attention to the multiple dimensions of poverty (Conconi, A. and Viollaz, M., 2018). According to Sen (1999), rather than an absence of income, it is the deprivation of capabilities that limits the poor's freedom to achieve something. In this sense, along with income, one should also measure the poor's access to education, justice, health, credit, etc. This multidimensional notion of poverty is central to the 2030 Agenda, which calls for *countries to reduce poverty in "all its forms and dimensions"* (Conconi, A. and Viollaz, M., 2018, p. 5).

The Human Development Index (HDI) represents one of the most important attempts to make Sen's capability approach globally operational, and provides an alternative to measure development in terms beyond GDP growth. The HDI covers three dimensions: a long and healthy life (measured by life expectancy), access to knowledge (measured by mean years of schooling across the adult population, and expected years of schooling for children of school-entry age), and a decent standard of living (measured by Gross National Income (GNI) per capita) (UNDP, 2019).

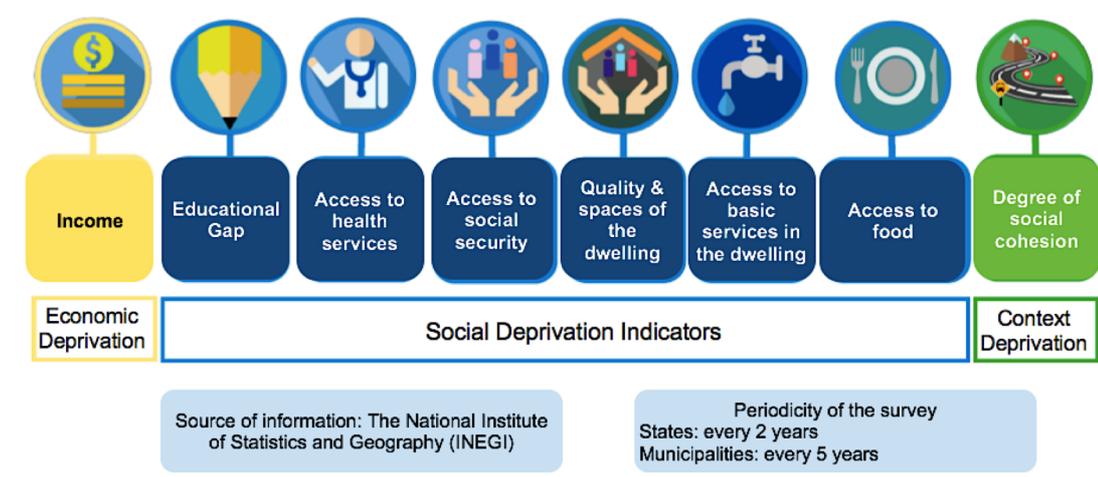
Unlike the HDI, which uses country averages to calculate aggregate deprivations in health, education and living standards, the Multidimensional Poverty Index (MPI) uses micro data from household surveys that permit all the indicators to be traced to particular individuals (OPHI, 2018). As for the study of pockets and layers of informal and insecure settings, it is the local reality that counts – and for this, locally sourced data is

essential (Carter, 2013). Thus, MPI index remains the best analytical tool for the study of welfare outcomes in Michoacán, Mexico.

In Mexico, the MPI is estimated by the National Council for the Evaluation of Social Development Policy (CONVEVAL) through eight indicators that are grouped into three categories of deprivation: *economic deprivation* (calculated by per capita income); *social deprivations* (measured by educational gap, access to health services, and access to social security; quality and spaces of the dwelling, access to basic services in the dwelling, and access to food), and *territorial context deprivation* (degree of social cohesion).

Figure 7

Multidimensional Poverty Dimensions in Mexico



Note: This figure presents the different economic, social and context dimensions of poverty in Mexico. Reprinted from “*Social Policy in the current Government*” by CONEVAL, 2020, p.4

Although the percentage of people living in moderate poverty in Mexico decreased by two points (from 44.4 to 41.9 percent) during the period 2008-2018, in absolute terms, the number of poor grew from 49.5 to 52.4 million people; almost half of Mexican workers (49 in 2008 and 48.8 percent in 2018) still have a salary that does not enable them to leave the poverty line. According to the National Survey of Occupation and Employment, more than half of the jobs (56 percent) in Mexico come from the informal economy, and represent 20 percent of the country's GDP (National Institute of Statistics and Geography (INEGI), 2020).

Despite improvements across all social deprivation indicators, the number of Mexicans deprived from access to food increased from 14.3 to 25.5 million during the period 2008-2018, with one in five Mexicans still going hungry. While access to health services has improved considerably (exclusion has fallen from 38.4 to 16.2 percent), more than half of Mexicans (57 percent) are outside the social security umbrella.

As a result of the marginal drop in poverty levels across all the states of the country, the north-south axis has continued to widen, with unprecedented poverty dividing Mexico into two geographical zones. While in 2018 the national poverty average was estimated at 41,9 percent, three south-southeast states saw more than 65 percent of their population sink further into poverty –Chiapas (74.7 percent), Guerrero (66.5 percent), Oaxaca (66.4 percent) (see Figure 8). Extreme poverty in these three states was more than three times the national average (7.4 percent)–Chiapas (29.7 percent), Guerrero (26.8 percent), Oaxaca (23.3 percent).

Figure 8.

Proportion of population living in poverty by Mexican state in 2018

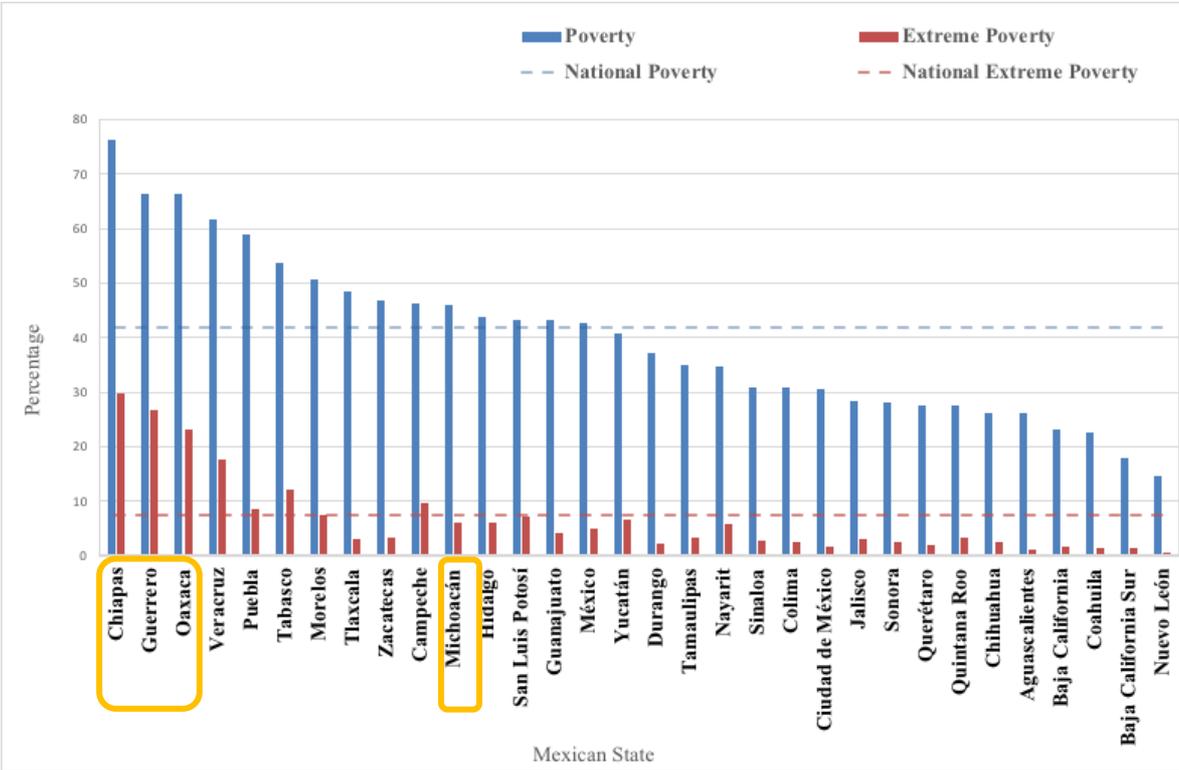


Note: The map depicts in red the three states in Mexico with the highest levels of poverty. Reprinted from “Ten years of multidimensional poverty measurement in Mexico: advances and challenges in social policy”, by CONEVAL, 2019, p. 66 (https://www.coneval.org.mx/Medicion/MP/Documents/Pobreza_18/Pobreza_2018_CONEVAL.pdf)

Michoacán was the 11th most impoverished Mexican state in 2018 (see Figure 9), with 85.7 percent of the population being classified either ‘poor’ or ‘vulnerable’ (46 percent being poor, 34.8 percent being vulnerable due to social deprivation, and 4.9 percent deemed vulnerable due to income). Despite this high incidence of poverty, the pace of poverty reduction in Michoacán is quite remarkable. During the period of 2008-2018, poverty decreased by 9.4 percent in Michoacán (from 55.5 to 46 percent), while at the national level it decreased by 2.4 percent (CONEVAL, 2018b).

Figure 9.

Percentage of Poverty and Extreme Poverty by Mexican state in 2018



Note: The chart presents the levels of poverty and extreme poverty by Mexican states in 2018, and compared to national averages. Own elaboration based on data from CONEVAL 2018

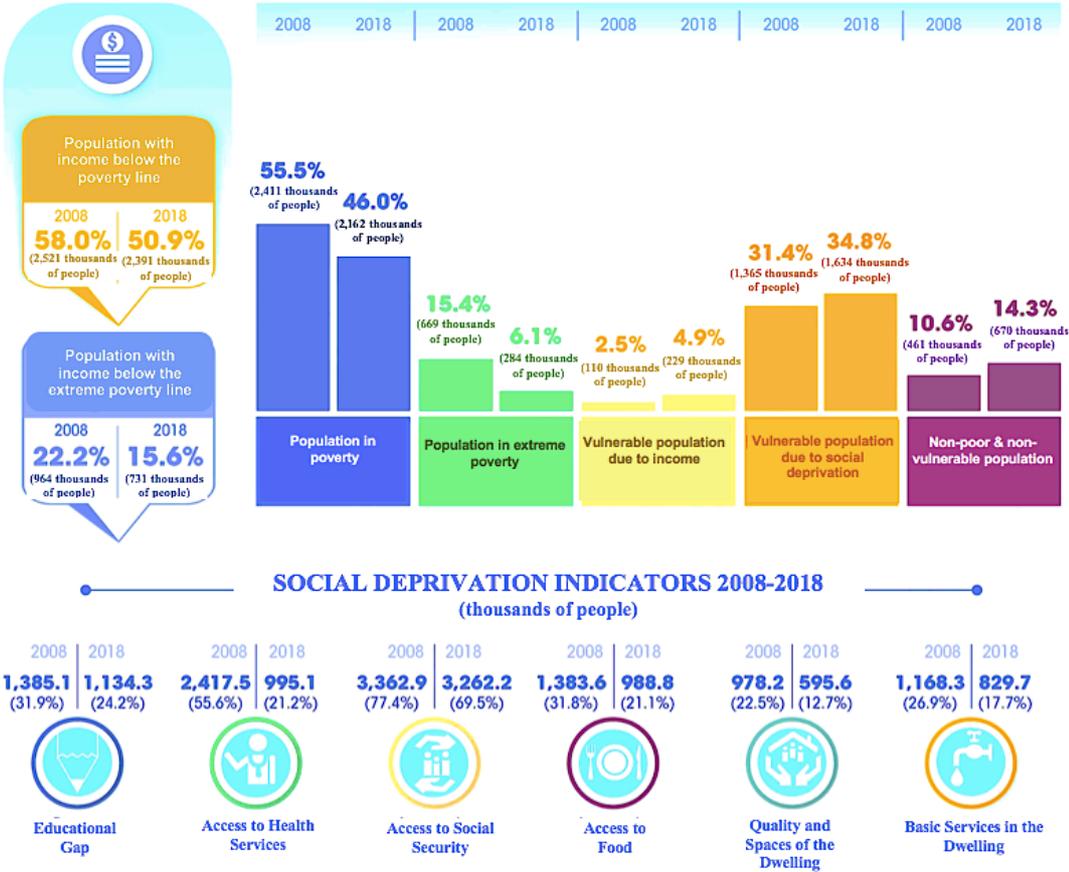
(https://www.coneval.org.mx/coordinacion/entidades/Michoacan/Paginas/Pobreza_2018.a.spx)

In general, social deprivation indicators in Michoacán present a percentage reduction (See Figure 10), however, the percentage of deemed vulnerable due to social deprivation (people with an income above the income poverty line, but with one or more deprivations) increased 3.4 percentage points - from 31.4 to 34.8 percent during the period 2008-2018 (CONEVAL, 2020b).

During the same period the population considered vulnerable due to income (people who do not have any deprivation, but whose income is equal to, or lower than the income poverty line) grew 2.3 percentage points, (reaching 4.9 percent in 2018) and about 119,000 more people were categorised as vulnerable due to income (CONEVAL, 2018b).

Figure 10

Multidimensional Poverty Measurement in Michoacán 2008-2018



Note: This chart presents indicators relative to the multiple dimension of poverty and social deprivation in Michoacán for the years 2008 and 2018. Reprinted from “Poverty measurement in Michoacán 2008-2018”, by CONEVAL 2018.

(https://www.coneval.org.mx/coordinacion/entidades/Michoacan/Paginas/Pobreza_2018.aspx)

ii) *the patterns of stratification and mobilisation in Michoacán, Mexico*

According to the Standardised World Income Inequality Database, Mexico is listed in the 25 percent of countries experiencing the highest levels of inequality in the world (OXFAM, 2015). One half of the 25 percent are African countries, and the other half are Latin American, including Brazil, Honduras, St. Lucia, Colombia, Panama, Guatemala, Costa Rica, Paraguay, Nicaragua, Ecuador, and Mexico (WB, 2019). As per CONEVAL's latest data, Mexico had a Gini index of 0.469 in 2018 (CONEVAL, 2020a), while the World Bank shows a national index with a value of 0.454 for the same year. In 2016, the richest 10 percent of the population earned 23 times more than the poorest 10 percent (OXFAM, 2016).

In Mexico, social mobility (changes that people experience in their socioeconomic status) is still low. Almost half (49 percent) of Mexicans born in those households on the lowest rung of the social ladder stay there their entire lives, and although the other half manages to ascend, a quarter of them cannot overcome the poverty line. This implies that almost 75 percent of Mexicans born at the bottom of the social ladder do not manage to overcome the condition of poverty. On the other hand, 57 percent of those born in households at the upper end of the social spectrum remain there for the rest of their lives (CEEY, 2019).

Social mobility in the north and south of Mexico is significantly different. A Mexican who is born poor in the north of the country has about 3.5 times more possibilities of extracting themselves from poverty, than one who is born in the same situation in the south (SHCP, 2020). In the north, only 23 percent of those who were born poor remain poor, but in the south, 67 percent of them remain impoverished for their entire lives. The percentage of Mexicans that ascend to the higher income level is only 2 percent of those who were born poor in the south, and 8 percent for those born poor in the north (El Economista, 2020). There is a tremendous discrepancy in income ratio among the northern and southern states. The three south-southeast states with most poverty have the highest income ratio: Chiapas (47.9), Guerrero (46.5), and Oaxaca (26.7), while

northern states, such as Nuevo Leon, present an income ratio of 0.1 (CONEVAL, 2018b).

Based on the Intergenerational Social Mobility Module of the National Household Survey 2016 (INEGI, 2016), Monroy-Gómez-Franco, Vélez and Yalonetzky (2018) estimated that in Mexico, at least 42 percent of total wealth inequality is caused by an inequality of opportunity resulting from differences in external circumstances (that which does not depend on personal effort and merit), including inherited wealth, parents' education and occupation, whether the person belongs to a indigenous population, the rural-urban place of residence, sex, and skin colour. This percentage increases to 48 percent when also considering the circumstances that characterise the environment or neighbourhood of origin (e.g. whether the localities have public lighting available, nearby schools or public libraries, health centers, places of recreation, clandestine alcohol sales centers, land / abandoned houses, easy transportation to other places, security in the neighbourhood, and if the streets were clean) (Monroy, L. and M. Corak, 2019).

Indigenous communities (10.1 percent of Mexican population (National Institute of Indigenous Peoples (INPI), 2015)) continue to be the most marginalised, with progress against poverty only showing an improvement of one percental point between 2008 and 2018 (from 76 percent to 74.9 percent). Of the most excluded sectors of this population, rural indigenous women are the most affected. In 2018, 84.3 percent rural indigenous women were poor, with 45.7 percent being 'extremely poor', compared to the 35.8 percent of non-indigenous men living in urban areas who were poor (CONEVAL, 2019a). The most pronounced social deprivations in the indigenous population are access to social security and basic housing services. In 2018, 78.2 percent of indigenous people did not have access to social security, and 57.5 percent did not have access to basic services for life such as water, electricity, gas, drainage and communications (CONEVAL, 2019b).

In 2018, Michoacán had a lower Gini index (0.424) than the national one, which means that the state had better income equality than the national average of (0.469). However, between 2016 and 2018, the Gini index in Michoacán remained at 0.424, while in the same period at the national level, the estimates of the Gini coefficient showed a decrease

of 5.9 percent - from 0.498 to 0.469. While in 2016, Michoacán was the 8th Mexican state with the least inequality in income distribution (measured by the Gini index), in 2018 the state moved to 12th position, out of 32 states (CONEVAL, 2020b). The income ratio in Michoacán in 2018 was 5.5, meaning that the income of the non-poor and non-vulnerable people was more than five times that of people living in extreme poverty.

In addition to income inequality indicators (Gini index and income ratio), the patterns of stratification and mobilisation in Michoacán are also measured by the degree of social polarisation, which considers the differences in the population's living conditions in terms of housing and educational levels. These differences are calculated through the marginalization index of the National Population Council (CONAPO), which classifies the degree of marginalisation as "*very low*", "*low*", "*medium*", "*high*" or "*very high*".

The percentage of marginalised population determines if a state is polarised, with left pole, with right pole, or no pole. A state is considered to be "*polarised*" if less than 20% of the population has a "medium" degree of marginalization and more than 30% of the population presents extreme levels of marginalisation (high, very high, low and very low). A state has a left pole (*high polarisation*) if more than 70% of its population lives in municipalities with "high" or "too high" levels of marginalisation; and a right pole (*low polarisation*) when 70% of its population lives in municipalities with "low" or "too low" levels of marginalisation (Núñez, G. et al., 2016). A state "*without pole*" excludes polarised municipalities and does not have left nor right pole.

In 2020 the level of marginalisation in Michoacán was "*high*", ranking tenth nationally (CONAPO, 2020b). However, according to CONEVAL (2020a), Michoacán is a state with "*right pole*" (*low polarisation*). This discrepancy can be explained by the distribution of marginalisation rates among the different municipalities. For example, only one municipality (Aquila) presented "*very high*" degrees of marginalisation (one of the highest at the national level), while no more than 13 of the 113 municipalities showed "*high*" degrees of marginalisation.

iii) institutional responsibility matrix (IRM) or welfare mix

IRM refers to the institutional context within which individuals and communities can pursue their livings and welfare goals (Wood, G. and Gough, I., 2006). IRM in Michoacán can be estimated by the *social network perception index*, which estimates people's appreciation of their access to support from local social networks to face challenging situations (e.g. being cared for during an illness, receiving financial aid, employment, child care assistance and others). The social network perception index in Michoacán is medium, which means that the proportion of people who perceive a high degree of support from social networks is greater than, or equal to, 20 percent, and less than 40 percent.

iv) the institutional framework

The institutional framework covers the legitimacy of institutions, the degree of social integration, and the cultural values that define informal societal rules (Wood, G. and Gough, I., 2006). As measuring the institutional framework of a country is not without its difficulty, governance indicators are useful as they reflect some of the components of the institutional framework, as well as cover issues regarding the legitimacy of the state and cultural values.

Compared to both high income OECD and LAC countries, Mexico ranks low across most of the six indicators of the Worldwide Governance Indicators (WGIs): (1) voice and accountability; (2) political stability and absence of violence/terrorism; (3) government effectiveness; (4) regulatory quality; (5) rule of law; and (6) control of corruption (WB, 2020). In 2019, the estimates of control of corruption, rule of law, government effectiveness, and political stability and absence of violence/terrorism were negative for Mexico.

At the state level, Michoacán ranked 29 from 32 states in 2019; meaning that it was the 4th state with the least democratic development according to the Mexican Democratic Development Index (IDD-Mex).

Insecurity levels scored high in Michoacán. Between 1990 and 2017, homicides in Michoacán grew 48 percent, with 92 percent of the victims being men. It is women, however, that have suffered a greater increase in deaths from homicide: 169 percent over the same period. From 2010 to 2017, the capital of Michoacán, Morelia, registered a rate of 146.5 homicides per 100,000 inhabitants, representing a growth of 725 percent (Zepeda, R. et al., 2018).

The steep rise in violence in Michoacán can be attributed to territory disputes between two cartels: “Los Viagras” and “Jalisco Nueva Generación Cartel” (Arrieta, C., 2018), mainly due to the State’s position being strategically valuable for the transfer of drugs from South America to the United States of America (USA) via the maritime port of Lázaro Cárdenas (Herrera, H., Arias, D. and Colín, R., 2017).

In terms of migration, the level of economic growth in Michoacán has not been enough to employ a significant proportion of the economically active population, which has caused waves of migration to other states within the country, and also to the USA. According to the Index of Migratory Intensity, Michoacán was the third state with highest migration numbers to the US, after Zacatecas and Guanajuato (National Population Council (CONAPO), 2012).

As it can be observed from the above institutional analysis (i. Welfare outcomes of the population; ii. Patterns of stratification and mobilisation; iii. Institutional responsibility matrix; and iv. Institutional framework), the patterns and dynamics of innovation in informal and insecure settings in the state of Michoacán, Mexico is full of complexity, and differs from the more largely studied welfare settings.

The particular focus of this thesis, on the study of innovation processes in informal and insecure settings in local contexts in developing countries, calls for the use of a conceptual framework to integrate the particularities of these contexts. In the next section, the framework of Dedicated Innovation Systems (DIS) is presented as a practical approach for the study of both innovation processes in pockets of institutional informality and insecurity, and the particular dynamics underpinning the transformation to sustainability in such contexts.

3. Sustainability Transformations through Dedicated Innovation Systems (DIS)

Science, Technology and Innovation (STI) play central roles in the 2030 Agenda as contributors to the achievement of the sustainability goals of the Paris Agreement (IATT, 2018). A widely-accepted and influential theoretical tool for understanding the chief drivers for STI processes (Schaile, M. et. al., 2017) can be found in the conceptual frame of innovation systems (IS), which claims to be instrumental in the analysis and development of policies for the diffusion of innovation, structural change, and economic development.

Despite the large variety of IS definitions (see Box 1), all modern IS theories build upon Schumpeter's seminal work, and the general understanding of innovation and innovation systems (IS) as *novel combinations of knowledge derived from non-linear, collective and cumulative processes, triggered by a variety of actors (e.g. companies, research institutions, political actors, consumers, etc) and their complex and multiple interactions (flows of goods, R&D cooperation, knowledge transfer, relationships between users and producers, etc)* (Freeman 1987; Lundvall 1992; Nelson 1993; Edquist 1997; Lundsgaarde, 2012; Pyka A. , 2017a, p. 3).

Box 1.

Various definitions of innovation system (IS)

'... the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies' (Freeman 1987, p. 1)

'... a system of innovation is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state' (Lundvall 1992, p. 3)

'... a set of institutions whose interactions determine the innovative performance, in the sense above, of national firms' (Nelson 1993, p. 4)

'... A national system of innovation is the system of interacting private and public firms (either large or small), universities, and government agencies aiming at the production of science and technology within national borders. Interaction among

these units may be technical, commercial, legal, social, and financial, in as much as the goal of the interaction is the development, protection, financing or regulation of new science and technology' (Niosi et al. 1993 p. 208)

'... the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country' (Patel and Pavitt 1994, p. 78)

'... that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies' (Metcalfe 1995, p. 463)

Note: This box presents a list of IS definitions. Reprinted from “*Capabilities, Networks, and Directionality Innovation Policy for Sustainable Development Goals*” in Imperial College London. Centre for Environmental Policy, Faculty of Natural Sciences, by Larsen, 2019, p.4.

Neo-Schumpeterian theories on innovation have brought ground-breaking insights to many fields currently dominated by mainstream economics. For example, international trade theories that previously explained trade competitiveness as a “black box” factor resulting from exogenous technical changes, have been enriched with new insights and evidence of the endogenous role of technological innovation in fostering comparative advantages (Dosi, G., Pavitt, K. and Soete, L., 1990).

The relationship between employment and technological innovation has also been studied by neo-Schumpeterian scholars, such as Freeman and Soete (1987), who proffered novel insights regarding labour-saving technical changes, and their structural effects on employment. Contrary to classical theories that described unemployment as a short-term disequilibrium triggered by exogenous technological change, Freeman and Soete analysed employment’s long-term problems, and cautioned against the potential lock-in effect of labour-saving technologies.

At the national level, Freeman (1987), together with Lundvall (1992) and Nelson (1993), made important contributions to the concept of “*national innovation systems*” (NIS), a framework that considerably influenced the literature covering a systems approach to technological innovation. NIS became a reference point for the study of innovation, and acted as a driving force for a country’s economic development, resulting from the interactive learning processes and knowledge exchange among actors of the system (government, universities, industrial sector players, etc.). The NIS concept has also been extrapolated to focus on the study of regions (regional innovation systems (RIS)) and sectors (sectoral innovation systems (SIS)).

At the firm level, scholars like Nelson and Winter provided insightful contributions to the evolutionary theories of how firms innovate. As opposed to Neoclassical assumptions, the authors describe innovation processes as fundamentally dynamic and uncertain, where firms searching for innovative solutions to improve their profits cannot always make rational and informed decisions. Rather than a maximisation of returns, technological changes result from routines that shape business behaviour, and that result from an evolutionary process (Nelson, R. and Winter, S., 1982).

Joseph Schumpeter’s seminal work on innovation, together with the more recent works of neo-Schumpeterian scholars, have brought about one of the most influential frameworks of our time. Today, the IS framework is positioned as a widely-recognised and powerful tool for the study of techno-economic challenges. There is general agreement among decision-makers as to how IS provides important guidelines on the interactivity and interdependence between different actors of a system (Metcalf 2003; Soete et al. 2010), and the factors that foster transformations in industrial structures.

The IS approach has become the theoretical basis for the development of economic policies promoting “*structural change*,” based on technological progress. However, in this thesis, it is argued that the IS approach has tended to focus (too much) on finding technological solutions to foster economic growth.

Considering our current challenge to deliver on both the Paris Agenda and the SDGs, the IS framework requires an extension to include analytical tools that broaden sustainability goals, and allow for re-evaluation where technological innovations

support such goals. The following section covers some elements that are important in refining IS framework, for the purpose of supporting the transformation of our economic system to a sustainable path.

3.1 Refining innovation systems approach (IS) to address sustainability

A central premise of this thesis is that the “*transformative change*” aimed at by the 2030 Agenda goes *beyond structural change*, in that it i) affects all sectors and their relations, as well as the consumers, and thus implicates more than the replacement of existing industries with new ones; ii) involves broader social and environmental challenges, including those related to socioeconomic inequality and environmental sustainability (Mazzucato, M. and Penna, C., 2020); and iii) requires the guiding assumptions, values, norms, and practices of the prevailing IS to be challenged.

Over the past decade, many researchers have worked to extend the IS approach to allow for the promotion of structural change that is compatible with social development, and the environmental goals (Nazrul & and Kenneth, 2018) of the Paris Agenda, for example, ending poverty and reducing inequality in all its forms around the world, promoting inclusive and sustainable production and consumption systems, and tackling climate change) (Mazzucato, M. and Penna, C., 2020)).

IS diverse extended approaches involve the use of integrational tools to better deal with wicked problems - that is, social challenges that are complex, unpredictable and with unclear boundaries (Rittel, H. and Webber, M., 1973). Thus, a comprehensive analysis of the *contestation, complexity, and uncertainty* (See Box 2) of societal problems and innovative solutions has been a common feature among the different approaches fostering the coupling of IS with sustainability goals.

Box 2.

Dimensions of wickedness of societal problems and innovative solutions

The degree of the wickedness of a problem, or an innovative solution is determined by:

- **Contestation**, which arises when different actors (businesses, companies, consumers and entire communities) have incompatible opinions about a social problem or innovative solution, as they do not share the same *norms, values, framings* and *interests*. As a result, there is a reduced legitimacy and acceptance of the innovation policies addressing these social challenges.
- **Complexity** refers to the multiple dimensions and scales of social problems (May et al. 2013; Carley and Christie 2017; as cited in Wanzenböck, et al., 2020). Due to their complexity, social problems must be addressed by policy solutions that i) foster the transformation of institutional systems, and subsequently trigger radical changes in social practices; and ii) involve the cooperation of a large number of actors from different policy spheres and governance levels (Head 2008; Van de Poel et al. 2012; as cited in Wanzenböck, et al., 2020).
- **Uncertainty** can reduce the broader acceptance and diffusion of innovations. It is caused by incomplete knowledge about an innovative solution (such as, whether a solution is available or viable, or if it represents the best option for tackling a particular challenge), as well as a lack of clarity surrounding its potential side-effects (Sengers et al. 2010; as cited in Wanzenböck, et al., 2020).

Note: Reprinted from “*A framework for mission-oriented innovation policy: Alternative pathways through the problem–solution space*” in *Science and Public Policy* By, Wanzenböck, et al., 2020, p. 476-477. (<https://doi.org/10.1093/scipol/scaa027>).

From the most recent endeavours to explicitly couple the IS concept with sustainability goals, Urmetzer and Pyka (2019) highlight the following concepts: *sustainable systems of innovation (SSI)* (Segura-Bonilla 1999,2003); *sustainability-oriented innovation systems (SoIS)* (Altenburg and Pegels 2012; Stamm et al. 2009), *reflexive innovation systems (ReIS)* (Lindner, R et al., 2016). Although a specific concept has not yet been proposed, some authors (Johnson et al., 2003; Lundvall, 2007; Kara and Pamukçu, 2011; Capriati, 2013; and recently Bajmócy and Gébert, 2014) suggest broadening IS boundaries by integrating elements from Sen’s *capability approach (CA)*.

Whereas the above concepts bring new elements to IS theoretical framework, there are some persistent shortcomings that limit their use in the study of transformative change towards sustainability. For example, while the sustainable systems of innovation (SSI)

concept draws new attention to natural ecosystems as a singular system element, the ultimate goal of SSI narrowly continues to be “long-term competitiveness” (Segura-Bonilla, 2003; p. 378). Likewise, the sustainability-oriented innovation systems (SoIS) (Altenburg, T. and Pegels, A., 2012) concept is argued to focus on technological innovations as the main triggers of environmentally-sustainable paths, and to reduce the role of civil society actors to either consumers or citizens (Urmetzer, S. and Pyka, A., 2019). As a result, the related mission-oriented innovation policies fail to integrate a holistic approach, in that they tend to favour top-down interventions to reframe the direction of economic growth (Mazzucato, 2018a, 2018b; Mazzucato; Miedzinski; and Ekins, 2019), rather than a mix of top-down and bottom-up approaches.

Meanwhile, the *reflexive innovation systems* (ReIS) concept (Lindner, R et al., 2016) allows for collective reflection and internalisation of system goals, and thus increased legitimacy (Schaile, M. et. al., 2017). However, the application of this concept may be considered problematic in some socio-political contexts. As the issue of “*power struggles*” remains underexplored in ReIS, the battlegrounds for reflexive governance arrangements among IS actors may look very different in contrasting settings (Van der Jagt, A. et al., 2021). This shortcoming is particularly relevant in cases where the concept of ReIS is used for the analysis of innovation processes in informal and insecure institutional settings in developing countries; where political clientelism and violence might limit the capability for collective reflection.

In a similar attempt to use IS framework to normatively address transformations to sustainability, an emerging field of research pioneered by GLOBELICS Network (Global Network for Economics of Learning, Innovation and Competence-building Systems) advances the use of Sen’s *capability approach* (CA) in the field of economics of innovation (Kara, O; and Pamukçu, T., 2011). The integration of both approaches (IS and CA) results in a theoretical approach that is adapted to jointly address sustainable development challenges and innovation-led transformations in any institutional context.

On the one hand, IS framework brings useful tools to understand how systemic change can be prompted by innovation and interactions among actors (Capriati, M., 2013). On the other hand, a CA approach can provide a normative framework that broadens the focus of IS from economic-centred growth. Rather than a goal in itself, in the CA

economic growth is a means to the expansion of disadvantaged people’s capabilities (opportunities) “to achieve outcomes that they value and have reason to value” (Sen, A., 1999, p. 291).

One main contribution of this thesis is the application of the concept of “*Dedicated Innovation System (DIS)*” (Pyka 2017; Schlaile et al. 2017; Urmetzer et al. 2018; Urmetzer and Pyka 2019), as a revised approach to IS that is adapted to the study of transformative change aimed at by the 2030 Agenda (See Table 2.). The next sections present the three proposed cross-cutting practical dimensions enabling DIS sustainability transformations, namely directionality, legitimacy, and responsibility.

Table 2.

Comparison of IS and DIS

	Innovation Systems (IS)	Dedicated Innovation Systems (DIS)
Leading assumptions	<ul style="list-style-type: none"> • Innovation takes place in complex (co-evolutionary) systems • Innovation fosters structural change and economic growth 	<ul style="list-style-type: none"> • Innovation takes place in complex (co-evolutionary) systems • Innovation fosters transformational change that accommodates all three dimensions of sustainable development (economic, social and environmental), while recognizing the implicit uncertainty of transformations (truly uncertain, open, non-linear, highly unpredictable and complex).
	<ul style="list-style-type: none"> • Innovation is “<i>per se</i>” desirable 	<ul style="list-style-type: none"> • Innovations “<i>that contribute to transformations towards sustainability</i>” are desirable • Links the impact of innovations to quality of life, inter-and intra-generational justice, continuity of ecological systems

Directionality	<ul style="list-style-type: none"> • IS goal: economic growth, efficiency, increased (international) competitiveness • One central pathway to economic growth • Focus on technological innovation solutions 	<ul style="list-style-type: none"> • DIS goal: sustainability, continuity of ecological systems, inter-and intra-generational justice, legitimacy, quality of life. • Plural pathways to a sustainability goal. Integrates the complex normativity of sustainability in dedicated innovation trajectories (stakeholders having conflicting visions, interests, values, norms, and expectations with regard to sustainability goals) • Comprehensive innovation approach (social, economic, <i>ecological, cultural & technological innovation</i>)
Legitimacy	<ul style="list-style-type: none"> • Innovation is based on expert sustainability knowledge • Innovation processes determined primarily by “supply side” 	<ul style="list-style-type: none"> • Innovation is based on diverse knowledges • Innovation processes determined by all systemic actors and institutions (e.g., citizens, mediators, social and sustainable entrepreneurs, etc). • Combinations of technology-led, market-led, state-led, and citizen-led processes.
Responsibility	<ul style="list-style-type: none"> • Top-down approach- Government actors are responsible for IS transformations • Policies tackle system failures 	<ul style="list-style-type: none"> • Bottom-up and top-down enabling approach: Dedicated actors (DAs) are responsible for fostering DIS sustainability transformations. • Policies tackle enabling (structural and systemic) failures for DIS transformation

Note: This table presents a comparative analysis of IS and DIS conceptual frames, in relation to the three proposed cross-cutting dimensions (namely directionality, legitimacy and responsibility). Own elaboration with elements from “*Innovation Systems for Transformations towards Sustainability? Taking the Normative Dimension Seriously*”, by Schlaile et al., 2017, p.5

3.1.1 DIS Directionality Dimension

Directionality, or goal-orientation in DIS, refers to the central question of “*what* is the ultimate goal of an innovation system (IS)?” (Daimer, S., et al., 2012; Lindner, R et al., 2016). (Lindner, R et al., 2016). As the sustainability goal of DIS implies a radical ‘*transformation*’ of our economic system to paths of sustainable development, in this thesis, *transformation governance theories* serve as a useful a framework to address such a question.

Although often used interchangeably, the subtle but important difference between the terms, ‘*transformation*’ and ‘*transition*’ is acknowledged in this thesis (Schaile, M. and Urmetzer, S., 2019). While ‘*transition*’ is used to describe a shift from one socio-economic regime to another (with different institutions, technologies, industry structures, infrastructures, skills, products, regulations, cultural preferences, etc.); ‘*transformation*’ encompasses radical changes across all elements of the regime, along with their interactions and feedbacks (Schot & Steinmueller, 2018 and Hölscher et al., 2018).

At a global level, there is extensive literature that analyses, theorises and understands transformation governance (e.g. *governance of socio-technical transformations; governance of socio-ecological transformations; governance of action-oriented perspectives, and governance of socio-institutional and socio-economic transformations*) (See Box 3).

Box 3.

The literature on governance of sustainability transformations

Socio-technical transformations involve the study of how socio-technical regimes created around central technologies are subject to evolve. This theory uses ideas from a variety of disciplines; notably evolutionary economics, innovation studies, and institutional theory to explain the dynamics of transitions. It is based on the work of neo-Schumpeterian economists, such as Nelson and Winter (1982), who emphasise the role of technological innovation in economic change. Two main analytical frameworks include: (i) *the multilevel perspective (MLP)* developed by Rip and Kemp (1998), Geels

(2002, 2011), and Geels and Schot (2007) and (ii) *the approach of technological innovation systems (TIS)* devised by Bergek et al. (2008), Hekkert et al. (2007), Jacobsson and Bergek (2011).

The *governance dimension of socio-technical transformations* comprises four main analytical frameworks: (i) *strategic niche management (SNM)* (Loorbach et al., 2017; Kemp et al., 1998; Geels, 2018); (ii) *transition management* (Loorbach, 2010; Rotmans et al., 2001; Rotmans and Loorbach, 2009; Smith and Stirling, 2010; Frantzeskaki et al., 2012); (iii) *reflective governance* (Voß and Kemp 2006); (iv) *transformative innovation policy* (Diercks et al., 2019; (Schot and Steinmueller 2018; Weber and Rohracher 2012).

A second set of theories comprises *socio-ecological transformations* (O'Brien and Sygna, 2018), which originated in natural sciences fields (particularly ecology, biology, and earth systems science) and resilience studies. As a result of an increase in social science contributions, this approach has evolved to study socioecological systems, and sustainability transformations directed by social change. Within the *governance theory of socio-ecological transformations*, two conceptual frameworks are distinguished: (i) *adaptive governance* (Folke et al., 2005; Patterson et al., 2017; Johnson et al. 2018; O'Brien and Sygna, 2018; Chapin et al., 2010; Future Earth, 2013); (ii) *the theory of governance of the Earth system* (Biermann et al. 2010, 2014). One of the main criticisms of these governance theories refers to the weak elements explaining how systemic change is fostered. Presumably, there is a missing link between system outcomes and individual actions, and potential trade-offs and lockdowns are not covered.

The action-oriented perspectives approach provides additional information as to the role of individuals, communities, cities, unions, and other groups in bringing about systematic changes that complement other theories on system transformations. Key areas of research include Ostrom's work (1990, 2010) on common resource governance and *polycentric governance*, and social practice theory by Steward (2018). In terms of governance approaches, the action-oriented perspective adapts the active interest of different actors to participate in new governance practices. The framework has been criticised for promoting limited linkages to formal governance structures as counterparts in the transformation process. The framework also lacks connections with innovation theories and value chain analysis.

The theory of socio-institutional and socio-economic transformations recognises the role of the market in shaping identity, values and human behaviour. Governance approaches proposed by this school of thought point to changes in the systemic characteristics that guide both individual and collective actions.

Note: Summary from “*Transitions to Sustainable Development*” in Encyclopedia of the UN Sustainable Development Goals: Decent Work and Economic Growth, by Schaile and Urmetzer, 2019 (DOI: 10.1007/978-3-319-71058-7_52-1) and “*Perspectives on transitions to sustainability*” by European Environment Agency, 2017 (<https://www.eea.europa.eu/publications/perspectives-on-transitions-to-sustainability/file>).

Across the variety of transformation governance theories, there is a prevailing common understanding as to how transformations are driven by “*systemic change*” —that is, transformations being defined as *co-evolutionary processes* arising from interconnections, mutual dependencies and the dynamic relationships between multiple actors, and based on experimentation, reflection, searching, and learning (European Environment Agency, 2019).

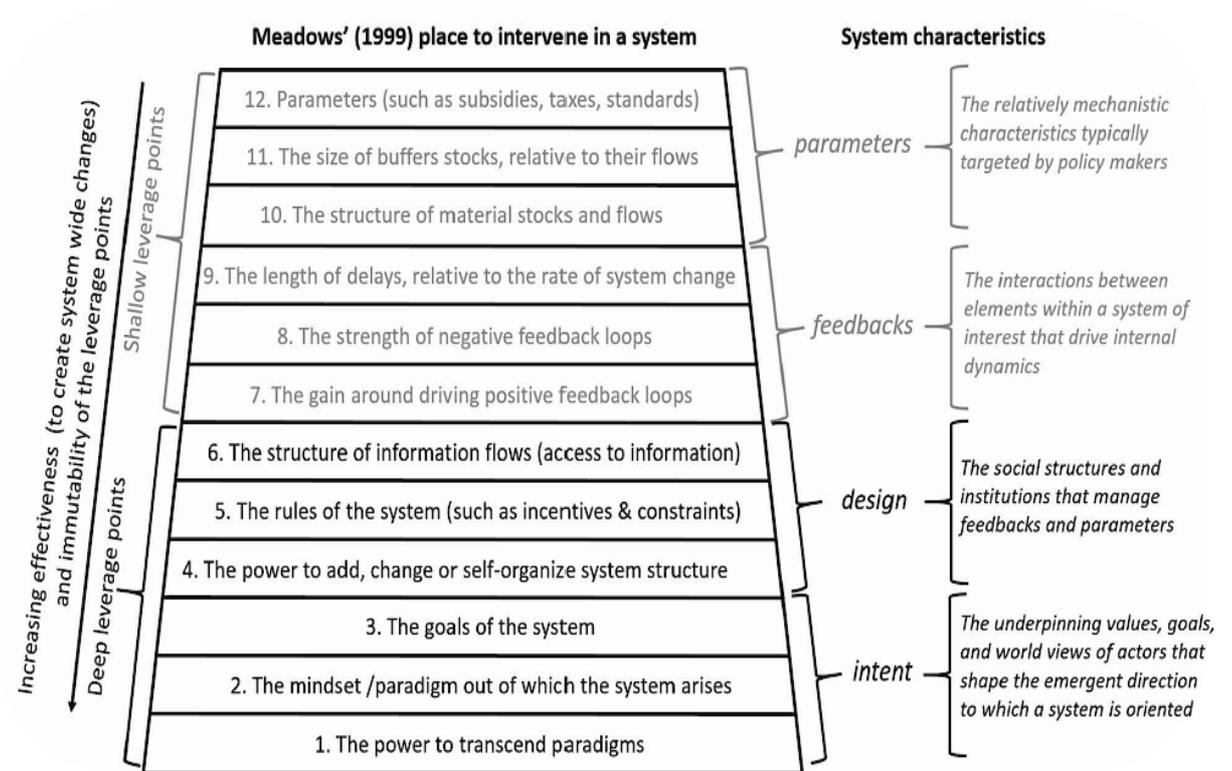
Considering that transformations are profoundly *uncertain, open, non-linear, highly unpredictable and complex processes* (European Environment Agency, 2019); a notable tension emerges when intending to direct transformations towards desired sustainable paths (Frantzeskaki, N., Loorbach, D. and Meadowcroft, J., 2012). By recognizing the highly variable, contingent, and conjunctural nature of sustainability outcomes (Scoones, I., 2016), DIS does not aim to delineate any central pre-defined sustainable technological path, but rather, to serve as a process-based, reflexive learning approach to achieve all three dimensions of sustainability through “*plural pathways*”.

DIS aims to operationalise the integration of directionality in IS framework through heuristic and practical tools that enable the formulation of DIS normative objectives, while allowing for the integration of qualitative difference in social and institutional contexts.

The “*leverage points perspective on sustainability*” (Meadows, 1999; Abson et al., 2017) for example, provides with a list of potential system interventions, which can lead to significant transformations. According to Meadow (1999), system interventions (ranging from superficial, to deep) can focus on: 1) *parameters* (shallow interventions that are generally used by policy makers, (e.g. prices of carbon and REDD+); 2) *feedback* (interventions that address the dynamics and interactions between the elements within a system); 3) *design* (interventions that focus on the social structure, and the institutions that manage feedbacks and parameters); and 4) *intentions* (deeper interventions that address the values and world views of actors, which subsequently determines the direction of the system. Intentions are much harder to change, but will bring about more fundamental transformations, and will also stimulate changes at all of the shallower leverage points) (Leventon, J. et al., 2020).

Figure 11.

From twelve leverage points to four system characteristics



Note: This figure presents the four system characteristics (namely parameters, feedbacks, design and intent) that group Meadow’s twelve leverage points. Reprinted from “*Leverage points for sustainability transformation*” by Abson et al., 2016, p. 3

Although valuable, the use of deep leverage points does have some limitations. First, engaging with deep leverage points - such as goals and system intent - can prove difficult due to path dependencies in the system, meaning that the structure reinforces the goals and values incorporated within it (Leventon, J. et al., 2020). Thus, the use of deep leverage points for influencing goal orientation of IS is reliant upon shocks and disruptive events that create windows of opportunity for actors to influence the goals incorporated into IS.

Secondly, the design of system interventions is consistent with top-down approaches, in that the goals of the system are designed by powerful state actors. While it is true that the SDGs help to guide national policy goals, the method of achieving these goals is not so clear-cut, as there is no *one right* path, but a *variety* of pathways for the transformation towards sustainability (Scoones, I; et al., 2020).

Therefore, although essential, the use of leverage points alone may prove to be insufficient for generating paradigmatic change across all different institutional settings. Moreover, the specific implementation of leverage points in the informal and insecure contexts of developing countries may pose challenges, due to the insubstantial role of formal institutions, and the conflicting interests, values, norms, and expectations of IS actors with regard to global SDGs (Schaile, M. et. al., 2017).

The formulation of IS normative goals should involve a deep appreciation of (local) norms, values and politics, as well as the active reflection of micro-level relations and practices (Ramalingam, B., 2013). Complementing top-down with bottom-up approaches to sustainability transformations is key to safeguarding the legitimacy of IS normative objectives, and ensures that the DIS approach is suitable for the analysis of innovation-led transitions in any institutional and social context.

This thesis integrates directionality in DIS by building upon the extensions made to Sen's capability approach (CA) for its applicability to innovation studies (Johnson et al., 2003; Lundvall, 2007; Kara and Pamukçu, 2011; Capriati, 2013; and recently Bajmócy and Gébert, 2014; and Pelenc, Bazile, and Ceruti, 2015). The '*agency perspective*', and specifically '*the choice mechanism*' incorporated into Sen's CA brings

forward useful tools to understand goal formulation, and thus, enables the integration of directionality in DIS framework.

The agency perspective refers to the ability of people to define and pursue their own goals (directions), and bring about change in their own lives. The ability of an individual to achieve their own goals in accordance with their values, and in their own context, inherently stems from that person's capabilities. A capability refers to a person's freedom to do and be whom she/he wants to be within a given opportunity space (Robeyns, I., 2005).

CA's choice mechanism is a central element of DIS directionality analysis. Unlike the representative agent of neoclassical economics (Hartmann, D., 2009), whereby one general rule of behaviour is assumed (*optimisation*), the CA integrates the "*real choice*" option of agents (Arocena and Sutz, 2001, Johnson, Edquist, and Lundvall, 2003; as cited in Kara, O; and Pamukçu, T., 2011). Sen's choice mechanism is based on the differentiation between capabilities and functionings, with the second latter referring to the "*effective or real achievement*" of opportunities.

As capabilities are not actual achievements (functionings), *choice* is an essential mechanism for the achievement of people's freedoms/opportunities. The choice mechanism advanced by Sen refers to the '*freedom*' a person has to '*choose to do X*,' and '*do X*' (Sen, A., 1988, p. 18). For example, a person may have the capability to avoid being hungry, but may *choose* to fast (Clark, A., 2005).

Although Sen's '*choice mechanism*' and '*the agency perspective*' establish useful tools for the understanding of goal formulation, the CA approach remains "*too individualistic*," as it focuses on the study of individual agency (Stewart, F., 2005). In this sense, some shortcomings may arise in the event of the concepts being used to explain the definition of socially desired goals in DIS, and their direction towards a specific end (*DIS directionality*).

Given the limitations of the individual agency concept, some scholars have advanced the notion of '*collective agency*' to understand system level goal formulation (Ibrahim 2008; Tiwari and Ibrahim 2012; Pelenc, Bazile, and Ceruti 2015). Collective agency is

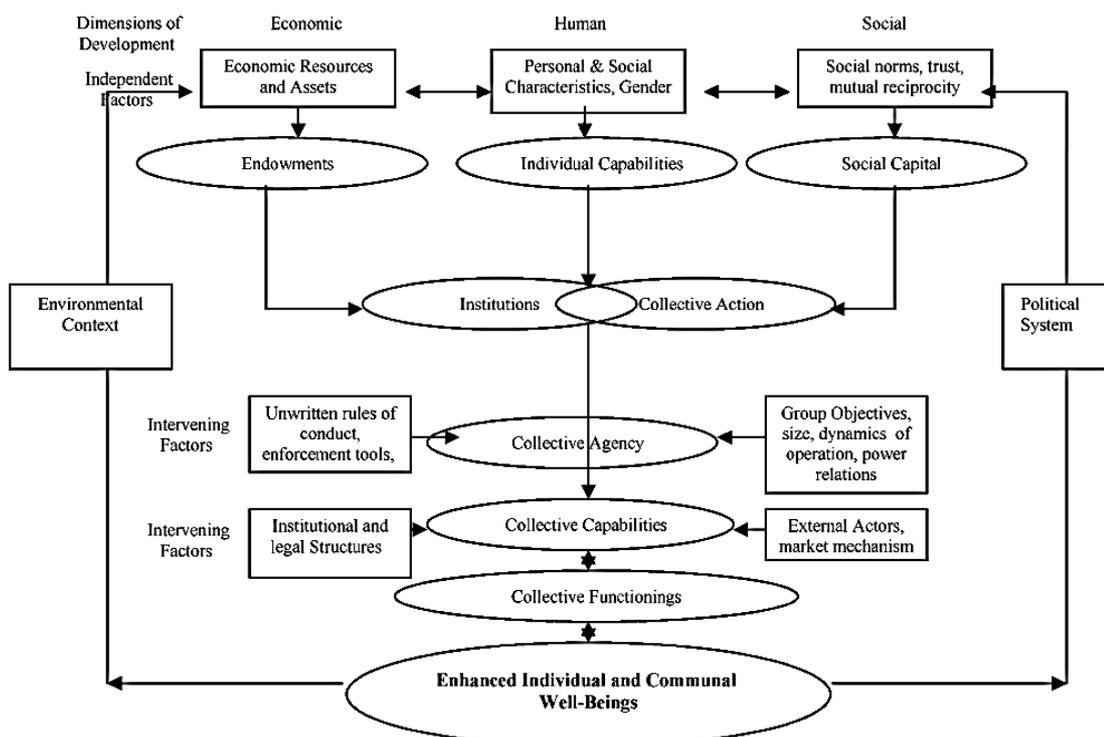
defined “as the capacity of the group to define common goals and the freedom to act to reach the chosen goals” (Pelenc, Bazile, and Ceruti 2015, p. 229).

Collective agency transcends an individual’s self-interested well-being, in that a group of individuals have the ability to pursue other-regarding goals and improve the living conditions of their societies (Ibrahim, 2008; 2017). According to Evans (2002), people act to benefit their community not because of individual values (e.g. sympathy, generosity, responsibility, etc.) (Sen, 2009; Ibrahim, 2006; and Ballet et al., 2007), but because of the perception of an individual as to what is valued as good by their community and associated social structures. In other words, it is a community’s appreciation of individual values that allows for collective agency.

Along with social norms, trust, and reciprocal communal relations (*social capital*), individual capabilities and economic resources (*endowments*), represent the main factors that define a group’s capacity to engage in acts of collective agency (See Figure 12). When a group exercises collective agency, it gains what Ibrahim (2006) calls ‘*collective capabilities*.’

Figure 12.

Developing an analytical framework for collective capabilities



Note: This figure illustrates an analytical framework for the analysis of the economic, human and social factors affecting the process of collective capability expansion. Reprinted from “*From Individual to Collective Capabilities: The Capability Approach as a Conceptual Framework for Self-help*” in Journal of Human Development and Capabilities, by Ibrahim, 2006, p.410.

Collective capabilities are defined as “*the newly generated capabilities attained by virtue of their (individual) engagement in a collective action or their membership in a social network that helps them to achieve the lives they value*” (Ibrahim, S., 2006, p. 404). These capabilities are not equal to the sum or average of individual capabilities, but are completely new capabilities (Comim, F.; Kuklys, W., 2002; von Tunzelmann et al., 2010; Kara, O; and Pamukçu, T., 2011).

Rosignoli (2018) distinguishes two types of collective capabilities: (i) ‘*resistant capability*’, an instrument of empowerment due to its strengthening of the ability of a group (e.g. associations, religious groups, community councils, youth groups, etc.) to confront what they see as major injustices (e.g. discrimination, climate change impacts, misery, violence, lack of social mobilisation, inequality, etc.); and (ii) ‘*resilient capability*’, or a means of adaptation to adversity that refers to a groups’ ability to build collective and constructive reactions to injustices (Rosignoli, F., 2018).

Building upon the ideas of Ibrahim, (2008; 2011; 2017) and Rosignoli (2018), goal formulation in DIS (*directionality*) can be described as a process through which system actors engage in collective innovation actions to address major wicked problems or challenges that directly harm the network of actors (group, community, etc.), leading to the convergence of an individuals’ values, norms, interests, and ultimately, a sense of responsibility towards IS sustainability goals. Consequently, innovation processes result in the creation of collective resilient and resistant capabilities.

3.1.2 DIS Legitimacy Dimension

In this section, it is argued that “legitimacy” is key to counteract any resistance to sustainability transformations generated by the inertia of established power relations, network structures, and free-riders of the oil-based paradigm (Pyka, A., 2017a). The

creation of legitimacy in sustainability transformations allows for the addressing of issues “*along the lines of “why” an IS should have a particular transformation goal? and “who” decides or determines the respective direction or pathway?*” (Schaile, M. et. al., 2017, p. 6).

Considering that the creation of legitimacy in sustainability transformations can be neither managed, nor controlled (due to system transformations being profoundly uncertain, open, non-linear, highly unpredictable, and complex processes), legitimacy in DIS relies on the development of collective agency. However, collective agency, cannot arise automatically, nor can it be imposed. Rather, it results from interactive learning processes (e.g. public debates and social dialogue) that either lead to the *convergence* of individuals' values, interests, motivations, and sense of responsibility, or to differences (*divergence*) between the individuals (Cleaver, F., 1999).

DIS uses ‘*inclusive innovation theories*’ for the study of legitimacy issues, and for broad participation and collaboration among system actors (Borras and Edler 2014; Kuhlmann and Rip 2018; Schot and Steinmueller 2018). The literature on inclusive innovation comprises the work of various scholars (Chataway et al. (2013), Cozzens and Sutz (2014), Foster and Heeks (2013), Papaioannou (2014), Sengupta (2016), and Lundvall et al. (2009)) to analyse the *participation and collective action of low-income actors in innovation processes; and how to strengthen institutions and support more inclusive innovation processes directed towards the poor.*

According to inclusive innovation approaches, a crucial element of generating legitimacy in sustainability transformations is the inclusion of local actors in innovation processes. The consideration of the perceptions and values of local people in DIS processes ensures that local actors become active agents in social change processes by fostering learning activities (e.g. public discussion and social interactions) that support the choice and design of those innovation paths that reflect socially-desirable results for the community.

The inclusion of multiple actors in DIS processes expands the criteria that determines the endorsement or rejection of different versions of sustainability, based on the specific elements valued by different actors, and/or the particular systemic goals pursued (Leach

et al., 2010; Ramos-Mejía, Franco-Garcia & Jauregui-Beckerb, 2018). By addressing the crucial need for integrating “diverse knowledges” in DIS framework, sustainability transformations are not homogenised into one view of development driven by technology and science (Wright, E. et al., 2018) (Scoones, I., 2016), but enlarge to include different worldviews, belief systems, and knowledge bases. In summation, inclusion has the ability to shape the quality of change for sustainability transformations, and the impact of the processes that unfold in numerous ways.

For example, sustainability transformations based uniquely on resource efficiency principles might result in energy savings and GHGs reductions, but may not tackle socio-economic inequalities and inclusion (Swilling, M. and Annecke, E., 2012). By contrast, innovations based on the values of inclusion and solidarity might reduce ecological impacts, while generating employment and reducing health impacts (Seyfang and Longhurst, 2013; Seyfang and Smith, 2007).

DIS engagement with issues of legitimacy is based on the '*Ladder of Inclusive Innovation*' (Heeks, R., Foster, C. and Nugroho, Y., 2014), which sees six levels of inclusion of an innovation proposed (see Figure 13).

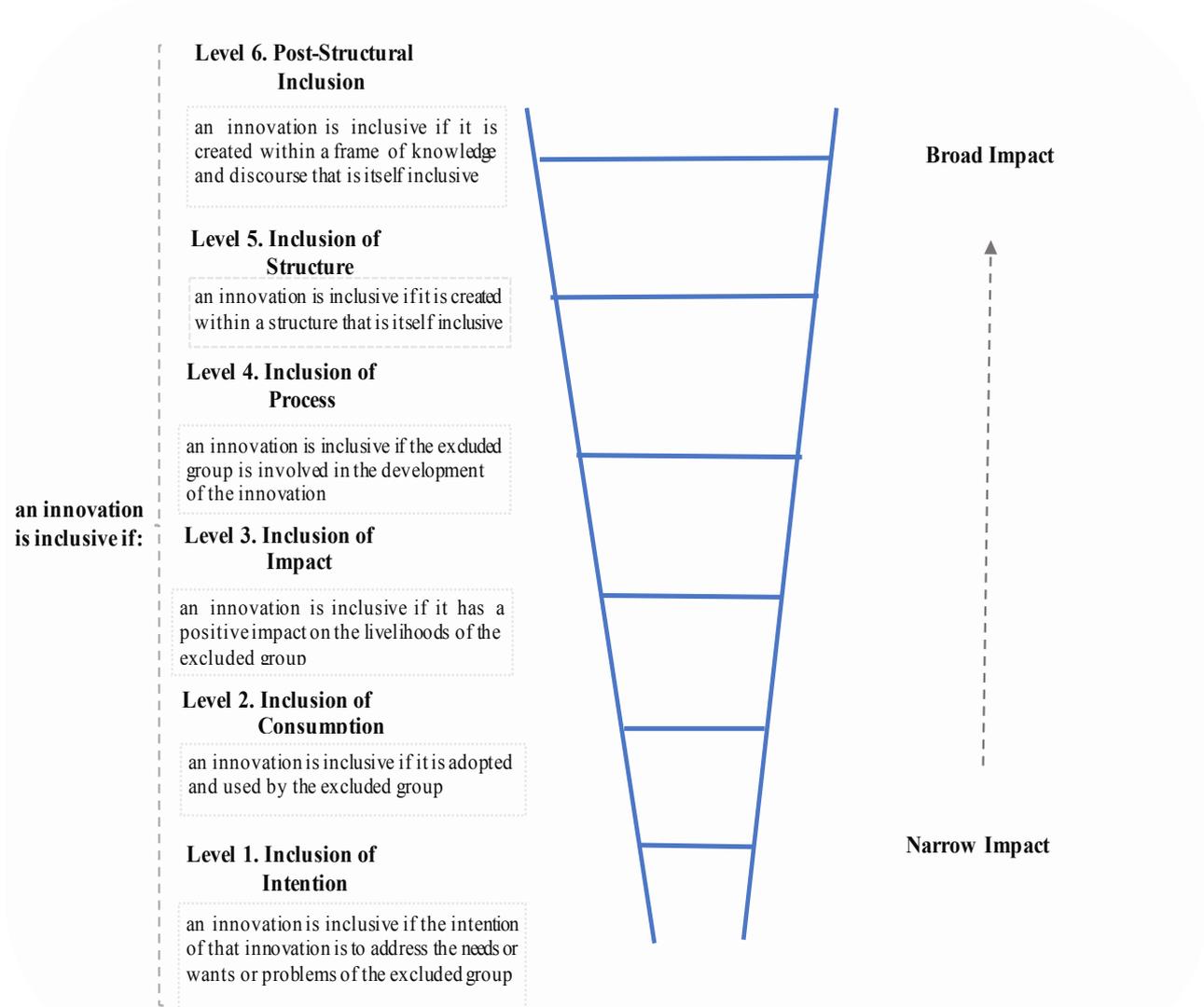
Level one refers to an innovation that has the *intention* of addressing the needs of the marginalised; *level two* implies that the innovation is *consumed* by the low income population; *level three* is achieved when there is a favourable *impact* on the incomes of the poor; *level four* implies that the poor is involved in the *processes* for innovation; *level five* refers to *structures* that are themselves inclusive, and allow for innovations; and finally, *level six* is the broadest level in that it goes beyond structures (*post-structure*) and refers to an innovation created within an inclusive knowledge framework (Heeks, R., Foster, C. and Nugroho, Y., 2014).

Level four of inclusion - particularly the so-called *interactive learning spaces* (Arocena, R., & Sutz, J., 2012) – has received increased attention from academics, who have described them as real mechanisms to promote the inclusion of the poor in innovation processes. (e.g. Ayuso, Ángel Rodríguez, García - Castro and Ángel Ariño, 2011; De Chiara, 2017; Jorna, 2017; as cited in Falcone et al., 2019). These spaces are presented

as innovation platforms that stimulate the participation and interaction of different actors, subsequently strengthening their learning capabilities (Harman, A., 2017).

Figure 13.

Ladder of Inclusive Innovation



Note: This figure uses a ladder to illustrate the increase in the marginalised being included in innovation processes. Reprinted from “*New models of inclusive innovation for development*”, in *Innovation and Development* 4(2):175-185, by Heeks et al., 2014, p. 4.

Some scholars have pointed out the shortcomings in promoting Level four of inclusion. For example, one critic highlights that “involving”, “inviting”, or “getting the excluded around a table” does not necessarily lead to their “empowerment” (Cornwall, A., 2002). A second critic signals that these interactive learning spaces often represent

substructures within much broader power structures, meaning that these power structures will keep replicating themselves without generating inclusion (Heeks, R., Foster, C. and Nugroho, Y., 2014).

A wider notion of inclusion refers to the generation of meaningful participatory opportunities for the poor, which are enabled by frames of knowledge that are inclusive in themselves (Level 6). Rather than merely “managing interventions” of the poor (Cornwall, A., 2002), these spaces allow for multiple and diverse sources of knowledge to interact, so that the marginalised segments of a population are given a voice in setting social priorities, defining problems, and finding solutions (Vogel, C., et al., 2007; Tengö, M, et al., 2014, Scoones, I; et al., 2020).

DIS seeks to promote inclusion across all levels of the ladder through the development of collective agency. Through post-structural inclusion in particular, all DIS actors jointly define the directions and pathways for *DIS* to reach its sustainability and transformational goals, regardless of individual values, aspirations, interests, and knowledges.

3.1.3 DIS Responsibility Dimension

Responsibility in DIS essentially explores (i) “*by whom*” is *dedication* in innovation systems introduced; and (ii) “*for whom*” is the transformation of DIS intended (Schaile, M. and Urmetzer, S., 2019). These questions are examined through “*enabling approaches*” that allow for analysing the “agency” involved in directing DIS towards sustainability.

Enabling thinking brings two complementary lenses together —the structural, and system traditions (See Table 3). It integrates valuable insights from structural approaches on the underlying architecture of politics, economy and society, and builds on system thinking tools to explore the interrelationships between multiple actors, institutions, and technologies, along with their complex, non-linear, and uncertain dynamics (Scoones, I; et al., 2020).

Contrary to structural thinking, the enabling approach focus less on the definition of specific system configurations, and differs from system approaches in that it does not attempt to manage IS dynamics. Another difference between enabling and system thinking is the integration of quality lenses for the study of sustainability transformations in the context of developing countries. As systems thinking emerged from the study of technological transformations in developed countries, system approaches tend to tacitly endorse Western values and assume “*deliberative democracy, pre-existing capacities for collective action, and general support for change that will result in enhanced equity, environmental integrity and improved public welfare*” (Shove, E.; and Walker, G.; 2007; as cited in Scoones, et al., 2020, p. 67). Enabling approaches re-evaluate these assumptions, and examine how the unique settings of democratic practice, cultures, and knowledges might lead to unlocking transformations towards sustainability in developing contexts.

Table 3.
Comparison of structural, systemic and enabling approaches

Approach	Definition/emphasis	Pros	Cons	Example
Structural	Major changes in how societies produce and consume	Analysis of economic and political structures that support current models	Does not integrate the study of individual agency	Global mobilisation on climate change
Systemic	Changes to the relationships between actors, institutions, and technologies to influence IS normative goals	Analysis of the complex dynamics across the system	Limited study of individual agency and contextual differences (capacities, governance structure and politics)	Technology-led transformations to low carbon economies

Enabling	Promotes “ <i>individual agency</i> ” and the development of <i>collective capabilities</i> to influence DIS normative goals towards sustainable pathways	Integrates the role of individual agency and collective action, and local contexts	Disregards structural and political barriers to sustainability transformation; Burdens vulnerable groups with an active role in sustainability transformations	Community-led environmental action; grassroots innovation for sustainable local development
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Note: This table presents the main focuses of structural, systemic and enabling approaches, as well as their limits and positive features. Reprinted from “*Transformations to sustainability: combining structural, systemic and enabling approaches*” by Scoones et al 2020, p. 68

As highlighted in the above table, a central element of enabling approaches is the analysis of the “individual agency”. In the next section, the concept of dedicated actors (DAs) is presented as a contribution to the study of individual agency, and its role in influencing DIS normative goals is explored.

3.2 Dedicated Actors (DAs)

The concept of dedicated actors (DAs) builds upon enabling approaches to foster the idea of actors “responsible” for the introduction of “dedicated” efforts towards sustainability through networked interventions in a DIS.

The concept of “*sustainability-driven entrepreneurship*” relates to the notion of DAs, in that it introduces these *dedicated* efforts via the entrepreneurial activity of stakeholders (Schaile, M., Urmetzer, S. Ehrenberger, M. et al., 2020), thereby leading to profound systemic change as the system is innovated from within itself (Disterheft, A., Mindt, L. and Rieckmann, M., 2017).

The scientific literature distinguishes different categories of sustainability-oriented entrepreneurship, such as *social entrepreneurship*, *ecopreneurship*, *sustainable entrepreneurship*, *institutional entrepreneurship*, and lastly, *system entrepreneurship*. The concepts vary in terms of the main goals and motivations behind entrepreneurial activity (Schaltegger, S. and Wagner, M., 2011). While either *ecopreneurship* or *social entrepreneurship* focuses on solving environmental issues or achieving social impact, *sustainable entrepreneurship* promotes these goals as a means to generate successful businesses (Schaltegger, S. and Wagner, M., 2011), p. 224). *Institutional entrepreneurship*, in turn, focuses on the role that actors play in transforming institutions (e.g., Battilana et al. 2014; Westley et al. 2013), while in *system entrepreneurship*, actors change the entire architecture of the system (WEF, 2017) including the interconnections, functions, and elements (Schaile, M., Urmetzer, S. Ehrenberger, M. et al., 2020), in order to put forward a particular social issue (Balfour, D., 2017).

The concept of DAs is closely related to system entrepreneurship in that it refers to actors enabling systemic change. However, there are major differences between the concepts. First, the notion of DAs does not (exclusively) refer to entrepreneurs as charismatic leaders responsible for driving commitment to sustainability. The DAs concept builds on the insights from “*polycentric environmental governance*” theories that study how “*multiple actors at multiple levels take responsibility for initiating, implementing, and enabling sustainability and resilience solutions at the system level*” (Carlisle and Gruby, 2017; Pattberg and Widerberg, 2016; Steffen et al., 2018; as cited in Morrison et al., 2019). DAs are then conceptualised as a system of actors, rather than individual entrepreneurs, that promote a dedication to sustainability in the form of networked citizen-led, state-led, technology-led, and market-led processes (Scoones, I., 2016) that result in the creation of collective capabilities. Thus, DAs can involve ‘grassroots’ actors, but can also consist of different government actors, universities or enterprises (Pel, B. et al., 2020).

Second, the use of the concept of “*entrepreneur*” can be misleading, as many authors refer to the concept as being unique to the private sector. For example, Hekkert et al. (2007) define *entrepreneurs* as “*those actors of an IS that turn the potential of new knowledge, networks, and markets into concrete actions to generate—and take advantage of—new business opportunities*” (p 421). Thus, the concept of entrepreneurs

involves exploiting *new business opportunities* (Schaile, M., Urmutzer, S. Ehrenberger, M. et al., 2020), which restricts the definition of entrepreneurs to the private sector, and thus cannot link it to the broader notion of DAs.

Finally, the DAs concept may appear problematic from an embedded agency perspective, where an agency is “*inescapably qualified and constrained by the social, political, and economic opportunities available*” (Sen, A., 1999, pp. xi-xii). According to this perspective, agents are embedded in social structures that determine, in significant and often unconscious ways, how actors behave, think, and act (Maier, F. and Simsa, R., 2020). Therefore, from this view, DAs may be unable to foster systemic change, due to their own conditioning to the same social structures (regulations, norms and beliefs) that they wish to change (“*paradox of embedded agency*”) (Seo, M. and Douglas, W., 2002).

DAs are not entirely conditioned to their institutional framework, however, as the DAs concept refers to actors who have had some exposure to institutional spheres that contrast their established beliefs (Creed, DeJordy, & Lok, 2010; Dorado & Ventresca, 2013; Seo & Creed, 2002). To that end, DAs are those actors that have gained an articulate awareness, and the reflexive notion as to how institutions are at present, and how they should be in the future (Nilsson, W., 2015). In this sense, DAs are able to identify opportunities for institutional and systemic change (Sudabby, R., Viale, Thierry, and Gendron, Y., 2016).

Moreover, thanks to their embeddedness in local institutions, DAs are often able to circumvent existent beliefs, and stretch societal norms in acceptable ways (Castellanza, L., 2019). DAs have the capacity to creatively recombine resources to generate value (Baker & Nelson, 2005; Mair & Marti, 2009) by exploiting their pre-existing skills and knowledge (Garud et al., 2007; Khan, Munir, & Willmott, 2007) in response to environmental contingencies favourable to change (Dorado, 2005; Zietsma & Lawrence, 2010).

In the next section, the specific characteristics of different types of DAs are explored; mainly “dedicated state actors (DSAs)” and “dedicated grassroots actors (DGAs)”,

which are aligned to the typologies presented in “*polycentric environmental governance*” approaches (Morrison, T. et al., 2019).

3.2.1 Different types of DAs: Dedicated state actors (DSAs) and Dedicated grassroots actors (DGAs)

DAs are classified according to the levels of ‘*authority*’ that they might possess to influence DIS goals towards sustainability. The level of authority is determined by a combination of power (economic resources) and legitimacy (trust and support of the local community) (Weber, M., 1922), which together determine the role of DAs in DIS (see Table 4). While *powerful* agents might possess sufficient economic resources to mobilise their views, DAs can only alter institutions in their community depending on their ability to garner the trust and support of the local community (*legitimacy*) (Khan, F., Munir, K. and Willmott, H., 2007).

Dedicated State Actors (DSAs) are top-down actors that have the *power to design* institutional reforms, rules, and policy instruments to introduce a commitment to sustainability in DIS. *Dedicated Grassroots Actors* (DGAs) are actors vested with *pragmatic power*— that is, the power to exert formal and informal rules on a day-to-day basis — along with “*practical authority*” among local actors (Morrison, T. et al., 2019).

Table 4.

Different types of Dedicated Actors (DAs) by level of authority

Type of DAs	Level of Authority (power and legitimacy) by DA
<p>Dedicated State actors (DSAs)</p>	<ul style="list-style-type: none"> - <i>Power by design:</i> written, legislated, and visible power to legislate and create policy instruments (taxes, incentives, etc. and norms (Jordan, A. et al., 2013) - <i>Legitimacy:</i> formal legitimate authority
<p>Dedicated Grassroots actors (DGAs)</p>	<ul style="list-style-type: none"> - <i>Pragmatic power:</i> discretion—or the application of formal and informal rules on a daily basis. Pragmatic power is <i>less visible</i> than power by design. - <i>Legitimacy:</i> local validation of DA’s <i>capabilities</i>

Note: This table describes two types of DAs, based on the power categories proposed by Morrison, 2019, in “The black box of power in polycentric environmental governance” published in Global Environmental Change.

Under the “*polycentric environmental governance*” perspective, individual actors or approaches -*regardless of whether they are top down or bottom up* – cannot successfully foster transformative systemic changes towards sustainability (Morrison, T. et al., 2019), as *enabling dedication* to sustainability in an IS requires commitments and negotiations at various levels and subsystems (Schaile, M. et. al., 2017).

Although *DSAs* may have the power to design legislation and influence *top-down* institutional reforms towards sustainability, the effectiveness of these policy reforms to foster sustainability transformations is contested as they tend to focus on shallow *leverage points*. Whereas these policy measures generate positive results and are easy to implement (*e.g.* setting carbon prices, green taxes, increasing the number of protected areas, and others), they are unlikely to lead to transformative change alone (Abson, D. et al, 2016).

For *DSAs* to engage in deep leverage points for sustainability transformations (*e.g.* DIS goal formulation), they would need to seize *shocks* and disruptive events. For instance, Covid-19 is an example of a punctuation in our equilibrium: a ‘breakout’ from our established routines (Leventon, J. et al., 2020) that can create a window of opportunity for *DSAs* to influence the sustainability goals that are incorporated into the policy agenda.

Without this external shock, real transformative changes in DIS will most likely need to start at the grassroots level (Mackinac Center for Public Policy, 2019). *Dedicated grassroots actors* (*DGAs*) are thus key agents in triggering such *bottom-up* processes for sustainability transformations. Due to their embedding in local institutions, *DGAs* possess the legitimacy and pragmatic power to foster (either directly or indirectly) systemic change through endogenous processes.

In informal and insecure institutional settings where individual agency tends to be repressed, *DGAs* can play an essential role in influencing the formation of the collective

capabilities at the grassroots level, from which all actors in the community can benefit—regardless of the equality of degree. (Ibrahim, S. , 2017). In this sense, Ibrahim’s 3C model can be a practical framework in the study of how DGAs foster three key processes that lead to transformative change at the grassroots, namely:

(1) *Conscientisation*, which involves the role of DGAs in developing the capacity of local actors to critically assess their present reality. and to aspire to better living conditions. DGAs accelerate the internalised need for change by helping individuals reflect on their current living conditions, and by broadening their scope of possibilities.

Individuals from deprived communities are particularly predisposed to adjusting their “aspirations to (what they perceive as) feasible possibilities” (Elster, J., 1982, p. 219). DGAs can expand the “capacity to aspire” of these individuals through the facilitation of dialogues and discussions that create awareness of the feasibility of broader aspirations (Rowlands, J., 1997, p. 24).

(2) *Conciliation* refers to how DGAs influence processes that establish a common vision among community members that ultimately leads to collective agency. DGAs help to reconcile individual and communal goals towards sustainability by linking sustainability goals to the problems directly affecting local people in informal and insecure settings (e.g. unemployment, violence, social security, inequality, social exclusion, human rights, working conditions, and others) (Colantonio, A. and Lane, G., 2007)). DGAs rely on public deliberation and inclusive innovation process to generate the collective endorsement of socially desirable outcomes and sustainability goals.

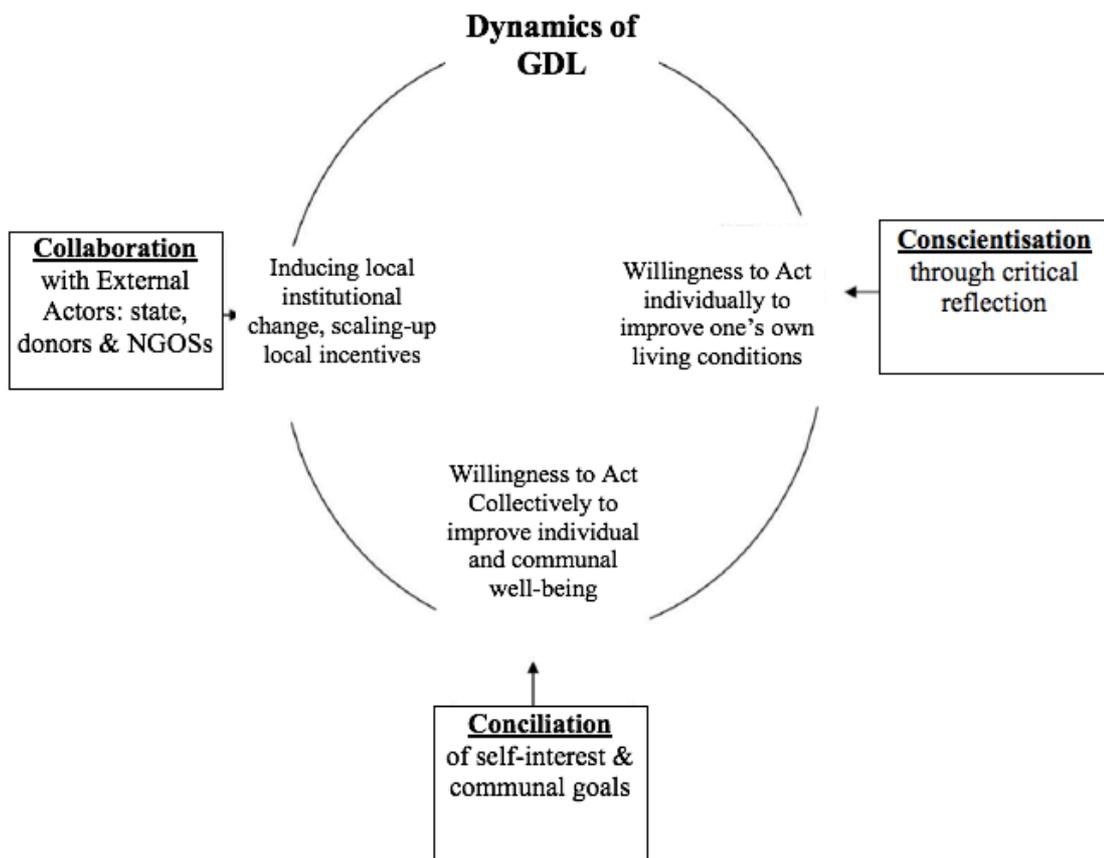
(3) *Collaboration*, which covers the role of DGAs as alliance-building actors responsible for making strong connections with both local actors and formal governance structures. Doing so links the individual micro-level action to broader changes in macro-institutional configurations (Cozens, S., and Sutz, J., 2014), meaning that although DGAs act as closely as possible to the local actors requiring influences on their behaviour, they also strive to incorporate their actions into larger systems through partnerships with broadened system actors (e.g. state actors, local NGOs and even donor agencies) (Cozens, S., and Sutz, J., 2014). These partnerships allow DGAs to challenge existing unequal power relations at the local level (Ibrahim, S. , 2017), while

simultaneously ensuring the sustainability, scalability, and success of transformative change.

Through the 3C model, DGAs induce transformative change across three different levels: the individual level (conscientisation of local actors), community level (conciliation of a common vision); and the institutional level (collaboration among broader DIS actors) (See Figure 14).

Figure 14.

The 3C-Model for Grassroots-Led Development (GLD)



Note: This figure illustrates how GDAs can induce conscientisation, conciliation and collaboration processes. Reprinted from "How to Build Collective Capabilities: The 3C-Model for Grassroots-Led Development" in Journal of Human Development and Capabilities by Ibrahim, 2017, p. 199

This chapter has explored the main dimensions of Dedicated Innovation Systems (DIS) framework, mainly goal-orientation (*directionality*), the endorsement of this goal (*legitimacy*), and actors with the authority to engage in DIS transformations (*responsibility*). Particular attention has been given to the study of the roles of Dedicated Grassroots Actors (DGAs) in inducing transformative change towards sustainability at the local level.

Before delving into the practical application of the aforementioned DIS conceptual frames and notions, the following chapter covers the methodology and research design employed for conducting this exercise. The chapter starts by stating the research purpose and questions; it continues with a detailed exploration of the use of case studies as the most appropriate method to answer the research questions. It then covers some relevant methods applied in the selection of case studies, the subsequent data collection, and analysis. Finally, some methodological limitations and challenges are presented.

4. Methodology and research design

The writing of a thesis requires a deep contemplation of the methodological approach most suitable to the purpose of the research. Beyond considering methods that are frequently used in similar research areas or disciplines, the selection should be defined by the research question(s) to be addressed in the study, as well as the contexts or realities (social, geographical, cultural, historical, etc.) that define the object of study.

This chapter describes the methodology and methods selected for this thesis. First, the chapter presents the purpose and questions addressed in this research. Section two then gives an overview of the ontological, epistemological, and methodological considerations, while section three outlines the characteristics of *flexible research design* methodologies. Section four covers case study design methods (case selection, and the data collection methods employed including interviews, participant observations, and documentary evidence) and data analysis. This chapter concludes with an account of the methodological challenges of the research, as well as the strategies used to address these limitations.

4.1 Research purpose and research questions

Defining the *purpose* of this research has been a crucial step for the initial selection of the methodology deemed to best support the investigations. The general rule proposed by Robson and McCartan (2016) has been applied as a guide for choosing among the three possible research purposes that are generically recognised (*explore, describe, and explain*). The rule suggests that when the research purpose is to describe or explain a phenomenon, *fixed research designs* are more appropriate; for work with exploratory purposes in which relatively under-studied areas are analysed, *flexible research designs* are considered more appropriate.

In this thesis, the terms "*fixed design*" and "*flexible design*" are preferred over the more commonly-used "*quantitative design*" and "*qualitative design*". Although many texts use the terms interchangeably —referring to fixed designs as quantitative methods, and flexible as qualitative methods— a realistic study does not always allow for such a strict division. While fixed designs often rely on the use of quantitative and numerical data and flexible designs on qualitative data, there is no rigorous rule that limits the use of certain quantitative data in flexible designs. In practice, many flexible real-world designs involve the use of two or more data collection methods, and it is common to use some small amounts of quantitative data. Similarly, while fixed design methods focus on the collection of quantitative data, in practice, some qualitative data is also collected (Robson, C. and McCartan, K., 2016).

As this research has an exploratory purpose, it follows flexible research designs guidelines; being grounded in post-positivism (logical empiricism), and aiming to investigate the practical application of DIS in social interactions in the informal and insecure local contexts of Michoacán, Mexico. In this sense, the research seeks to contribute to the understanding of innovation trajectories that lead to transformative change towards sustainability at the local level.

Further to the definition of a research purpose, the formulation of research questions informs the selection of a research design methodology. One prevalent method used in social sciences to formulate specific research questions is that proposed by Aleson and Sandberg (2013), which is based on "*detecting gaps*" in the literature; that is, "*poorly*

addressed areas that inspire particular research questions" (p. 24). Some of the types of gaps that can be detected refer to: a) *confusion detection* (where there are competing explanations of a phenomenon), b) *negligence detection* (an area that is overlooked; has had limited research conducted, or lacks empirical support; the lack of a specific aspect), and c) *detection of lack of application* (expanding and complementing the existing literature) (Alvesson, M. and Sandberg, J., 2013).

Although detecting gaps is a helpful approach to refine the scope of a research question, other authors, such as Kilduff (2006), suggest that engaging with real world problems inherently leads to the definition of concrete research questions.

This thesis explores real world problems, and engages with the general research question as to *how DAs introduce a dedication to sustainability in DIS in informal and insecure settings in Michoacán, Mexico*. It then addresses the following specific questions: (a) *what are the characteristics of DAs that allow them to direct IS towards sustainable outcomes in informal and insecure institutional settings in Michoacán, Mexico?* (b) *what is the role of DAs in building collective capabilities in informal and insecure institutional settings in Michoacán, Mexico?* and (c) *what local capabilities result from DIS in informal and insecure institutional settings in Michoacán, Mexico?*

Linking research questions to a specific research method is not a straightforward process. In general, those questions beginning with "*How many?*" or "*How much?*" or "*Who?*" or "*Where?*" are often linked to a *non-experimental fixed strategy*; while questions referring to "*What?*" "*How?*" and "*Why?*" are commonly addressed through a *flexible design study* (Robson, C. and McCartan, K., 2016). In the case of this thesis, flexible design methods were found to be most suited to address the research questions.

Although the act of defining the research purpose and questions proves to be a good starting point for selecting a methodological approach, an underlying element worthy of consideration for the appropriate and meaningful interpretation of the research is the definition of the *philosophical standpoint* that frames the research, and determines the methodological choices (Moon, K. & Blackman, D., 2017); in other words, the methodological approach of this thesis results from both the author's philosophical standpoint (on ontology — what constitutes reality and the comprehension of existence,

and epistemology — that which constitutes valid knowledge and its dissemination), and the tools and perspectives offered by flexible design methods to achieve the research purpose (Hesse-Biber, S., 2016).

The next section presents a significant reflection of the ontological, epistemological, and methodological considerations that framed this thesis.

4.2 Ontological, epistemological, and methodological considerations

The founding ontological and epistemological assumptions that influence research choices and methods can be classified a *grosso modo* in:

i) Positivism, which is grounded in ontological and epistemic realism, with the assumption that reality is “objective” (or independent of the individual’s perception of the world), and can be observed via statistical regularities (Wildemuth, B., 1993);

ii) Post-positivist, which is similar to positivism in that it assumes that reality is objective, but it also recognises the possible influences of the background knowledge, theories, and values in the observations made by a researcher, as well as the interpretation of the results of the research;

iii) Critical realism, which considers the objectivity of reality, but is also critical of our ability to know it with certainty; in other words, although the goal of research is to reflect reality, this goal is unattainable;

iv) Pragmatic constructivism, which is based on the epistemic assumption that each person constructs their own view of reality to guide their actions (*epistemic relativism*);

v) Interpretive research; which considers that there is no singularly objective reality, but rather, many realities that arise from the social constructions of phenomenon (Orlikowski and Baroudi, 1991; Sandberg, J, 2000) (See Table 5).

Table 5.*Alternative epistemological frameworks and founding assumptions*

	Post-positivism	Critical realism	Pragmatic constructivism	Interpretivism
<i>Ontological founding assumptions</i>	<i>Ontological realism:</i> Objective reality exists independently of our capacity to investigate it	<i>Ontological realism:</i> Objective reality exists independently of our capacity to investigate it	It does not deny an objective reality, but claims that it is beyond our experience	<i>Ontological relativism:</i> there is no singularly objective reality, but many realities resulting from social constructions
<i>Epistemic founding assumptions</i>	<i>Epistemic realism:</i> it is possible to obtain knowledge independently of one's mind	<i>Epistemic relativism:</i> knowledge is always relative to an epistemic system of reference.	<i>Epistemic relativism.</i> The intention of inquiry influences the inquirer's experience of the situation.	<i>Epistemic relativism:</i> knowledge is acquired only through social constructions.
<i>Goal of the knowledge generation process</i>	Identify regularities and patterns of observable events	Identify causal mechanisms responsible for the events and patterns of events observed	Build models for organising the world of experience	Understand how individuals interpret reality and engage in situations
<i>Status and shape of knowledge</i>	Knowledge corresponds to reality	Testable statements concerning causal mechanisms	Reasonable interpretations of an experience and leads to an action	Reasonable interpretations of an experience

Note: This table describes four epistemological frameworks and their key features. Reprinted from “*Finding one’s way around various methodological guidelines for doing rigorous case studies: A comparison of four epistemological frameworks*” by Avenier and Thomas (2017), p. 9-10

The research described in this thesis follows a post-positivist approach, as it retains the idea of objective truth (contrary to relativism) while considering both fixed and flexible design methods as valid approaches to identify regularities and patterns of observable events.

A post-positivist approach is most applicable to the purpose of this research as i) qualitative aspects of sustainability transformations are better investigated through multiple methods to facilitate the exploration of the in-depth explanations of social behaviour to foster responsible and social innovations at the community level; and ii) practical (context-dependent) knowledge is considered in this thesis to be of more valuable than general, theoretical (context-independent) knowledge.

In the next section, an overview of the flexible research design methodology is presented, followed by a description of case study methods as relevant tools for the endeavours of this research.

4.3 Overview of the flexible research design methodology

This thesis builds upon *flexible design methods* to support the search for “real” solutions to wicked DIS-related problems at a local level context. The considerations and adaptations proposed in this chapter for the use of flexible research methods in the study of regional IS problems have been inspired by the approach described by Robson & McCartan (2016) as “*real world research*”, which refers to research projects for which the social dimension is of paramount importance, and in which the phenomena of study tends to be fluid social constructions, rather than firm facts.

The priorities and emphasises of the real-world researcher differ in several ways from those of the traditional academic researcher. While the main interest of the academic is delegated to bringing new knowledge to an academic discipline, the objective of the real-world researcher is to solve social problems. Despite the different research focuses of these approaches, rather than being inconsistent in comparison to academic research, applied research is considered complementary; many problems studied as part of a real-world research approach (particularly global challenges such as climate and environmental change) involve the use of the so-called “natural sciences” (such as

physics, chemistry and biology) to better understand their causes and possible large-scale effects (Robson, C. and McCartan, K., 2016).

A long list of social problems can be studied under a real-world research approach, which are of direct relevance to the lives of people in society – a small and fairly random selection of which includes the study of social transitions towards sustainable lifestyles, the study of climate change impacts, security, migration, social inclusion, education, terrorism (Robson, C. and McCartan, K., 2016), and DIS processes at local levels.

Real-world research is largely dependent upon the use of case study methods to analyse contemporary phenomena in real-life contexts. As Eisenhardt (1989, p. 548) states, *'there are times when little is known about a phenomenon, current perspectives seem inadequate because they have little empirical substantiation, or they conflict with each other or common sense. ... in these situations, theory building from case study research is particularly appropriate because theory building from case studies does not rely on previous literature or prior empirical evidence'*

In this thesis, the practical application of DIS conceptual framework in the informal and insecure contexts of Michoacán, Mexico, has been analysed through case study methods that serve to generate new key insights on this topic, which has seen very limited study thus far.

The next section provides an overview of the case study methodology, as well as the selection methods and data collection processes that facilitated the development of the research.

4.4 Case study

A case study is a useful research strategy in the instance of a research topic being a vast and complex one, for which little theory exists (Dul, J. and Hak, T., 2008). Case studies allow the *research questions* of "How?" "What?" and "Why?" to be answered, and they are useful for the establishment of relevant theories derived from the observation of real practice (Meredith, J., 1998).

A case study strategy is often used for research that involves: (i) *early exploration*: when variables are still unknown, and the object of study is not fully understood); (ii) *theory development*, when theories or a hypothesis needs to be tested, enriched, or refined with more real-world insights (Dul & Hak, 2008; and Handfield and Melnyk,1998); (iii) *context specific*, which refers to particular social and geographical contexts that influence phenomena in different ways, and need to be analysed through various sources of evidence (Yin, R., 2003).

As flexible design strategies, case studies allow the researcher to adapt research methods to the realities and contexts studied, thus, they can better answer the research question(s) (Hyett, N., Kenny, A. and Dickson-Swift, V, 2014). This *flexibility* is often confused with *a lack of academic rigor*, leading to the misconception of case studies occasionally being considered an inferior research strategy, as opposed to “more rigorous” scientific methods. In response to this criticism, several authors have proposed an adjusted and structured methodological design, with defined research phases (see *Table 6*).

Table 6.

Different research phases in case study methodological design

Author	Yin (1984,1995)	Stake (1995)	Tellis (1997)	Merriam (1998)	Voss et al. (2002)	Dul and Hak (2008)
Research stages for case studies	<ul style="list-style-type: none"> - case study design; - case study development; - analysis of evidence from the case study; - development of conclusions, recommendations and implications. 	<ul style="list-style-type: none"> - flexible design 	<ul style="list-style-type: none"> similar to Yin (1995) 	<ul style="list-style-type: none"> - conducting a literature review - construction of a theoretical framework - identification of a research problem - elaboration and sharpening of research questions - sample selection 	<ul style="list-style-type: none"> - define the research framework, constructions and questions - choose cases - development of research instruments and protocols - conduct field research - analysis 	<ul style="list-style-type: none"> - preparation phase (<i>define research topic and specific objectives</i>) - investigation phase (<i>define the type of case, selection of the cases and data analysis</i>) - reporting phase

				(intentional sampling)		
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Note: This table presents the research stages proposed by different authors for the development of case studies. Reprinted from “*Toward Developing a Framework for Conducting Case Study Research*” in *International Journal of Qualitative Methods*, by Ebneyamini, S.; Moghadam, M., 2018, p. 17.

In contrast to Yin’s (1984,1995) proposal of a methodological design involving four clearly structured phases, Stake (1995) supports more flexibility in case study design. As “*qualitative research is a messy, non-linear and often unpredictable undertaking*” (Sinkovics, R. and Alfoldi, E., 2012, p. 1), researchers require some freedom to gradually refine or change their approach throughout the phases of field work to reflect upon “what really matters”, and to adapt to unanticipated developments. This approach is in line with the notion of “*progressive focusing*” (Parlett and Hamilton, 1972, as cited in Ebneyamini, S.; Moghadam, M, 2018), which recognises that research stages cannot be anticipated, as they overlap, and are functionally interrelated.

It should be noted that a flexible design is not akin to an investigation that lacks a reliable structure and conceptual framework, but rather refers to adjustments made to the stages according to the progress and purpose of the investigation. For example, if the main purpose is exploratory—that is, if there is little data about the phenomena, and variables are still unknown—the case design will be very flexible with overlapping stages. However, if the purpose of the case study is confirmatory, with some existing theories and hypothesis regarding the phenomenon, then the researcher can anticipate following the phases of a more structured case study design. It is important to note that other practical aspects can influence the degree of flexibility designated to the design of the case study, for example, the time and funding available for the research (Robson, C. and McCartan, K., 2016, p. 152).

Considering the exploratory nature and the flexible design of this research, the nature and number of methods used during the investigation progresses have been adapted according to the progress of the research. Four (non-linear) stages have been identified and followed: case selection, data collection, data analysis, and report.

- **Case selection**

Case studies can be classified according to different approaches. Yin (1989), for example, defines them in terms of *exploratory, explanatory and descriptive*, while Stake (1995) classifies them as *intrinsic, instrumental and collective*; Zainal (2007) as *interpretive and evaluative*, and according to Dul and Hak (2008), as *single or comparative* (Ebneyamini, S. and Moghadam, M, 2018).

To fulfil the purpose of this research, a multiple case study design was chosen as the appropriate method of research (See Table 7). In contrast to a single case study design that focuses on documenting rare cases to serve as the first phase of a multiple study, using multiple case studies allows for the analysis of the theoretical replication of DIS conceptual framework in the informal and insecure settings in Michoacán, Mexico.

Table 7.

Selection of case study design: single vs multiple cases

Single case	Multiple cases
<p>Critical case</p> <ul style="list-style-type: none"> • Assessing an established theory 	<p>Literal replication</p> <ul style="list-style-type: none"> • Cases selected to forecast equivalent results or when rival theories are entirely opposed • Involves three to four cases
<p>Unique case</p> <ul style="list-style-type: none"> • Evidence and exploration of a rare case 	<p>Theoretical replication</p> <ul style="list-style-type: none"> • Cases selected to forecast contrasting results, or when rival theories have small differences, or to increase the degree of confidence of results • Involves two (or three) sets of three to four cases to pursue two (or three) patterns of theoretical replications
<p>Revelatory case</p> <ul style="list-style-type: none"> • Observation and evaluation of a phenomenon difficult to analyse through fixed methods 	
<p>Preliminary case</p> <ul style="list-style-type: none"> • Exploratory, e.g. initial step in a multiple case study research 	

Note: This table presents the guiding criteria for selecting single or multiple case studies. Reprinted from Yin, 1994, as cited in “*The selection of case studies: Strategies and*

their applications to IS implementation cases studies” in *Research Letters in the Information and Mathematical Sciences*, by Shakir, 2002, p.192.

Three separate — but interlinked — cases have been selected to explore the applicability of DIS framework for informal and insecure settings in Michoacán, Mexico. The selected cases share the following features: 1) they are all consistent with this paper’s definition of DIS, and allow for the analysis of innovation processes to drive the specific pathways for local change towards sustainability; 2) they all occur in informal and insecure settings in Michoacán, and as a result, can help to improve comprehension of the ways in which different geographical, socio-economic, political, and cultural characteristics shape dissimilar knowledges, technologies knowledge, values, and worldviews, and foster innovation in these regions; 3) they all allow for the study of the roles of DGAs to foster the collective capabilities of locals to shape (and accelerate) processes of transformations towards inclusive sustainable paths at the community level (e.g. generating income opportunities, social resilience, biodiversity protection, improvement of water supply, air quality, healthier food, etc).

The second (non-linear) phase for conducting case studies refers to data collection, and is covered in the next section.

- Data collection

There are multiple approaches to methods of data collection, with the most prevalent being interviews, participant observations, and document review (Stake, 1995; Merriam, 1998; Dul and Hak, 2008; Ebneyamini, S.; Moghadam, M., 2018). For this thesis, these three mentioned methods are used to obtain data, and to ensure a triangulation process is in place to enable the validation of empirical findings, and reduce any potential biases.

Interviews

Interviews are one of the most common methods used for the collection of data and evidence that cannot be generated through alternative ways (Darke, P., Shanks, G., and Broadbent, M., 1998, p. 283). They serve as guided discussions that can be conducted in either structured, semi-structured, or unstructured forms (Baškarada, S., 2014).

Structured interviews do not easily adhere to flexible design studies, as they are conducted via a number of predefined questions into a list of answers clustered in small categorised groups to be coded by the interviewer (Miles, M. and M. Huberman, 1994). *Unstructured interviews*, however, allow for greater flexibility due to their presentation as open-ended questions that do not require answering through preestablished categories of response (Fontana, A. and Frey, J. , 1994). Although unstructured interviews are more difficult to code, and require extensive researcher experience, they can produce comprehensive data and reveal unforeseen evidence (Baškarada, S., 2014).

Semi-structured interviews are extensively used in flexible research design methods. They allow the researcher to refocus a question if a point of particular interest is mentioned during an interview, or if more information must be gathered to better grasp the viewpoint of an interviewee (Daymon, C. and Holloway, I., 2002.).

In this thesis, semi-structured interviews have been selected as the most suitable data collection method due to the context-sensitive nature of the research. The method facilitates the investigation of the qualitative characteristics of DIS (e.g. geographical, socio-economic, political, and cultural characteristics) by allowing for the design of a flexible interview guide that is worded according to the specific contexts and backgrounds of the interviewees, and enables an adaptability in the sequence, amount of time, and attention designated for each question (Robson, C. and McCartan, K., 2016).

The thesis draws upon more than 30 semi-structured interviews collected during fieldwork in Michoacán in 2021, and during a research stay with the UAM in 2019 (See Annex 1. Interview script). Although the research protocol initially envisaged face-to-face interviews only, the majority of interviews were conducted either via phone or video call interview platforms to circumvent the travel constraints imposed by the COVID-19 pandemic in Michoacán, Mexico.

In general, each interview lasted between 30 –60 minutes, and was digitally recorded with the agreement of the interviewee. As the interviews do not contain sensitive information, but rather the opinions and perceptions of the interviewees, the interviewees approved the direct reproduction of their quotations. A key instrument to

ensure reliability was to provide each interviewee with the opportunity to verify the written case description (Mosley, L., 2012). This procedure served two main purposes: first, to inform the interviewees of the purpose of the research, and second, to ensure the validity of the empirical findings (Sarantakos, S., 2005).

Participatory observation

Participatory observation refers to a particular style of observation whereupon the researcher is an active participant in the phenomena analysed (Yin, R., 2003). It is a relevant data collection method for the endeavours of this thesis, as it allows for the collection and interpretation of the subjective meanings and experiences (Robson, C. and McCartan, K., 2016) of the participants of informal and insecure settings in Michoacán, Mexico.

Participatory observation was limited during fieldwork due to COVID-19 restrictions, but in the instances this was enabled, data collected by the Author has been derived from her own interpretations of the events in which she participated. This data was then triangulated and combined with other data from interviews and document reviews to increase the validity of the case studies.

Documentary evidence

Documentary evidence was another method used in this thesis to triangulate findings from interviews and participatory observation. Documents, such as newsletters, presentations, research papers, and reports provided new insights and the better understanding of evidence and additional data that had not been captured during interviews. or observed during field visits.

The third (non-linear) phase for conducting case studies refers to data analysis, and is covered in the next section.

- Data analysis

Data analysis is the research phase devoted to observing, classifying, organising, testing, or connecting evidence to generate research conclusions (Yin, R., 2003). The following

methods can be used to analyse case study evidence: *pattern matching, construction of explanations, time series analysis, logic models, and cross-case analysis*.

Pattern matching involves comparing anticipated behaviours or results with those that have been observed in reality, and detecting any variation or gap (GAO, 1990). *Explanation construction* refers to the use of data for the generation of conclusions or explanations (Yin, R., 2003). *Time series analysis* is based on the use of statistical tools for the analysis and understanding of temporal patterns. *Logic models* combine pattern matching and time series analysis to generate projections of the causes and effects of an event; *Cross-case analysis / synthesis* is applied to multiple cases, and may include any of the methods described above (Baškarada, S., 2014).

Cross-case analysis was used to examine data from the three selected case studies. The analytical process involved: i) the identification of thematic categories relevant to the research question; ii) the coding of collected data and analysis of results. This process involved recognizing the meanings and patterns that matched each identified theme from different data sources (interviews, participatory observation, and documentary evidence). (Robson, 2016; Denzin & Lincoln, 2011).

- Methodological limitations and challenges

The methodological limitations of this research have been assessed in terms of *validity*, or the degree to which the study measures the object that it claims or purports to be assessing, and the reliability or scope for the *replication* of research results.

The selection of the most appropriate research design and data collection methods was key to ensure the validity and reliability of research results. The case study, as a flexible design strategy, has often been criticised for a lack of academic rigor. From a critical realist perspective, however, case study research provides a unique scientific value (Flyvbjerg 2006, Eisenhardt and Graebner 2007) in that it allows the researcher to produce significant descriptions of social phenomena, and detailed accounts of events as a way of producing reliable results (Hyett, N., Kenny, A. and Dickson-Swift, V, 2014)

From a post-post-positivist perspective, research outcomes are always value-laden, contextually unique, and inductively produced (with observations that lead to

generalisations). The views and values of the researcher must, therefore, be recognised as influential to the research process, and can at best, be managed by applying appropriate standards.

Validity was therefore achieved through triangulation (using different sources of data), establishing a chain of evidence, and verifying the written cases. One challenge in triangulating the research results was the occasional lack of feasibility in conducting participant observations as the COVID-19 pandemic posed considerable obstacles to accessing some of the communities in Michoacán. This challenge was addressed by collecting data through interviews and literature reviews.

Another challenge faced referred to the scope for the replication and transferability of the research results. Although the number of observations was limited to 30 interviews, the quantity of observations as such, is not wholly decisive for acquiring new meanings and understandings (Larsen, H., 2019). Rather, as Sayer (2000) explains, *‘what causes something to happen has nothing to do with the number of times we have observed it happening. Explanation depends instead on identifying causal mechanisms and how they work, and discovering if they have been activated and under what conditions’* (p.14).

The definition of the criteria for case study selection allows for similar analysis to be conducted across different geographical and cultural contexts, within insecure and informal institutional settings. In this sense, the limited number of observations (30) do not represent a limitation to the transferability of these research results.

5. Overview of Case Studies

This chapter provides a synopsis of the three case studies that were investigated in the thesis, namely: 1) Local Security Councils addressing Violence and Forest deforestation hailing from the Avocado Industry in Tancítaro; 2) Ejido Verde: Regenerating Forests through Social and Financial Innovation; 3) Red Tsiri: an experience of social innovation for sustainable local food systems. The selected case studies adhere to the identified pathways for the development of the KBBE in Latin America and the Caribbean (LAC), and take place in Michoacán, Mexico.

5.1 Local Security Councils addressing Violence and Forest deforestation hailing from the Avocado Industry in Tancítaro

The avocado is a native fruit from central Mexico. According to the country's Secretariat of Agriculture and Rural Development (SADER being its acronym in Spanish), Mexico is the world's leading producer and exporter of avocado, with a contribution of 34% of global production, and 44% of exports in 2017. The three main markets for exportation are The United States (77%), Canada (7%), and Japan (6%) (SADER, 2019).

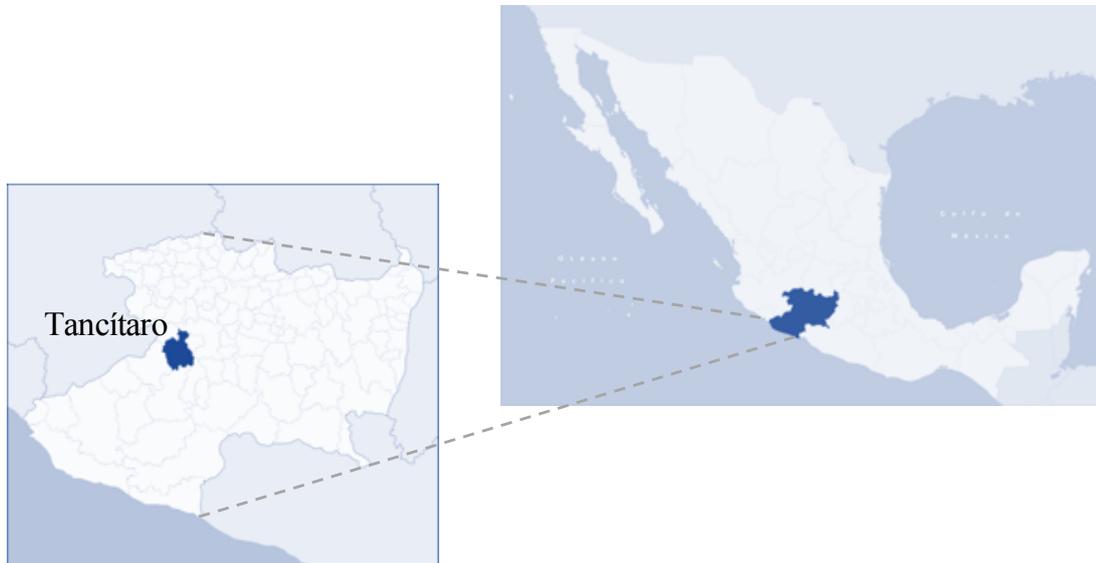
Avocados are an important source of revenue and employment; particularly for the state of Michoacán, which is the main producer and exporter of the fruit. Around 26,980 farmers across Michoacán are responsible for 80% of the total national exports (SADER, 2019).

The avocado belt in Michoacán represents 12.9% of the total state area, and creates approximately 310,000 direct and permanent jobs, and 78,000 indirect and seasonal jobs; representing an increase of 106% over the last decade (SENASICA, 2020). Approximately 80.8% of the Michoacán avocado producer area is located across seven municipalities. The municipality of Tancítaro contributes to 17.7% of the total state production (Salazar, S., Zamora, L. and Vega, R., 2005), even being named "the avocado capital of the world."

The avocado sector in Mexico has been the subject of a great quantity of framework-based studies, including the chain of value, the cluster and the Porter diamond, and even the sectoral innovation system (SIS) (Carbajal and Padilla, 2008; Sánchez, 2006; the Centre for Scientific and Technological Research for Avocados of the State of Mexico (CICTAMEX being its acronym in Spanish); the Faculty of Agro-biology of the University of San Nicolás de Hidalgo in Michoacán (UMSNH being its acronym in Spanish), and others).

Figure 15.

Map of Tancítaro, Michoacán



Note: This map presents the geographical localisation of the case study in Tancítaro, Michoacán, Mexico. Own elaboration.

Carbajal and Padilla (2008) examined the avocado industry in Michoacán as a sectoral innovation system (SIS). The analytical elements used to study the functioning and dynamics of the avocado SIS were the actors, the sources of innovation and institutions, and internal mechanisms (knowledge base, technology and learning, raw materials, and demand).

Of the actors of the SIS identified as generators or diffusers of innovation, the study highlighted the following: *producers or cultivators of avocados* (approximately 17,000, with sales representing 95% of the national market); *packing businesses* (around 100); avocado processors located primarily in Michoacán (around 19); *research associations* (two local: the -National Institute for Agricultural and Livestock Forestry Research (INIFAP) and the Faculty of Agro-biology, and one regional: the Center for Scientific and Technological Research on Avocado in the State of Mexico (CITAMEX)); *associations or councils* (Association of Producers and Exporters of Avocado Packers of Mexico (APEAM), Local Agricultural Association of Avocado Producers of Uruapan, Michoacán (AALPAUM), Union of Avocado Packers and Marketers of Michoacán (UDECAM) and Avocado Commission of Michoacán (COMA) and the

National Council of Avocado Producers (CONAPA)); *trade promotion institutions and research services*, such as the PRODUCE Foundation (an organism of Secretaría de Agricultura y Desarrollo Rural (SAGARPA), the State Delegation of the Secretary of Agriculture and Livestock Sector (SEDAGRO), the Local Committees for Vegetable Health (JLSV); and *financial institutions* (The National Bank of Foreign Trade S.N.C. (BANCOMEXT), Guarantee and Promotion Fund for Agriculture, Livestock and Poultry (FIRA).

According to the study, actors are classified as either creators, or diffusers of innovations. In regard to the creators of innovation, the study details the presence of research institutes (CICTAMEX, INIFAP, UMSNH), while farmers and the Secretary of the Agriculture and Livestock Sector are deemed to be the main diffusers of innovation.

Table 8.

Creators and diffusers of innovations in Avocado SIS in Michoacán

<i>Innovators agents \ Innovations</i>	Innovations by technological function	
	Investment – Production	Support
<i>Diffusers of innovations (Farmers)</i>	<ul style="list-style-type: none"> • Incorporation of new varieties of avocado from 1960 • Adoption of new avocado cultivation techniques • Nutrition of avocado tress • Improvement of avocado quality • New harvest 	<ul style="list-style-type: none"> • Improvement of the cultural practices for the consumption of the avocado • Orientation of the production towards the market
<i>Diffusers of innovations (Secretary of the Agriculture and Livestock)</i>	<ul style="list-style-type: none"> • Studies on ecological aspects for the selection of areas and the establishment of orchards 	<ul style="list-style-type: none"> • Advising to primary producers • Validation of the quality of avocado of exportation • Advising on the negotiations for the

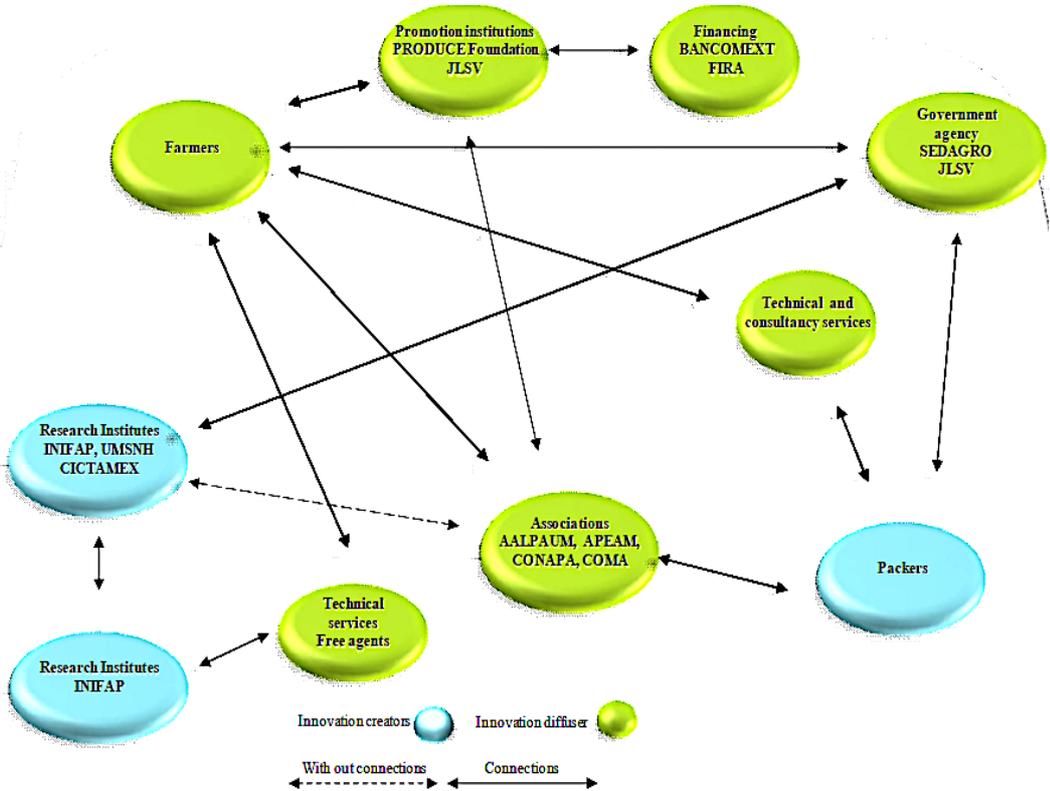
Sector)		marketing of the avocado on the American market on the frame of the NAFTA
Generators of innovations CICTAMEX, INIFAP, Faculty of Agrobiology of the UMSNH	<ul style="list-style-type: none"> • Genetic improvement of avocado varieties • Prevention and control of plagues • Distances of plantation, pruning of trees, mutation of varieties to achieve smaller trees. • Demonstrations in orchards on irrigation, control of plagues and diseases and chemical fertilization (Producers) • Organic handling of orchards. • Ecological issues to establish an orchard • Technologies for the establishment of nursery • Studies on filtration of chemical fertilisers to phreatic surface and utilisation of organic products. • Study of salinity of the soil. • Studies of biotechnology 	<ul style="list-style-type: none"> • New cultural and consumption practices • Direct advising to producers in field • Courses of training for the integrated maintenance of the cultivate

Note: This chart presents principal innovations developed by creators and diffusers of innovations in Avocado SIS in Michoacán. Reprinted from “*Avocado Production and the Sectoral Innovation System*” in Paper presented for the VI GLOBELICS Conference, by Carbajal and Padilla, 2008, p. 28.

The connections between network actors varies in intensity, and is complementary. For example, the relationships between producers and research institutes, such as INIFAP,

occurs in an indirect manner through technical services. While the relationship of INIFAP with associations such as APEAM has begun to improve, farmers have no direct connection with financial institutions. Although there are agricultural public funds like FIRA designated for farmers, in reality, an avocado producer can rarely meet FIRA's requirements (Carbajal, M. and Padilla, S., 2008).

Figure 16.
Avocado sectoral system of innovation in Michoacán



Note: This map presents the IS actors in the avocado sector in Michoacán. The actors considered to be innovation creators are highlighted in blue, with those actors acting as innovation diffusers being in green. The solid lines represent the direct connections between actors, while the dotted lines signal no connections between the actors in the system. Reprinted from “Avocado Production and the Sectoral Innovation System” in Paper presented for the VI GLOBELICS Conference, by Carbajal and Padilla, 2008, p. 20.

According to the results of the study, behind the outstanding commercial success of the Mexican avocado sector and the economic benefits generated, were the following four distinct characteristics of the SIS:

- (1) The diffusion and application of global knowledge from different disciplines (e.g. chemistry, bio-technology, mechanical and electronic engineering, and information technologies) in the development of the sector.
- (2) The strengthening of the linkages between system actors (e.g. agricultural units, private and public organisations) resulted in agricultural extension services and innovations in terms of the methods of production, and practices for avocado planting, harvesting, and packing.
- (3) The opening of the US market for Mexican avocado exporters: tariff and non-tariff barriers for the entrance of avocados into the market — particularly in the US — act as determining factors for the initiation of activities of innovation and technological learning across system agents.
- (4) International quality standards and norms have forced system actors to change and learn best practices to comply with market requirements.

Although the SIS theoretical framework is relevant to better understanding the interactivity and interdependence between the different actors of a system that leads to technological innovation, it is argued that the approach falls short in terms of incorporating the environmental and social dimensions for the sustainable development of the avocado industry in Michoacán – especially for the municipality of Tancítaro.

In regard to the environmental dimension of SIS, a recent study from Ruiz-Sevilla (2020) on the sustainability of avocado production in Tancítaro signals that the current way of producing avocados results in negative and alarming consequences for changing land use and water balance (ecological balance); the detrimental impact on ecosystems and the hydrological cycle affects forests, fauna, climate, and other environmental aspects. The effects of avocado cultivation on water balance during the period 2011-2019 in the municipality of Tancítaro has been highlighted in the study using Geographical Information System (GIS) quantification tools and production indicators (Ruiz, G., 2020).

While water precipitation has oscillated between 800 and 1000 mm in 79.32% of the study area over the last 10 years, 57.3% of this average annual rainfall is used in avocado production in Tancítaro. Ruiz-Sevilla (2020) argues that the economic value of the water is not considered in the avocado production costs, despite it representing of 50% of its value. This value is only invested in the construction and expansion of water containers for the sole agricultural purpose of modifying the natural patterns of runoff water, rather than improving the water catchment areas using good agroecological practices.

As for the social dimension of SIS, in analysing the multidimensional Poverty Measurement in Tancítaro for the period 2010-2015 (Figure 17), it can be observed that although at the state level, the population with an income below the poverty line increased (from 59.1 to 62.4%), it decreased in Tancítaro from 63.6 to 62.1%. The same was observed in the population with income below the extreme poverty line (from 21.9 to 20.2%). Moreover, the vulnerable population in terms of income in Tancítaro is below than the state level average for the same period.

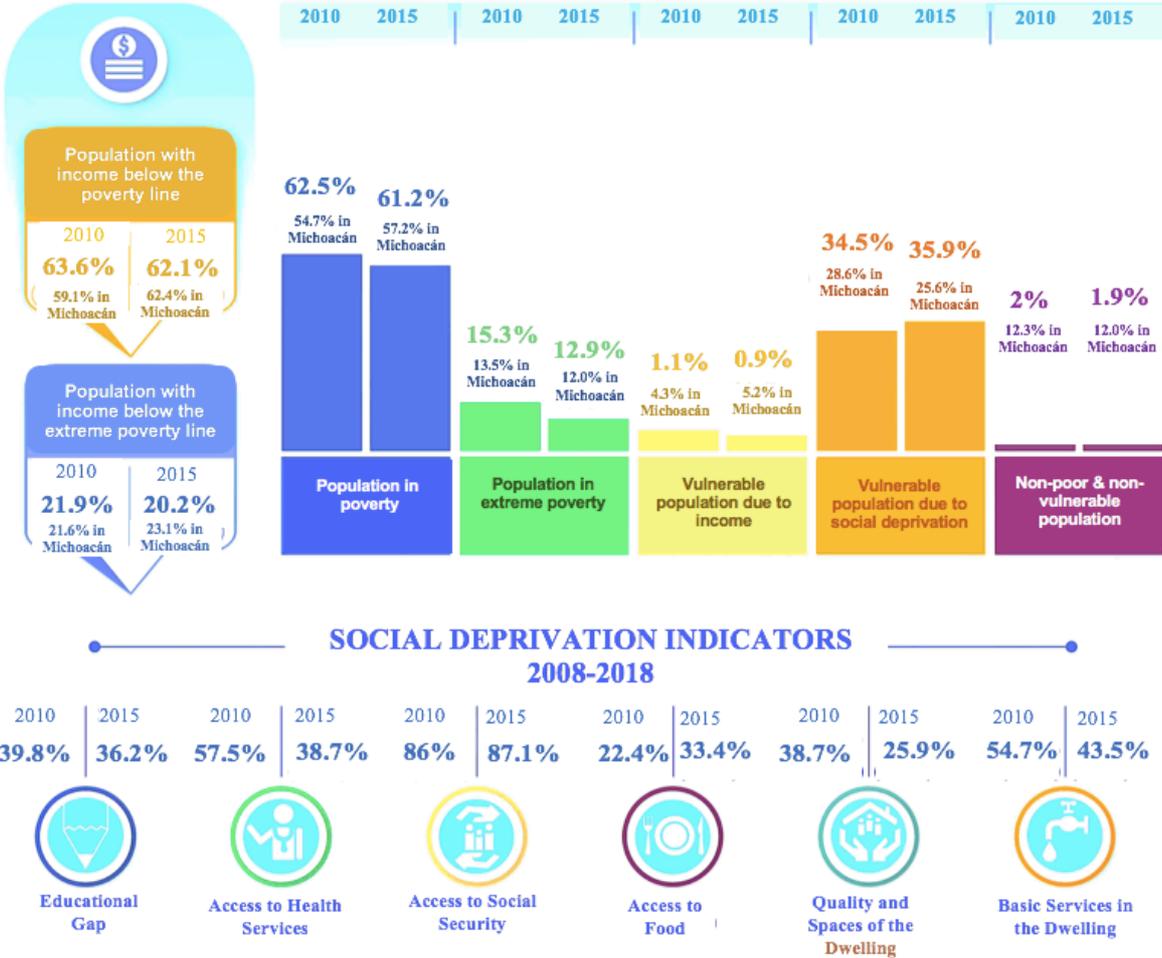
This indicates that avocado production in Tancítaro may positively impact and increase the wellbeing of the population in relation to income generation. However, the population deemed vulnerable due to social deprivation in Tancítaro increased during the period 2010-2015, from 34.5% to 35.9%, while decreasing in the state of Michoacán (from 28.6% to 25.6%).

Of the social deprivation indicators that presented a negative trajectory, “*access to food*” is emphasised, with the percentage of population lacking access to food increasing from 22.4 to 33.4%. The deterioration of food security in Tancítaro can be explained by multiple factors, including difficulties of availability, access to, and consumption of food. The increase of income in the population might have been accompanied by a rise in food prices in the municipality, which may have impacted the most vulnerable lower-income households (with 37.9% of the population still having an income below the poverty line) (CONEVAL , 2010).

A lack of access to social security in Tancítaro also increased from 86 to 87.1% during the period of 2010-2015. A high rate of informality, in addition to a wide gap in wages

and productivity with respect to the formal sector, might explain the low rate of access to social security in Tancítaro, and should signify the creation of formal jobs with social benefits that guarantee the means to overcome health or occupational risks constituting a priority effort for the development of the avocado sector in Tancítaro.

Figure 17.
Multidimensional Poverty Measurement in Tancítaro 2010-2015



Note: This chart presents indicators relative to the multiple dimensions of poverty and social deprivation in Tancítaro, Michoacán for the years 2010 and 2015. Own elaboration with information from “Poverty measurement in Michoacán 2008-2018”, by CONEVAL 2018.

(https://www.coneval.org.mx/coordinacion/entidades/Michoacan/Paginas/Pobreza_2018.aspx)

In sum, the SIS analysis of avocado production in Tancítaro allows for a better understanding of “structural change”, and emphasises the ability of technological innovation to foster economic growth in the municipality; creating higher incomes. However, when DIS analytical lenses are integrated, questions arise regarding the normative assumption that technological innovation is *per se* desirable, and that the ultimate goal of the SIS should be economic growth.

Although technological innovation in the avocado sector in Tancítaro can be linked poverty reduction in the region, poverty can only be measured using income indicators in SIS analysis. However, in considering the multiple dimensions of poverty, only a minimum contribution is made to social welfare in economic terms, as the increased income of the population see a reduction of 13% if the cost of water was included. (Ruiz, G., 2020). According to Ruiz-Sevilla (2020), technological innovation in the avocado sector in Tancítaro is not ending poverty *per se* nor reducing all forms of inequality, as it does not promote inclusive and sustainable production and consumption systems, and it takes a high toll on both people and the environment.

Finally, SIS analysis does not incorporate the institutional setting into the analysis of the formal and informal rules that play a key role in securing equitable social objectives and welfare outcomes for the population of Tancítaro.

Tancítaro’s institutional setting can be described as “insecure”, with a prevalence of informal rules being linked to criminality. Between 2011-2013, the criminal organisation, Knights Templar Cartel (Spanish: Los Caballeros Templarios), controlled several municipalities of Michoacán, including Tancítaro, and managed to establish a system of income extraction and extortion from avocado producers and manager in packaging companies, who were regular victims of kidnappings and homicides.

As a response to the violence perpetuated by the Knights Templar Cartel, an armed defensive group (Autodefensas) was formed by local men and led by a medical doctor, José Manuel Mireles. Mireles was invited to Tancítaro by avocado producers to help them stop the violence in their community. In only a matter of days, this group of local men achieved what the Federal Police and the Mexican Army could not achieve in years: capture members of the Knights Templar. The “Autodefensas” group supported the

creation of a network of barricades from where the circulation of vehicles and people in the municipality could be monitored and controlled (Roman, D., 2020).

The electoral year of 2015 saw the population of Tancítaro demand security above all else. Political and social leaders from different parties (PRI, PAN, PRD), an NGO (Jesuits for Peace), and some members of the Vigilance Council began to meet weekly to discuss security issues and subsequently formed the Group for Peace and the Tancítaro Unit, which morphed into a coalition that won the election. As a result, the NGO, Jesuits for Peace, with the support of the coalition, launched the “*Project for the Reconstruction of the Social Fabric*” (PRTS) (Roman, D., 2020).

At this time, Jorge Atilano González Candia, a Jesuit priest, was responsible for leading the PRTS. As Tancítaro is a very religious community, Jorge Atilano became a trusted and influential actor in the community, with a deep awareness of the local context and a strong relationship with local people in Tancítaro.

The PRTS is organised around five axes - social economy, community governance, education, spirituality, and family reconciliation - that seek to address that which its ideologists consider to be the components of the social fabric affected by violence: social ties, identity, and the making of agreements.

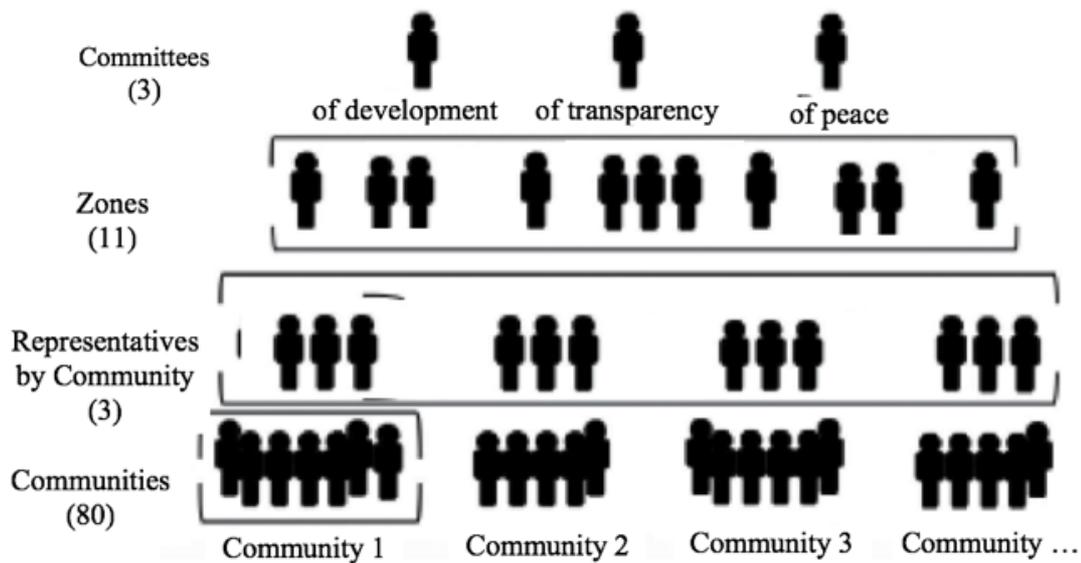
To support the governance axis, the *Citizen Council of Good Coexistence (CCBC)* was created with the objective of integrating the nearly 80 towns and villages of the municipality into the same body of citizen participation and accountability (Roman, D., 2020).

The structure of the CCBC was as follows: each of the 80 towns appointed three representatives, who were then invited to participate in zone meetings. Tancítaro was divided into 11 zones, with each zone nominating a representative to attend municipal assemblies and was serve on the security council (see Figure 18 in next page).

In building upon the experience of the Citizen Council of Good Coexistence (CCGC) and its ecological councils, the “*Movement for the defence of the Tancítaro Forest and*

Watersheds” emerged in 2016 as a community-led action to face the pressing environmental challenges related to water scarcity, deforestation, and biodiversity loss.

Figure 18. Structure of the Citizen Council of Good Coexistence (CCBC)
Structure of the Citizen Council of Good Coexistence (CCBC)



Note: This figure illustrates the structure of the CCBC, according to communities, zones and committees. Adapted from “*We have a privilege that not everyone has. Agroindustry, State reforms and the formation of enclaves in Tancítaro, Michoacán*”. In “*Towards justice when guarantees are scarce. Civil society in contexts of violence. The case of Michoacán*”, by D. Roman, p. 199

For years, one of the main challenges in the municipality of Tancítaro and the entire avocado belt in Michoacán, has been the environmental, social, and economic impacts of land-use change. Due to the accelerated increase in avocado production, soils are being converted for their dedication to avocado cultivation in the upper parts of the Protected Natural Area (ANP), which interrupts the capture of water, and prevents the recharge of the aquifers; this has resulted in increased droughts and changes in environmental temperature (Ruiz, G., 2020).

Figure 19.

Ecological impact of avocado cultivation in Michoacán



Note: This image illustrates the conversion of forest land in Michoacán to avocado production, and the use of water for agricultural irrigation. Reprinted from “*The War for Avocado: Unstoppable Deforestation and Pollution*” by Biodiversity in Latin America, 2019. (<https://www.biodiversidadla.org/Noticias/La-guerra-por-el-Aguacate-deforestacion-y-contaminacion-imparables>)

The Pico de Tancítaro constitutes an extensive water catchment area, and is made up of 16 hydrological basins that combined, represent a surface of 678.1 km². This area is therefore of great importance within the cycle of water capture and aquifer recharge (Ministry of the Environment and Natural Resources, 2021). It also encompasses the source of economic development for at least 40,000 inhabitants across 82 towns and communities that are dedicated to the cultivation of avocado, peach, apple, and pear crops, as well as rainfed agriculture, and extensive cattle ranching (National Institute of Ecology and Climate Change (INECC), 2021).

The government of Tancítaro has been urged to act and provide solutions to the encroaching problems of water scarcity, forest deforestation, and biodiversity loss, and has so far responded with system interventions that Meadow (1999) would describe as

shallow leverage points. The government has focused on measures related to parameters. In 2003, the government launched the programme, "Payment for Hydrological Environmental Services" (PSAH being its acronym in Spanish), with the objective of providing economic incentives to ejidatarios (members of peasant communities that have usufruct rights on forest land, but no ownership rights). This measure was intended to reduce deforestation, while addressing the causes of water scarcity (Muñoz, C., 2007, p. 79). However, the programme did not have the expected results, as the payment conditions led to disagreements among ejidatarios in Michoacán, who were to receive between MXN \$ 380-800 (USD \$ 19-40) per hectare, as opposed to their payment in the State of Mexico, of almost MXN \$ 1,600 (USD \$ 80) (La Voz, 2019).

Furthermore, as another way potentially solving environmental problems, particularly for forests and water, Pico de Tancítaro was designated a Federal "Flora and Fauna Protection Area", and recognised as an "Area of Importance" for the conservation of birds (AICA being its acronym in Spanish), and a "Priority Terrestrial Region" for the Programme for the Conservation of Biodiversity of the National Commission for the Knowledge and Use of Biodiversity (CONABIO being its acronym in Spanish) (Ruiz, G., 2020). None of these actions have proved helpful in reducing the environmental impact of avocado cultivation in Tancítaro. This result shows that, although parameters are important — especially in the short term - they rarely change behaviour (Meadows, D., 1999).

In 2016, the town council of Tancítaro, in coordination with the Forestry Commission of the State of Michoacán (COFOM being its acronym in Spanish), and the National Commission of Natural Protected Areas (CONANP being its acronym in Spanish) embarked on a "*Sanitation Project in the Pico de Tancítaro Protected Natural Area*". The objective of the project was to address a forest phytosanitary contingency in the Pico de Tancítaro that involved the 86.84 hectares affected by bark insects, and 20.46 hectares affected by the fungus, *Sphaeropsis sapinea* (SIVICOFF, 2019).

According to local testimonials, the sanitation project was linked to an increase in illegal logging and soil destruction, as it provided illegal loggers with "an excuse" of cutting trees to contribute to the "sanitation" project (Yamada, J., 2021). In response, members

of the CCGC decided to create a barricade to monitor the passage of trucks transporting wood, leading to the emergence of the “*Movement for the defence of the Tancítaro Forest and Watersheds*”, as local communities organised themselves to resist structural injustice and criminality (illegal logging) created by their government’s fragmented approach to local environmental challenges; treating sanitation, land use, and water management as separate issues.

The movement focused on four axes of action: surveillance and safeguarding of the Pico de Tancítaro, environmental awareness and education, political incidence, and capacity building (generating community regulations / agreements, the implementation of protocols in cases of illegal logging, mediation, and others). The movement has gained significant outreach due to the stimulation of links and synergies with other movements in the states of Oaxaca and Veracruz.

Figure 20.

Members of the Movement for the Defence of the Forest and Water Basins of Tancítaro



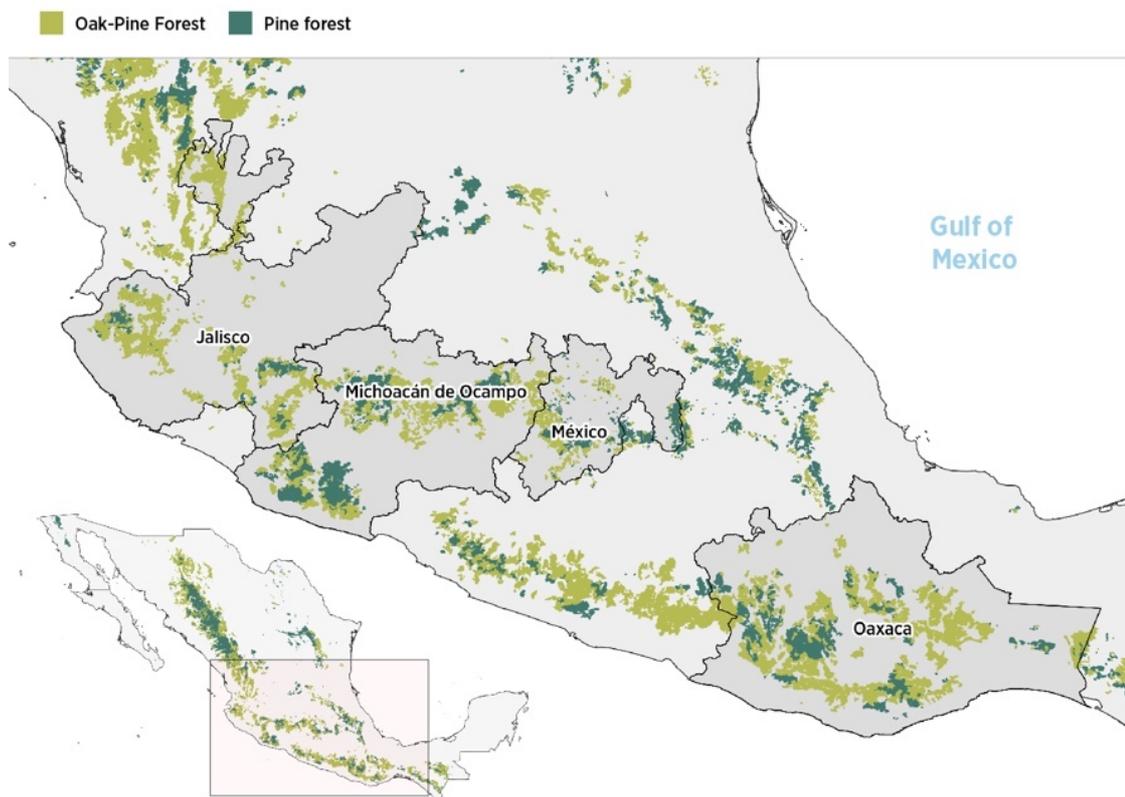
Note: Members of the Movement for the Defence of the Forest and Water Basins of Tancítaro. Photo by Juan José Estrada in “*The defence of the environment in Mexico, A matter of life or death?*” in *Voices of citizenship*, by Velázquez, 2020, p.1 (https://www.gob.mx/cms/uploads/attachment/file/538902/14_DefensoresD.pdf).

5.2 Ejido Verde: Regenerating Forests through Social and Financial Innovation

Pine resin is a sap collected from pine trees, with hundreds of commercial applications including food preservatives, pharmaceutical medicines, biodegradable plastics, chewing gum, and other products. Mexico produces around 20,000 tonnes of pine resin per year and is among the world's five largest producers for an industry valued at USD \$10 billion (French, J., 2020). Almost half of the pine species used for commercial purposes are endemic to the country (French, J., 2020), with about 90% of this being produced in state of Michoacán.

Figure 21.

Spatial distribution of Oak-Pine and Pine Forest in Mexico



Note: The map illustrates the geographical distribution of oak-pine forests (light green) and pine forests (dark green) in Mexico. Reprinted from The National Institute of Statistics, Geography and Informatics (INEGI), as cited in “*The Community Company that is Renovating an Ancestral Industry*” by IDB, 2020. (<https://www.iadb.org/en/improvinglives/community-company-renovating-ancestral-industry>)

Systemic deforestation in Michoacán has had a devastating impact on endemic biodiversity, and has created short supply challenges for the pine industry (CleanTech, 2020). By way of illustration, one of the biggest generators of employment in the local resin industry, “The Pinosa Group”, has seen its production levels decline by 70% in the last years (Ejido Verde, 2020).

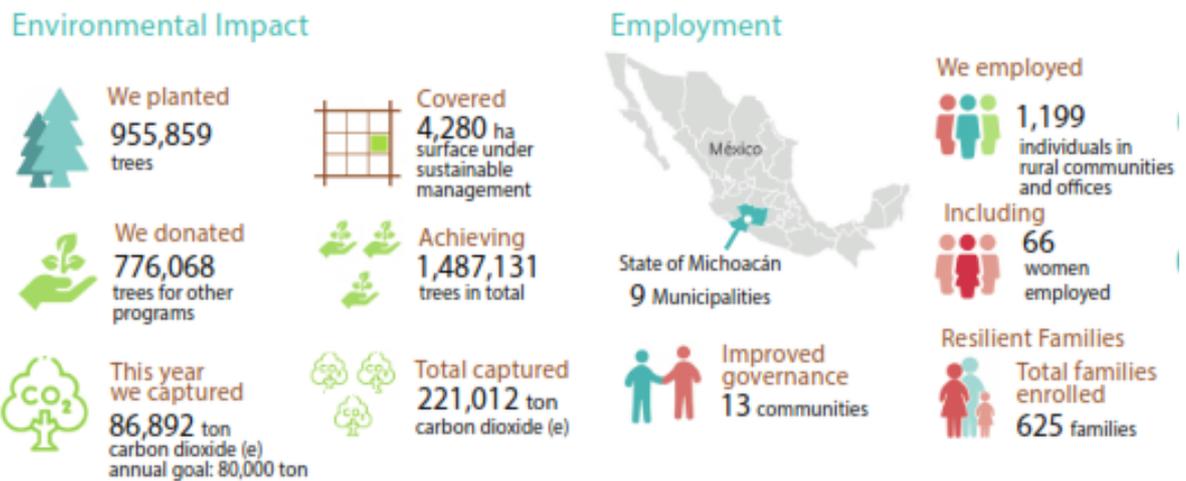
The reforestation of the pine plantations in Michoacán may be key to tackling the sustainable supply of resin, biodiversity loss, and job generation. However, there is a chronic underinvestment in reforestation projects across the state, mainly stemming from finance accessibility challenges. Part of the challenge originates from the long-term return of investment (ROI) for pine plantations and resin tapping, which is usually estimated at a duration of eight to ten years for the investment to pay off (IDB, 2020). The other aspect of the challenge is linked to the lack of financial instruments that recognise the local “ejido” system. Indigenous communities in Michoacán own land collectively (ejidos), which means that although members of that community have the right to use the land, they cannot access loans, as banks do not recognise ejidos as a form of guarantee (CleanTech, 2020).

In 2009, The Pinosa Group launched “Ejido Verde” as a philanthropic tree-planting project intended to tackle the economic, environmental, and social challenges caused by the systemic deforestation of Michoacán:

- Economically: Ejido Verde fosters the development of the resin industry by supporting The Pinosa Group to reach full its production capacity through a sustainable supply of pine resin.
- Environmentally: The project supports the restoration and conservation of forests. As of last year, Ejido Verde has planted 955,859 trees in Michoacán; covering a surface of 4,280 ha under sustainable management, which supported the capture of 221,012 tons of carbon dioxide.
- Socially: Ejido Verde reduces forced emigration by creating jobs targeted at rural and indigenous communities (1,199 jobs created in 2020), increasing income (of up to twice the minimum wage in Mexico) by guaranteeing a fair market price for all resin tapped, and by building the local capacity of communities (63 workers trained, 625 families enrolled, 13 communities involved).

Figure 22.

Environmental and Social Impact created by Ejido Verde in 2020

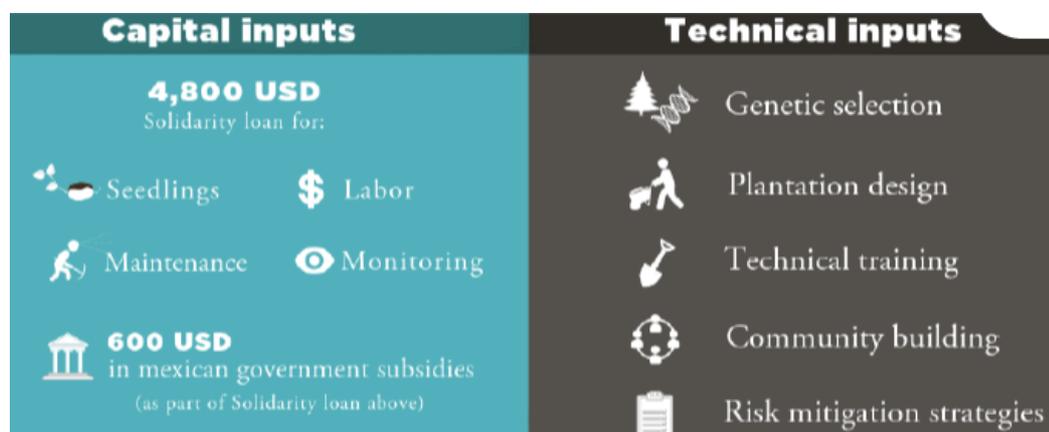


Note: This figure presents Ejido Verde’s annual impact dashboard, including the environmental and social impacts in 2020. (<https://ejidoverde.com/our-commitment/>)

Ejido Verde’s regenerative agroforestry model relies on strong partnerships with local forest communities — predominantly of indigenous origin — to establish commercial plantations. The company provides communities with capital (for seedlings, labour, maintenance, and monitoring), and technical inputs (trainings, community building, and risk mitigation strategies, etc); the communities then allocate responsibilities and land rights to individual families (See Figure 23.)

Figure 23.

Capital and technical inputs provided by Ejido Verde to local communities per hectare



Note: This chart presents Ejido Verde’s One Hectare Model. Reprinted from “*Catalysing sustainable pine resin production in Mexico*” by Ejido Verde 2019, p. 4.

Ejido Verde tackles the chronic underinvestment in reforestation projects of Michoacán through innovative financing models that consider a long-term ROI (30 years), and adapt financial instruments to the ejido system.

The agroforestry company offers communities a zero-interest loan of 4,800 USD per hectare, and provides training and technical inputs. It is only at year ten that pine resin can be harvested, and tappers are authorised by the community to start repaying the loan to Ejido Verde with 10 to 15% of the harvested resin. The remaining 90-85% of the produce is bought by Ejido Verde at a fair market price during year 11 to 20, when the loan is fully repaid. Thereafter, and until year 30, resin tappers are paid 100% of the production. Ejido Verde receives a commission from The Pinosa Group for providing a sustainable supply of resin (Ejido Verde, 2020).

At present, there are 09 municipalities in the State of Michoacán, and 13 communities working with Ejido Verde, including San José de las canas, la Cebadilla San Miguel, Pomacuarán, Nahuatzen, Tarimbaro, Ucareo, Santa Ana Jeráhuaro, Jacuarillo, Patamban, San Juan Capacuaro, Barrio de San Miguel, and Cheran.

The institutional setting in most of these municipalities can be described as “insecure”, with a prevalence of informal rules being linked to violence. For example, Cheran municipality was regular victim of illegal deforestation lead by criminal drug cartels (The Knights Templars and The Michoacán Family). The community didn’t believe in local government institutions, as a resin farmer of the community stated: “We couldn’t go to the police,” he said. “The police were in the pay of the gangsters.” (Ejido Verde, 2017).

On April 15, 2011 a group of local women created barricades to stop the illegal lumber trucks, and chased the cartel raiders with rocks and fireworks. The whole community joined them in overturning the local government and police that (in their view) had been supporting the criminals. The municipality created a group of Autodefensas (appeal for self-protection) and a provisional government.

The Mexican government officially recognised the new autonomous status of the Purepecha community (Ejido Verde, 2017). According to Ejido Verde (2017) it is

thanks to the group of indigenous women that stood up to the drug cartel lords that it is possible (and safe) today to use the resin from pines as an income for the community.

Ejido Verde aims to scale up its impact and generate sustainable transformative change in the whole pine industry. The agroforestry company relies on strong partnerships with multiple, local, national, and international actors including the National Forestry Commission (CONAFOR being its acronym in Spanish), the Secretary of the Environment and Natural Resources (SEMARNAT being its acronym in Spanish), the National Institute of Forestry (INIFAP being its acronym in Spanish), the Agricultural and Livestock Research, the National Union of Resiners, KAYA capital advisory, and Reforestamos Mexico; additionally, KIVA, Inter-American Development Bank (IDB Invest and IDB Lab), the World Resources Institute (WRI), Biofin, Initiative 20X20, Energy Globe, and the Global Environment Facility are involved, amongst others (Ejido Verde, 2020).

5.3 Red Tsiri: an experience of social innovation for sustainable local food systems

The rich diversity in today's maize crops is the result of a long selective breeding process, and has been nurtured by farmers over several generations who have saved and exchanged a variety of seeds that they considered to be better adapted to different climates and geography. Currently, 59 maize landraces (native maize varieties) can only be found in Mexico (CIMMYT, 2016), particularly in the south-eastern parts of the country, where indigenous communities still maintain the tradition of using and consuming a wide variety of maize landraces (Nadal, A. and Wise, T., 2004).

Mexican native maize varieties are crucial to the conservation of maize diversity (Nadal, A. and Wise, T., 2004), however, agricultural reforms and trade liberalisation have arguably threatened their conservation. When the Mexican government first embarked on agricultural trade liberalisation in the 1990s, the inclusion of maize in the North American Free Trade Agreement (NAFTA) was highly contested, as maize is the country's most important staple crop and food source. "*Tortillas*" (cooked maize dough)

provide Mexicans with almost 60% and 40% of their daily energy and protein intake, respectively (Turrent, A., 1997).

In the face of farmer objections, maize was included in the NAFTA, which scheduled an end to trade barriers ahead of Canadian and American maize exports using a tariff-rate quota (TRQ) system. As a result, US maize exports since 1996 have increased 323% from the pre-NAFTA period (FATUS, 2003), and by 2002, producer prices fell by 47% (SIACON 2003). The rapid substitution of Mexican landraces for commercial hybrid seeds have impacted Mexican smallholder farmers severely; forcing them to migrate in search of better income opportunities unrelated to their traditional farming activities (Nadal, A. and Wise, T., 2004).

Today, the conservation of native maize varieties is fostered by value-added activities such as traditional tortilla-making. Mexicans consider hand-made tortillas prepared from maize landraces to be the gold standard for quality, and far superior to the white hybrid maize (used for industrial tortilla production) (CGIAR, 2020).

Traditional tortilla-making is also an important income provider for peasant families and rural women. It provides the “tortilleras”— rural women (mostly indigenous) who make tortillas — of Michoacán with currency on a daily basis (Astier, 2004; Preibisch et al., 2002; Astier et al., 2019).

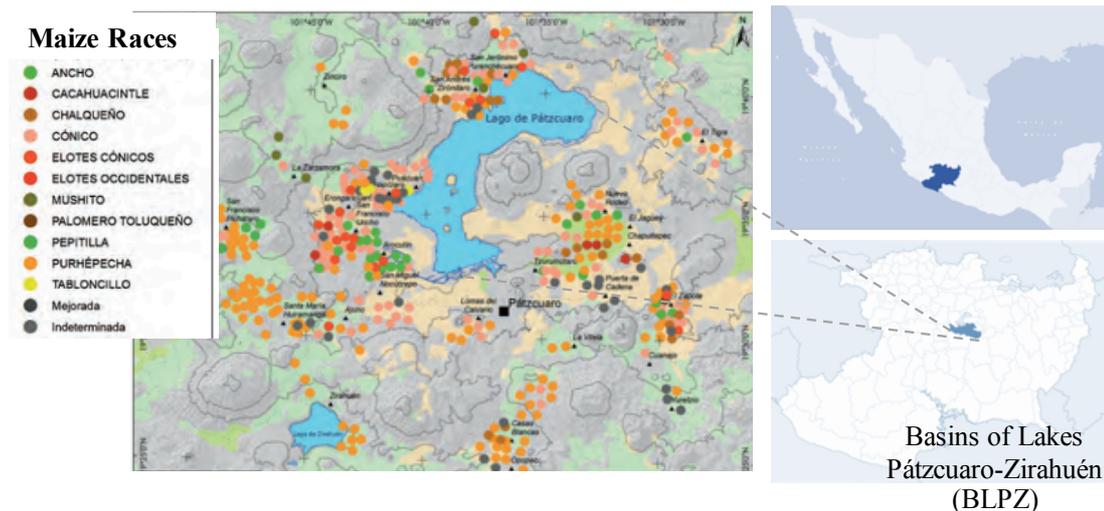
The Basins of the Lakes Pátzcuaro-Zirahuén (BLPZ) region, in the western Mexican state of Michoacán, is a major crop area for Mexican maize landraces, where a large portion of the rural population is part of the native maize-hand-made-tortilla food system (Astier, M., 2014). At least six native species and twenty varieties adapted to the climate throughout this BLPZ region have been identified (See Figure 24 in next page).

Besides being a rich maize biodiversity hub, the BLPZ region risks becoming the next battlefield of the drug cartels Jalisco Nueva Generación (CJNG) and Pueblos Unidos (also identified as the United Cartels), who are disputing the ruling of the territory. On July 17, 2021 Pueblos Unidos deployed a convoy in broad daylight and with total impunity through the main streets of the municipality of Pátzcuaro, Michoacán. Around 25 vans with one hundred heavily armed hitmen circulated through the main roads

without being stopped by any authority, showing the power they have in the territories of the entity. The main objective of the “parade” was to mark their forceful authority before the people and local government institutions.

Figure 24.

Map of maize races distribution in the Basins of Lakes Pátzcuaro-Zirahuén (BLPZ) region, Michoacán



Note: This figure displays the different varieties of maize races in BLPZ region. Reprinted from “*Maize Diversity in Pátzcuaro, Michoacán, México, and its Relationship with Environmental and Social Factors*” by Orozco-Ramírez; Odenthal and Astier, 2017, p. 874 (<http://www.scielo.org.mx/pdf/agro/v51n8/1405-3195-agro-51-08-867-en.pdf>)

It is within this insecure institutional setting that “Red Tsiri” or the network of maize (as per its Spanish: red and Purépecha: tsiri translation) operates. The network was created in 2009 by the Center for Research on Environmental Geography of the National Autonomous University of Mexico (UNAM-CIGA being its acronym in Spanish) and the Interdisciplinary Group for Appropriate Rural Technology (GIRA being its acronym in Spanish), with the objective of creating a direct link between farmers and conscious consumers willing to pay for high-quality tortillas made from local varieties of organic maize (Conecto, 2016).

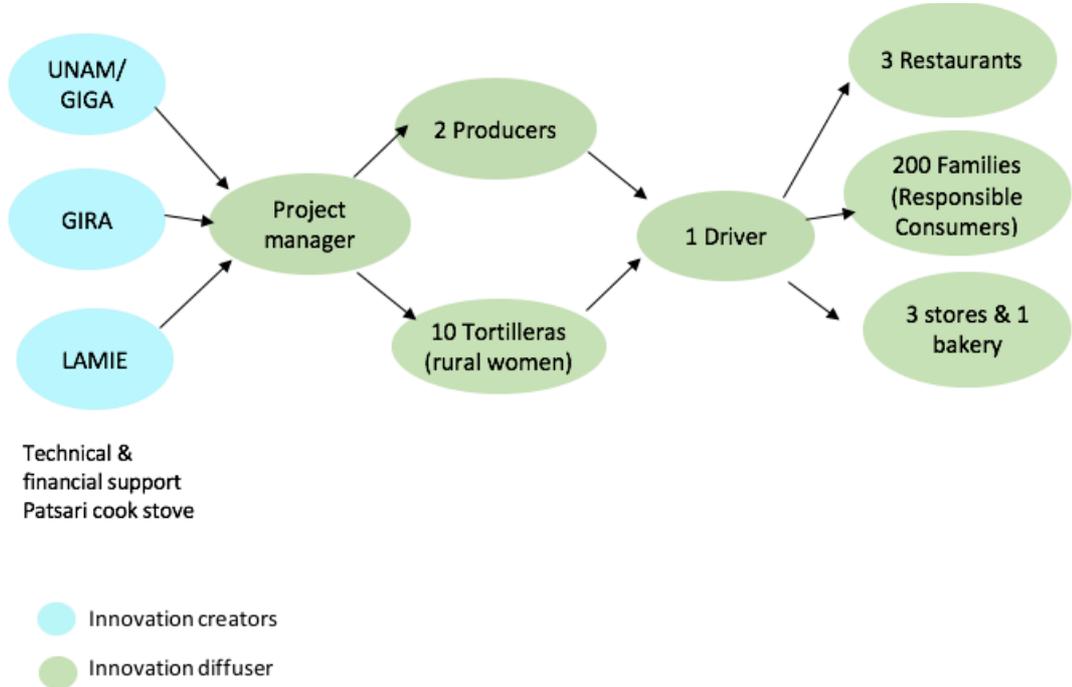
Today, Red Tsiri transforms seven tonnes of blue corn, and half a ton of white corn per year, and pays higher prices to farmers and tortilleras. For example, Red Tsiri pays

farmers MXN \$9 pesos (USD \$0.44) for one kilo of maize, instead of the market price of MXN \$ 5.50 pesos (USD \$0.27). A dozen handmade tortillas are usually sold at MXN \$12 pesos (USD \$0.59) at the market, while Red Tsiri pays MXN \$18 pesos (USD \$0.88) for them (Fundación Tortilla, 2021).

Marta Astier Calderón is the founder of Red Tsiri, and a researcher at UNAM GIGA. She has engaged the following actors in Red Tsiri: ten women that make the tortillas by hand, two producers of organic native maize, 200 families from Morelia who buy directly for the Tsiri Network, a driver that distributes the tortillas across three restaurants and three local stores. Other actors also buy Tsiri products, such as Panoli, a Morelian chain of bakeries that use flour and pinole from Red Tsiri. Tierra Mestiza, a store in another state (Guanajuato) offers Tsiri’s products to the public (Fundación Tortilla, 2021).

Figure 25..

Red Tsiri: Network actors



Note: This map presents the network actors of Red Tsiri. Actors considered to be innovation creators are highlighted in blue, while actors acting as innovation diffusers are in green. Own elaboration.

GIRA, in collaboration with UNAM-GIGA and the Laboratory for Monitoring and Innovation in Ecotechnologies (LAMIE) of the Solid Biofuels Cluster, have developed

the concept of “*Patsari*” firewood-saving stoves - a technological innovation that reduces fuel consumption by 50%, and prevents women and family members from inhaling smoke produced by the stoves. The stoves are designed to expel smoke outside of the house, and reduce the indoor concentration of carbon monoxide by 66% (Patsari Project, 2021)

Figure 26..

GIRA Patsari Cookstove



Note: Picture of woman making tortillas with a Patsari cookstove. Reprinted from “*Workshop for the Construction and Installation of Efficient Wood Burning Stoves*” by Educational Center for Rural Development (CEDER being its acronym in Spanish), 2014. (<https://www.esfacilserverde.com/portal25/archivo-de-eventos/554-taller-de-construccion-e-instalacion-de-estufas-eficientes-de-lena>)

While GIRA, UNAM-GIGA and LAMIE are the main generators of technical innovation within Red Tsiri, UNAM-GIGA plays a central role in supporting the diffusion of social and technological innovations (e.g. conservation of native maize varieties, the revaluation of cultural and consumption practices of traditional tortillas;

capacity building for tortilleras; financial support for the acquisition of Patsari Cookstoves, and the orientation of the production towards the market, amongst others) (See Table 9).

Table 9.

Creators and diffusers of innovations in Red Tsiri

<i>Dedicated Agents</i>	<i>Innovations</i>
<p>Diffusers of social and technological innovations</p> <p>(UNAM GIGA, farmers, tortilleras)</p>	<ul style="list-style-type: none"> • Conservation of native maize varieties • Revaluation of cultural and consumption practices of traditional tortillas • Capacity building for tortilleras • Financial support for the acquisition of Patsari cookstoves • Orientation of the production towards the market
<p>Generators of technical innovation</p> <p>(UNAM-Campus Morelia, GIRA, A.C. and the Solid Biofuels Cluster through the Laboratory for Monitoring and Innovation in Ecotechnologies (LAMIE))</p>	<ul style="list-style-type: none"> • Reduction of indoor concentration of carbon monoxide (CO) by 66% • 50% reduction in fuel consumption • Cost savings related to replacement of fuelwood • Direct advising to users of Patsari cookstoves • Training for the construction of Patsari cookstoves

Note: This table presents principle innovations developed by creators and diffusers of innovations in Red Tsiri. Own elaboration.

The scalability of the impact of Red Tsiri has proven a significant challenge. Although the vision of Red Tsiri is to increase the number of network members in Michoacán (e.g. Morelia, Uruapan and Paracho) and other states across Mexico (e.g. Chihuahua, Oaxaca and Chiapas) (Astier, M., 2019), there are several constraints. For instance, there is a need to increase the supply of native maize from local farmers, and the number of tortilleras participating in the network. From the market side, Red Tsiri needs to increase

awareness among those consumers willing to pay a higher price for a quality product, and improve tortilla packaging for the product to reach broader markets.

Following this overview of the three case studies to be investigated in the thesis (i. the avocado industry in Tancítaro; ii. Ejido Verde; and iii. Red Tsiri), the next chapter presents the adaptation of the 3C-model for GLD for the analysis of GDA characteristics and roles for building the collective capabilities to introduce a dedication to sustainability in DIS for informal and insecure settings in Michoacán. The chapter also explores the collective capabilities developed by the local people in the case studies.

6. Applying the 3C-Model for Grassroots-Led Development (GLD) in case study analysis in informal and insecure institutional settings in Michoacán, Mexico

In this section the 3C-model for GLD is adapted in the analysis of: 1) GDAs characteristics; 2) GDAs role in building collective capabilities for the introduction of dedication to sustainability in informal and insecure institutional settings in Michoacán, Mexico; and 3) collective capabilities developed by local people in informal and insecure settings in Michoacán.

Table 10 presents the different GDA's characteristics and roles investigated in each case study according to the 3C processes. The data collected in the case studies responds to the categories presented in section 3.3.1 on the 3C-model for GLD, mainly:

- *Resources*: what distinguish GDAs from other actors in terms of their capability to influence internal and external factors that make individuals want to change. Recourses are measured in terms of GDA's distinctive individual values, motivations and responsibility, as well as the financial, social and economic resources that positions them as agents of systemic change.
- *Conscientisation*: involves GDAs role in triggering the capability to aspire to better lives in local actors, through awareness raising and critical reflection about alternatives to what is perceived as feasible possibilities.

- *Conciliation*: refers to GDAs role in fostering the creation of collective agency by supporting initiatives that link individual ambitions with broader community goals, and foster community participation and active voice, as well as knowledge exchange and skills acquisition.
- *Collaboration* comprises GDA's role in facilitating alliance-building with local and external actors to scale-up the impact of sustainable innovation, leading to DIS transformations in informal and insecure institutional settings in Michoacán, Mexico.

Table 10.

GDA's Characteristics and Role in building Collective Capabilities in informal and insecure institutional settings in Michoacán, Mexico

GDAs characteristics

<p>1. Resources <i>economic, personal and social assets</i></p>	<p><i>Capability to influence internal and external conversion factors</i></p>	<p>1.1 GDAs individual values, motivations and responsibility 1.2 GDAs social and economic resources</p>
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GDAs Role in building Collective Capabilities

<p>2. Conscientisation <i>capacity to think critically and aspire to better living conditions</i></p>	<p><i>Creation of individual capability to aspire (through internal conversion factors)</i> ↓</p>	<p>2.1 Create awareness and foster critical reflection about alternatives to perceived as feasible possibilities 2.2 Inspire desire to improve life</p>
<p>3. Conciliation <i>of individual and community goals</i></p>	<p><i>Creation of collective agency (through external and environmental conversion factors)</i> ↓</p>	<p>3.1 Linking individual needs with wider sustainability communal goals 3.2 Coordinating community participation and active voice 3.3 Facilitating knowledge exchange and skills acquisition</p>

<p>4. Collaboration <i>alliance-building with broader actors to scale-up impact</i></p>	<p><i>Creation of collective capabilities</i></p>	<p>4.1 Facilitating collaboration with regional actors: other communities, local initiatives, local government, etc. 4.2 Facilitating collaboration with external actors: state, donors and NGOs</p>
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Note: own elaboration with inputs from Pelenc et al., 2015; and Ferreira, 2020.

6.1 Results/Findings: GDAs Characteristics in informal and insecure institutional settings in Michoacán, Mexico

This section analyses the characteristics of GDAs that provides them with legitimacy and practical power to influence system level change towards sustainable goals. GDAs are studied through the *internal* (e.g. individual capabilities, values, motivations and responsibility, gender, physical and physiological conditions, etc.) and *external* factors (*social* —norms and power structures— and *environmental*—context and circumstances in which GDAs live) that define their level of authority at the grassroots level.

Three GDAs have been selected from the different case studies covered in the research. The selection has not focused on charismatic leaders at the local level, but on local actors that promote a system-level dedication to sustainability through networked forms of citizen-led, technology-led, and market-led processes (Scoones, I., 2016).

The selected GDAs come from different backgrounds (private sector, academy, and church) and are all considered system entrepreneurs, not because of their focus on generating and exploiting new business opportunities, but because of their role in creating dedicated collective agency for inducing local systemic change towards sustainability (See Table 11).

Table 11.

Description of GDAs from case studies (Ejido Verde, Red Tsiri and Security Councils in Tancítaro)



(Ejido Verde, 2021)

Shaun Paul is the chief executive officer (CEO) of Ejido Verde and has more than 30 years of entrepreneurial experience in private finance, natural resources, and rural and indigenous communities in Latin America. Prior to joining Ejido Verde, Shaun founded four impact venture funds (Reinventure Capital, EcoLogic Development Fund, Pico Bonito Forests LLC, Root Capital). Shaun currently serves as board member at a donor affiliate organisation (International Funders for Indigenous People), as well as a business accelerator (Accelerating Appalachia for nature-based companies). He is an advisor to EcoMadera in Ecuador (Ejido Verde, 2021).



(CIGA, 2021)

Dr. Marta Astier Calderón is a senior researcher at the Research Center in Environmental Geography of the Autonomous National University of Mexico (UNAM-CIGA), campus Morelia, Michoacán. She is the founder of *Red Tsiri* and has conducted research on the agroecological production of maize in Michoacán since 2005. Dr. Astier is member of the "Agroecology for Sustainable Food Systems" (ASAS) University Group (CIGA, 2021)



(Herrera, J., 2017)

Jorge Atilano González Candia is a Jesuit priest, the General Director of the Center for Research and Social Action (CIAS), and a member of the Citizen Council in Tancítaro. Father Atilano is also co-author of the book *“Reconstruction of the Social Fabric: A Bet for Peace”* (2016). During 2005-2012, he was Director of the Jesuit Vocations Team of the Mexican Province, and was responsible for coordinating housing projects for the victims of Hurricane Mitch as part of the Reconstruction Committee of the Catholic Church in El Progreso, Yoro, Honduras. He has

published ethnographic research on the gangs of Honduras in the book, *“In search of the lost fraternity”* (2001). Father Atilano received his master's degree with the thesis entitled “Strategies for public security policies, an analysis from the community perspective”. He currently coordinates the *“Social Tissue Reconstruction Program”* promoted in Tancítaro. (Jesuitas Mexico, 2019)

Note: This table presents a brief description of each of the three GDAs selected from the case studies. Own elaboration.

Among the selected GDAs, the following common characteristics can be highlighted (See Table 12 for a complete list) : GDAs’ individual values, motivations, and responsibility are *“positively” embedded in local institutions*. Positive embeddedness refers to GDAs possessing a good understanding of the ethnocentric nature of local people, that is, the culture and norms that the community perceives as being normal and morally correct (Peng, M., 2019). Thanks to this embeddedness, GDAs are able to circumvent existent beliefs, to stretch societal norms in acceptable ways (Castellanza, L., 2019). At the same time, GDAs are not entirely conditioned to their institutional framework. The vision and background of these different GDAs demonstrates an *articulated awareness of the institutional constraints and opportunities for change*.

The three selected GDAs hold strong *social interpersonal skills*, and a sound capacity to bring sustainability ideas and solutions “down to earth” (Bernhardt, J. et al., 2015). GDAs have the ability to promote sustainability changes (e.g. reforestation, biodiversity conservation, etc.) as solutions to the problems that directly affect local people in informal and insecure settings (e.g. unemployment, violence, social security, inequality, social exclusion, human rights, working conditions, and others) (Colantonio, A. and Lane, G., 2007).

Table 12.

GDA's Characteristics in informal and insecure institutional settings in Michoacán, Mexico

DGAs' Characteristics		Shaun Paul CEO Ejido Verde (Private Sector)	Dr. Marta Astier Founder Red Tsiri (Academia)	Jorge Atilano Local Security Councils (Church)
1.1 GDAs individual	• Values	Experiences shaping values:		
		Entrepreneurial experience in private finance, natural resources and rural and indigenous communities in Latin America	Research experience in rural development and sustainable food systems	Member of the Citizen Council in Tancítaro; exposed to community level insecurity and violence.
	Academic background shaping world vision:			
	Master's degree in Economics, University of Michigan. Research fellow at the Global Development and Environment Institute at Tufts University.	PhD degree on agronomy and sustainability. Senior Researcher at CIGA/ UNAM.	Master's degree on "Strategies for public security policies, an analysis from the community perspective.	
	• Motivation	Main drivers:		
		"It is my view that on the systemic problem of deforestation is one essential piece of the solution is building and strengthening local governance. We work on as part of mitigating our business risks"	"Support the conservation of maize diversity and food security, while improving the livelihoods and income of farmers and rural women"	"Work on the reestablishment of broken community ties, which is the deep cause of violence and crime in the community"
		Expectations leading to action:		

	<ul style="list-style-type: none"> • Responsibility 	Address systemic deforestation to ensure reliable supply of pine resin, while generating income for rural and indigenous communities	Support the conservation of maize biodiversity in BLPZ, while creating income opportunities for rural women and local farmers	Create cultural, environmental, and structural conditions for peace and harmonious coexistence in Tancítaro
1.2 GDAs	<ul style="list-style-type: none"> • Social interpersonal skills 	Practical authority to influence “on-the-ground” agreements:		
		Ejido Verde is an intergenerational business built on trust. The same families have been selling pine resin to Ejido Verde, thus there is an established relationship of trust between forest communities and Ejido Verde. “My role is to understand local culture, local customs, as well as agrarian law, and know how things get done in a practical basis in each community”	“My role is to build trust with farmers and rural women in BLPZ by understanding their roles and needs, and connect this with the opportunities offered by Red Tsiri”	“For at least ten years, I was responsible for the vocations area of the Society of Jesus in Tancítaro. I have a solid relationship of trust with the community and a good understanding of the main social problems”
	<ul style="list-style-type: none"> • Resources 	Financial and economic resources		
		Social impact investment and international impact investment	Public finance for research projects	Public and private finance for local security councils

Note: This table presents the individual values, motivations, and responsibilities of the selected GDAs, as well as their social and economic resources. Own elaboration.

6.2 Results/Findings: GDAs Role in building Collective Capabilities in informal and insecure institutional settings in Michoacán, Mexico

The 3C-model for GLD (conscientisation, conciliation, and collaboration) allows for the analysis of the role played by GDAs in the creation of individual capabilities to aspire, as well as fostering the processes of collective agency that ultimately leads to the formation of collective capabilities.

6.2.1 Conscientisation

GDAs are actors with the capacity to stimulate critical reflection processes in individuals to conclude why a change is necessary in informal and insecure institutional settings in Michoacán, Mexico. Through established networks of trust, GDAs instigate local actors to broaden their perceptions of “feasible possibilities”, by helping them to craft different “pictures” of their future that reflect the short and long-term impacts of their decisions, including the opportunity to strengthen their capacities of coping with uncertainty and risks.

GDAs have the ability to inspire a desire to improve the lives of local communities in informal and insecure institutional settings in Michoacán, Mexico by fostering local commitment and personal engagement. GDAs stimulate the capability to think with foresight through short- and long-term incentives that respond to local needs (e.g. employment, higher market prices, reduced violence, etc.).

The following table summarises the role of DGAs in building collective capabilities through conscientisation processes, specifically through awareness creation and fostering critical reflection on alternatives to perceived as feasible possibilities; and their role in inspiring the desire to improve life

Table 13.

GDAs role in fostering conscientisation in local communities in informal and insecure institutional settings in Michoacán, Mexico

DGAs' Role: "Conscientisation"		Shaun Paul CEO Ejido Verde (Private Sector)	Dr. Marta Astier Founder Red Tsiri (Academia)	Jorge Atilano Local Security Councils (Church)
2.1 Create awareness	•Critical reflection	Broadening perception of feasible alternatives		
		<p>"The commitment with Ejido Verde is long term (30 years), we create awareness through training & community building"</p> <p>"The dominant mindset is very short-term focus: they like what we do because they get paid immediately, and we create jobs immediately"</p>	<p>"Initially tortilleras join Red Tsiri to get paid higher prices, but then they participate in workshops and learn about the value of their work and feel proud"</p> <p>"Red Tsiri works with producers who are already exporting to niche markets and are aware of the value of maize biodiversity".</p>	<p>"Thanks to the project "Social Tissue Reconstruction" in Tancítaro, there is awareness of the importance of environmental issues for the security of Tancítaro (deforestation and change of land use to expand avocado cultivation)"</p>
2.2 Inspire	•Desire to improve life	Personal engagement through incentives		
		<p>"We're asking communities and farmers to make a 30-year commitment to take care of pines. In return we offer financial support, technical assistance and jobs"</p>	<p>"Women don't need to go sell their tortillas in the street, and they get paid above the market price".</p>	<p>"Inhabitants from Tancítaro were inspired to create the Citizen Council to face the intensified wave of violence and crime in their community"</p>

Note: This table presents DGAs role in building collective capabilities through conscientisation processes, specifically through awareness creation and fostering critical reflection on alternatives to perceived as feasible possibilities; and their role in inspiring the desire to improve life. Own elaboration

6.2.2 Conciliation

DGAs have a thorough understanding of prevailing communal values and social structures, which allows them to develop effective strategies for *linking individual needs with wider sustainability communal goals*. Beyond relying on local people’s sympathy and generosity to engage in sustainable transformations, DGAs develop narratives and incentives that relate environmental issues to the daily struggles of local people (e.g. job creation, migration, violence, insecurity, inequality, poverty, and others) (See Table 14).

Table 14.

DAs responsibility to reconnect the environmental sustainability agenda with local community development agendas in informal and insecure institutional settings in Michoacán, Mexico

<p><i>Local community Development agenda in informal and insecure institutional settings in Michoacán, Mexico (for whom?)</i></p>	<p>DGAs’ role in finding ways in which the transformation to environmental sustainability contributes to local agendas in informal and insecure institutional settings in Michoacán, Mexico? (by whom?)</p>
<p>•<i>Job creation & economic contribution</i></p>	<p>- How can environmental sustainability contribute to a portfolio of livelihoods in informal and insecurity settings? (e.g. local employment produced, improved access to formal labour market, working conditions, child labour, equal opportunity, and salary women-to-men labour force, etc).</p>
<p>•<i>Migration</i></p>	<p>- How is this transformation helping to reduce the impacts of climate change generating migration and displacement? (e.g. reducing the number of community members that migrate because of climate change impacts -this is particularly relevant for “ghost towns” with high rate of youth departs).</p>
<p>•<i>Food security</i></p>	<p>- In the absence of a formal policy, how can the environmental agenda contribute to strengthen community food security in communities (e.g. reducing deforestation, land degradation, drought and water scarcity, low agricultural productivity, etc).?</p>

•Violence & insecurity	- How can the transformation to environmental sustainability help to reduce violence and insecurity (e.g. improve legitimacy of institutions and enforcement of laws, etc.)?
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Note: This table presents some areas of opportunity for DGAs to link sustainability and social agendas at the local level. Own elaboration with social impact categories from Falcone et al. 2019. “*Transitioning towards the bio-economy: Assessing the social dimension through a stakeholder lens*”, in CSR and Environmental Management, by Falcone et al., 2019, 1142

DGAs play a strong role as *coordinators of community participation and active voices in DIS goal formulation*. They empower communities through frames of knowledge and discourse that are themselves inclusive, and allow different local knowledges, values, and interests to shape local transformation processes towards DIS sustainability (Scoones, I., 2016).

DGAs *foster knowledge exchange and skill acquisition* from local actors, through the creation of joint learning processes that allow the re-evaluation of knowledge production and use to guide local communities towards sustainable paths.

Table 15.

GDAs role in fostering conciliation in local communities in informal and insecure institutional settings in Michoacán, Mexico

DGA’s Role: “Conciliation”		Shaun Paul CEO Ejido Verde (Private Sector)	Dr. Marta Astier Founder Red Tsiri (Academia)	Jorge Atilano Local Security Councils (Church)
3.1 Linking individual needs with wider sustainability communal goals	•Articulation	Individual struggles:		
		Poverty, forced migration, social exclusion.	Poverty, inequality, health problems (traditional stoves causing respiratory diseases).	Poverty, violence insecurity, kidnapping, extortion, murder, impunity for drug cartels.

		Wider sustainability goal:		
		Reforestation, biodiversity conservation, soil restoration.	Maize biodiversity conservation.	Peace, reforestation, biodiversity conservation, sustainable water management.
		Building linkages through incentives:		
		Creating jobs, technology and financial package, paying higher market prices.	Income opportunities, and higher market prices.	Providing security, justice, inclusion in decision making processes.
3.2 Coordinating community participation	• Participatory goal formulation	Active voice		
		There's an iterative process of dialogue with community leaders, the General Assembly, and the farmers.	Plans to form a cooperative where the tortilleras and producers participate and the roles/functions are rotated.	The Citizen Council of Good Coexistence (CCBC) integrates the nearly 80 towns and villages of the municipality in the same body of citizen participation and accountability.
3.3 Facilitating knowledge exchange and skills acquisition	• Knowledge exchange	Trainings, workshops and seminars		
		“We provide technical trainings on farming and promote peer to peer exchange”.	“We organise several workshops and roundtables on the importance of maize biodiversity”.	“We organise seminars on solidarity, social economy, and communal governance”.

Note: This table presents DGAs’ roles in building collective capabilities through conciliation processes, specifically by linking individual needs with wider sustainability communal goals, coordinating community participation and active voice, and facilitating knowledge exchange and skills acquisition

6.3 Results/Findings: Local Collective Capabilities in informal and insecure institutional settings in Michoacán, Mexico

This section explores the collective capabilities developed by the local people in the case studies. Ten community members were interviewed for each case study. Table 16 present the list of communities that are related to the selected case studies. While the study of local security councils is only focused in Tancítaro, Ejido Verde works with 13 communities and ejidos in Michoacán, and Red Tsiri involves a number of communities living in the Basins of Lakes Pátzcuaro-Zirahuén (BLPZ).

Table 16.

Local communities analysed in each case study

Case Study	Communities
1. <i>Local Security Councils addressing Violence and Forest deforestation from Avocado industry</i>	<ul style="list-style-type: none"> • Tancítaro
2. <i>Ejido Verde: Regenerating Forests through Social and Financial Innovation</i>	<ul style="list-style-type: none"> • San José de las canas • La Cebadilla San Miguel • Pomacuarán • Nahuatzen • Tarimbaro • Ucareo • Santa Ana Jeráhuaro • Jacuarillo • Patamban • San Juan Capacuaro • Barrio de San Miguel • Cheran.
3. <i>Red Tsiri: an experience of social innovation for sustainable local food systems</i>	<ul style="list-style-type: none"> • Aranza • Santa Ana Chapitiro • Zirahuen • Morelia

Note: This table list the local communities involved in each case study. Own elaboration

Of the collective capabilities analysed, particular attention was given to the *resistant and resilient capabilities* presented in chapter 3.2.1 of this thesis. While the former refers to the removal of unfreedoms by strengthening the capacity of a community to

confront what they see as major injustices (e.g. discrimination, misery, violence, lack of social mobilisation, inequality, impacts of climate change, etc.), the former involves the promotion of human freedoms by supporting communities to adapt to adversity and build collective and constructive reactions to injustice (Rosignoli, F., 2018).

The analysis of these capabilities is of particular interest to understand the goal formulation processes in DIS informal and insecure institutional settings. The next sections present a summary of the main findings concerning the building of both the resistant and resilient capabilities in each of the selected case studies.

6.3.1 Resistant capabilities

Resistant capabilities were particularly relevant in the community of Tancítaro. After a period of intensified violence between 2004 and 2013, the residents of Tancítaro developed a *sense of collective injustice*. Drug cartels such as “La Familia Michoacana”, “Los Zetas” and “Los Caballeros Templarios” generated a wave of deaths, violence, and impunity in Tancítaro, which not only caused pain and anger among community members, but also a generalised loss of trust in local institutions. According to local narratives, government institutions (the army and police) did not only lack the capacity to confront criminal groups fighting for control of the territory, but also were infiltrated by cartel members, especially in regards to the operations responsible for public security.

In these local communities, there was great level of *awareness of the power of local cartels, and a limited capacity to face them individually*. This generated a general sense of helplessness, because even when a close member of a family was assassinated or extorted, individuals had no one to turn to for justice, and fear prevented them to stand up and face organised crime. People felt abandoned by the institutions.

This was the context of the establishment of the “Autodefensas”. A group of agro-industrial businessmen sought support from the leader of the self-defence groups, Mireles, to banish the criminal groups that were causing so much damage to the community. As a result, two organised groups emerged: the Municipal Security Council and the Citizen Council of Good Coexistence. These groups managed to re-establish

local order through various strategies, such as consolidating a common candidacy for the municipal presidency to avoid the re-infiltration of the local government, professionalising a security body financed between by businessmen and the municipality, in addition to the self-defence groups continuing to monitor the entrances and exits in the south of the municipality. Similarly, The NGO Jesuits for Peace carried out projects to rebuild trust among community members through five axes: social economy, community government, education, spirituality, and family reconciliation (Roman, D., 2020).

The case is relevant for the understanding of how local social groups (whether consisting of industry representatives, political leaders, or community members) managed to develop collective agency with the common goal of addressing deep criminal violence.

The engagement of different members of the community in collective action led to the formation of new collective capabilities; what initially started with the formation of the Citizen Council of Good Coexistence continued with a search for different communal goals valued by the community, such as addressing illegal logging and forest deforestation.

The creation of the “*Movement for the Defence of the Forest and Water Basins of Tancítaro*” illustrates how the formation of collective agency in resistance of structural injustice in informal and insecure settings can then be linked to wider sustainability communal goals.

6.3.2 Resilience capabilities

Resilience capabilities were analysed in all three case studies. Of particular relevance in these cases is revelation that adverse institutional settings (e.g. poverty, insecurity and violence) did not result in the overexploitation of natural ecosystems, but rather, to the development of collective and constructive reactions that ultimately led to a transformative change towards sustainability.

This collective agency of communities emerged mainly from social networks, civic engagement, cultural identity, and trust. Initially, the main incentive for communities working with Ejido Verde or Red Tsiri was the generation of additional income, jobs

and higher market prices. however, thanks to the influence and practical power of GDAs, communities actively engaged and participated in the implementation of the projects, which brought a sense of belonging and trust between locals. In the face of deforestation and loss of maize biodiversity, Purhépecha communities in Michoacán managed to successfully adapt and transform to create economic, social and environmental benefits.

7. Discussion and conclusion

This thesis aims to support the application of Dedicated Innovation System (DIS), as a revised approach to IS that is adapted to the study of transformative change promoted by the 2030 Agenda. In particular, this research contributes to the development of analytical tools for the local implementation of the SDGs, through the operationalisation of the three cross-cutting practical dimensions of DIS, namely directionality, legitimacy, and responsibility. The concept of “Dedicated Actors (DAs)” has been explored as an integral component of DIS.

This chapter summarises the central insights of the research by addressing the general question: *How can Dedicated Actors (DAs) introduce a dedication to sustainability in DISs in informal and insecure institutional settings in Michoacán, Mexico?* The following specific questions are then addressed: (a) what characteristics of DAs allow them to direct DIS towards sustainable outcomes in informal and insecure institutional settings in Michoacán, Mexico; (b) what role do DAs play in the building of collective capabilities in informal and insecure institutional settings in Michoacán, Mexico? and (c) what local capabilities result from DIS in informal and insecure institutional settings in Michoacán, Mexico?

This chapter is structured as follows: section one provides a summary of the main research findings from the case studies, while section two outlines the conclusions of the research; section 3 presents some general policy implications of the research, and finally, section four suggests a future research agenda.

- **Research findings – Responding to the research questions**

The empirical research findings of this thesis result from chapters five and six, which present new key insights for the operationalisation of the DIS concept and cross-cutting dimensions. The case studies have provided instrumental evidence in response to the general research question guiding this thesis: “*How can DAs introduce dedication to sustainability in DISs in informal and insecure institutional settings in Michoacán, Mexico?*”.

As the focus of the thesis has been the study of innovation-led transformations towards sustainability at the local level, the research has prioritised the analysis of DGAs’ characteristics and roles in informal and insecure institutional settings in Michoacán, Mexico.

A first proposition of the research concerns the characteristics that define DGAs, as the actors that promote the dedication of DIS towards sustainability through networked forms of citizen-led, state-led, technology-led, and market-led processes (Scoones, I., 2016). In this thesis, DGAs are presented as actors that (1) break out of the “paradox of embedded agency” (because of their prior exposure to the institutional spheres that contrast local established beliefs), and that (2) are “positively” embedded in local institutions (allowing them to circumvent existing cultural beliefs, and stretch societal norms). The distinguishing factor of DGAs in comparison to other actors is their distinctive individual values, motivations, and sense of responsibility, as well as the financial, social, and economic resources that position them as agents of systemic change.

A second proposition of the research refers to the *roles of DGAs in the building of collective capabilities in informal and insecure institutional settings in Michoacán, Mexico*. One contribution of this thesis is the application of 3C-Model for grassroots-led theoretical framework in the analysis of DGAs’ role in fostering grassroots innovation processes of: (1) *conscientisation*: DGAs create awareness in local people, foster critical reflection on alternatives to perceived feasible possibilities in informal and insecure institutional settings in Michoacán, Mexico, and inspire a desire to improve their lives; (2) *conciliation*: DGAs play a strong role in fostering the creation of

collective capabilities by enabling linkages between individual needs with wider sustainability communal goals, and coordinating community participation and active voice, as well as facilitating knowledge exchange and skills acquisition; (3) *collaboration*: DGAs facilitate collaboration with regional actors (e.g. other communities, local initiatives, local government, etc.), and with external actors (e.g. state, donors & NGOs).

A third proposition of the research refers to the creation of collective capabilities in informal and insecure settings at the local level. DIS framework allows for the study of how collective innovation processes lead firstly to the convergence of individuals' values, interests, motivations and sense of responsibility, and ultimately, to the creation of collective capabilities. One contribution of this thesis is the use of case studies for the practical analysis of the categories of resistant and resilience collective capabilities, as proposed by Rosignoli (2018).

The case studies bring new insights on the formation of these capabilities in real life contexts. It was found that a general sense of collective injustice within these institutional settings has encouraged local communities to adopt collective strategies to resist injustices caused by external conditions (such as structural inequalities, discrimination, hazardous events, climate change impacts, etc.). Local communities in informal and insecure institutional settings in Michoacán, Mexico tended to develop resilience capabilities to face poverty traps, violence, and a lack of social mobilisation. Although the creation of collective capabilities was initially triggered by issues related to economic and social factors (that are viewed and valued as high priorities in insecure and informal settings), these capabilities have also served to address other environmental challenges affecting local communities (e.g. climate change, biodiversity loss, deforestation, etc.).

A fourth proposition of the research relates to the patterns and dynamics of innovation processes in informal and insecure institutional settings in Michoacán, Mexico. These settings have been shaped by context-specific factors that must be considered in the tabling of strategies and innovation policies promoting local development. For example, while UN initiatives such as the platform, “Localising the SDGs (Local2030),” have been designed for the purpose of integrating subnational contexts within the 2030

Agenda, the complexity and great variety of power configurations and institutions at the local level might require an alternative/complementary approach.

Although essential, a singularly top-down approach may not be sufficient for generating paradigmatic change across all institutional settings - particularly the in informal and insecure contexts of developing countries. To that end, a contribution of this thesis is the integration of these informal and insecure settings in its analysis of the patterns and dynamics of innovation processes in in Michoacán - a state with extreme levels of poverty (with 85.7% of the population in Michoacán being either poor or vulnerable), and increasing insecurity (with an estimated increase of 48% in homicides in Michoacán during the period of 1990- 2017).

The analysis of the prevailing welfare regime for each of the Michoacán communities investigated in the case studies covered the four main components of Wood and Gough's (2006) framework, those being (1) the institutional conditions, (2) the institutional responsibility matrix (IRM), (3) the welfare situation of the population, and (4) the pattern of stratification and mobilisation.

This analysis allowed for the investigation of how institutional components shape the dynamics of innovation processes, and are closely linked to the broader social, environmental, and economic problems that directly affect local people in informal and insecure settings (e.g. unemployment, violence, social security, inequality, social exclusion, human rights, working conditions, and others).

- Research conclusions

The central statement of this thesis suggests that the “*transformative change*” aimed at by the 2030 Agenda requires the innovation systems (IS) approach to simultaneously adapt to respond to the variety of local contexts in both the Global North and South, and to extend beyond its technology-centric innovation logic. This work suggests that although IS provides a useful heuristic for the design of economic policies that promote structural change (including innovation-based growth, increased competitiveness, productivity and employment), the integration of the more expansive environmental and social goals in informal and insecure institutional settings (e.g. ending poverty, reducing inequality, promoting inclusive and sustainable production and consumption systems,

tackling climate change, etc.) require extended analytical lenses. Because of the underlying contestation, complexity, and uncertainty of these systemic challenges in such settings, a methodological framework that goes beyond the technology-centric innovation logic is sorely needed.

Consequently, the use of flexible research design methods has been fundamental in analysing the ways in which (the poorly defined boundaries of) SDGs are shaped locally through collective innovation processes in informal and insecure institutional settings. The post-positivist methodological approach followed in this thesis has opened up the possibility of investigating the contextually unique qualitative characteristics of DIS transformations in insecure and informal institutional settings in Michoacán, Mexico (e.g. inequalities, insecurity, poverty, nature degradation, climate change, and others). It has also enabled an in-depth exploration of the social behaviours that foster responsible and social innovation at the community level. Value-laden research outcomes that resulted from the selected methodological approach were addressed through data and theory triangulation.

The main conclusions of this research can be classified across three different levels. The first refers to the extension of the DIS concept through new empirical findings from real-life informal and insecure contexts, and through the development of conceptual constructs. The second explores the characteristics and capabilities of “dedicated actors” (DAs) to direct IS towards sustainable outcomes, and the third relates to the building of collective capabilities in informal and insecure institutional settings in Michoacán, Mexico. These conclusions are interlinked, and jointly contribute to answering the overall research question of this thesis, and thereby provide the building blocks to advance the innovation system approach.

Firstly, the thesis contributes to the operationalisation of DIS by bridging the gap between theory and practice. The concept of DIS, as a revised framework of IS, constitutes a practical and heuristic approach to the study of transformative change aimed at by the 2030 Agenda, in that it provides greater space for the introduction of “dedicated” efforts in IS for the realisation of the SDGs. Chapter 3 has focused on refining the IS approach to address sustainability, and provides a series of arguments to justify the introduction of the DIS concept. It then elaborated on each of the three

aforementioned dimensions (directionality, legitimacy, and responsibility) to present a detailed description of the contribution of each proposed methodological framework to the operationalisation of DIS dimensions.

The theoretical foundations of the DIS concept emerge from the valuable insights of previous work dedicated to the extension of IS theory to better address this transformative change, and to the promotion of structural changes that are compatible with both social development and environmental goals (e.g. sustainable systems of innovation (SSI), sustainability-oriented innovation systems (SoIS), reflexive innovation systems (ReIS), and others).

Despite the significant contributions of DIS to system innovation theory, the application of the concept has been limited. In this thesis, three cross-cutting practical dimensions have been proposed as fundamental to the application of the DIS concept in informal and insecure institutional settings, namely directionality, legitimacy, and responsibility. A further contribution of this research has been the identification and adaptation of the theoretical frameworks to support the operationalisation of these three cross-cutting dimensions:

1) *Directionality*: the leverage point perspective of sustainability, and the extension of Sen's capability approach (CA) have been used as theoretical frameworks to enable the practical formulation of IS normative goals for sustainability transformation. The integration of CA in the study of innovation-led sustainability transformations has facilitated the application of the DIS concept to any social and institutional context, and is key to combining top-down with bottom-up approaches to sustainability transformations.

2) *Legitimacy*: The engagement of DIS with issues of legitimacy is based upon the 'Ladder of Inclusive Innovation' approach, and allows for the study of how different values, interests, motivations, and the sense of responsibility in people can be devoted to the processes that lead to sustainability transformations. To that end, collective agency can be created within a frame of knowledge and discourse that is inclusive within itself, and that allows for an expansion of the legitimate collective capabilities of poor

and marginalised groups – so they can meaningfully and actively participate in sustainability transformations.

3) Responsibility: A central contribution of this thesis refers to the concept of Dedicated Actors (DAs) as the agents “responsible” for the introduction of “dedicated” efforts towards sustainability through networked interventions in an IS. Specifically, two different types of DAs— Dedicated State Actors (DSAs) and Dedicated Grassroots Actors (DGAs)— have been identified in accordance with the various levels of authority required to enable a dedication to sustainability in DIS.

The characteristics and roles of DGAs in directing DIS towards sustainable outcomes in informal and insecure institutional settings in Michoacán, Mexico have been analysed through three practical case studies, which provided relevant empirical contributions and unique insights to drive the DIS theory of development forward. Chapter 6 explored the characteristics of DGAs that answers for their legitimacy, and practical powers used to influence conversion factors - both in terms of DGAs’ distinctive individual values, motivations and responsibility, as well as the financial, social and economic resources that position them as agents of systemic change.

Given the restrictions on individual agency in the local communities that formed the focus of the case studies, the analysis investigated the characteristics and roles of Dedicated Grassroots Actors (DGAs) as agents with the authority to trigger bottom-up processes of sustainability transformations in informal and insecure institutional settings in Michoacán, Mexico. Future work should be directed to the analysis of Dedicated State Actors (DSAs), which was beyond the scope of this thesis.

In building particularly upon the recent work of Ibrahim (2017), the 3C-Model for grassroots-led development provided a theoretical framework to analyse how DGAs act as initiators and agents of change (in collaboration with other development actors/institutions) by fostering three processes at the grassroots level, namely: (1) Conscientisation, (2) Conciliation, and (3) Collaboration.

Thirdly, the thesis expanded upon the categories of collective capabilities proposed by Rosignoli (2018), and generated new practical insights on the analysis of such

capabilities in real life contexts. Through the three case studies, this work analysed the rise of the ‘resistant capability’ and ‘resilient capability’ of local communities living in insecure or informal institutional settings in the State of Michoacán, Mexico. Chapter 6 studied the elements that allowed these local communities - whose individual agency was severely restricted by weak institutional settings - to build a collective capability to resist structural injustice, and to promote broader sustainability goals.

In conclusion, this research suggests that local communities have a vital contribution to make in solving humanity’s greatest challenge: “*how to restore the sustainability of the global economic system*”. While it is true that the many indicators of the SDGs usefully expand a targeted space, the means of achieving these sustainability goals is not straightforward, as there is no singularly correct right path, but rather, a variety of pathways for the transformation towards sustainability (Scoones, I; et al., 2020).

Thus, advancing the SDGs in informal and insecure institutional settings in the Global South should involve more than merely integrating the SDGs within sub-national level planning. As was observed in the different case studies, sustainability transformations stem from different origins (e.g. geographical, cultural, economic) and institutional settings (welfare, informal and insecure institutional settings), and involve changes within different configurations of power and institutions. Therefore, although essential, top-down approaches alone may prove insufficient in generating paradigmatic change across all different institutional settings, particularly in the informal and insecure contexts in developing countries.

While deep leverage points are fundamental tools to influence the goal orientation of DIS, their effectiveness largely depends on shocks and disruptive events to create windows of opportunities for actors to influence the goals incorporated into IS. In that regard, the leverage point framework should be accompanied by the study of gradual and path-dependent processes that may involuntarily occur as communities adapt their practices to comply with an evolving environment.

This research suggests that DIS supports the incorporation of the strategic orientation of the innovation systems that result in processes of transformative change, to address the SDGs in informal and insecure institutional settings in the Global South.

The individual case studies featured in the thesis provide empirical support for the three following conclusions: First, that collective capability formation — particularly in insecure and informal institutional settings in the local contexts of developing countries— is essential for building different paths of innovative and sustainable development.

Second, DGAs play a key role in the formation of collective capabilities in informal and insecure institutional settings. As agents embedded in local institutions, they possess the legitimacy or local recognition “on-the-ground”, as well as the pragmatic power to foster systemic change through bottom-up processes of sustainability transformations. DGAs have the capacity to influence (either directly or indirectly) the enforcement of the formal and informal institutional elements that motivate, coordinate, and enable individuals to follow particular behaviours directed to sustainable goals.

Thirdly, although sustainability narratives (circular economy, green economy, and bioeconomy/knowledge based bioeconomy) are all interconnected and share the common purpose of transforming the current economy towards a more sustainable one, they emerge from general/global assumptions.

This research helps to bring about a better understanding of how different geographical, socio-economic, political, and cultural characteristics can shape these narratives; by including different knowledges, values, and worldviews, context-specific sustainability strategies can be promoted and adapted to local innovation processes in informal and insecure settings in Michoacán, Mexico.

Notwithstanding these findings, in order to arrive at a fully operational DIS framework that explicitly incorporates directionality, legitimacy, and responsibility in innovation systems to address contemporary societal and environmentally wicked problems, more research is needed (e.g. more case studies from different local contexts, combined with an analysis of the use of leverage points at the local level).

- Implications for innovation policies for sustainability transformations

This thesis concludes by presenting the broader implications for innovation policies for sustainability transformations, as well as recommendations for future research areas that could accompany the findings of this work.

A diverse team of researchers from Globelics network, the Sustainability Transitions Research Network (STRN), and the Transformative Innovation Policy Consortium (TIPC) agree that innovation policies can further the type of transformative systemic changes called for by the 2030 Agenda, provided that the variety of contexts in both the Global North and Global South are integrated in policy design processes (TIPC, 2019).

This thesis draws upon the assumption that local grassroots experimentation and adaptation in real world policy contexts in the Global South can contribute to transformative changes and promote diverse pathways for transformative innovation policy.

In relation to the first proposition of this thesis, specifically regarding Dedicated Innovation Systems (DIS) and the analysis of the three cross-cutting dimensions that lead to transformative change at the local level (directionality, legitimacy, and responsibility), a focus on applying DIS to real world contexts has provided new insights on the often overlooked dynamics, interstices, and determinants that influence innovation in informal and insecure institutional settings in developing countries. The integration of these insights in the formulation of transformative innovation policies is fundamental for a down-to-earth delivery of the SDGs in the Global South.

With respect to the second proposition of the thesis, namely the Grassroots Dedicated Actors (GDAs), the notion of a group of actors with the agency to improve innovation systems, and direct them towards sustainable outcomes, is a significant contribution to the design of transformative innovation policies. The identification of the underlying characteristics and roles of these actors allows for their integration in the consultative process of transformative innovation policies.

Regarding the third proposition of the research, the fostering of the creation of collective capabilities in informal and insecure settings should be a fundamental objective of transformative innovation policies in the Global South. Without policies to support and foster the building of such capabilities, innovation processes may be unable to be incubated in institutional settings at the local level. This thesis builds upon the categories of collective capabilities proposed by Rosignoli (2018), and presents the exercise of practically applying the concept. Transformative innovation policies can integrate the resulting analysis in the fostering of local transformations to sustainability in the Global South.

Finally, regarding the fourth proposition of the patterns and dynamics of innovation processes in informal and insecure institutional settings, it was found that there is a need for transformative innovation policies to embrace the complexity of system transformations within diverse institutional contexts. Most notably in the Global South, where institutional dynamics vary widely, and where innovation processes cannot always be measured through established indicators, DIS represents a practical framework for the incorporation of the particular dynamics that emerge from these institutional settings.

- Future research agenda

Although transformative innovation policy is considered an emerging field (Diercks, G., Larsen, H. and Steward, F., 2019, p. 892), insights from the Global South must be integrated into the core ideas, concepts, and categories of the evolving policy practice. As pointed out by researchers from TIPC, GLOBELICS, and STRN, innovation policies can only deliver on sustainability transformations if they can “*be reflexive on the problems we are addressing through transformation—which could be radically different in global North and global South*” (TIPC, 2019, p. 1).

The complexity involved in the study of innovation processes in informal and insecure settings in Latin America has resulted in limited research being conducted in this area so far. Of the few grassroots innovation cases documented in the literature, most take place in ‘welfare’ settings (Ramos, M., Franco, M. and Jauregui, J., 2018). A better understanding of ‘informal’ and ‘insecure’ institutional settings in LA economies can contribute to unveiling patterns and dynamics of innovation processes appropriate to

these contexts, and help policy makers to gain new insights key to the design of effective and inclusive policies that promote local transformations towards sustainability.

Future research on innovation policies for sustainability transformations in developing countries should supplement the building of empirical support with more case studies from different local regions and contexts, which would enrich the understanding of how collective capabilities are created in informal and insecure settings. It would also allow for a comparative analysis of the innovation processes in welfare regions, and those in contrasting institutional settings.

One central argument of this thesis is that that single actors, or singular approaches - whether top down or bottom up - cannot effectively foster transformative systemic changes towards sustainability (Morrison, T. et al., 2019), as enabling a dedication to sustainability in DIS requires commitments and negotiations at various levels and subsystems (Schaile, M. et. al., 2017).

This research has focused on the study of DGAs as agents with the authority to trigger bottom-up processes of sustainability transformations. Through the use of Ibrahim's (2017) 3C model, DGAs were analysed to determine their roles as initiators and agents of change towards sustainability (in collaboration with other development actors/institutions) through their fostering of three processes at the grassroots level, namely: (1) conscientisation, (2) conciliation, and (3) collaboration.

Future research on Dedicated State Actors (DSAs) may enhance the findings of this thesis, particularly regarding the impact of building synergies between those DSAs with the power to design legislations and influence top-down institutional reforms, and DGAs. Of particular importance to future research would be the study of deep leverage points as fundamental tools for influencing the goal orientation of DIS. The findings of this thesis will be richer with further studies of how DSAs engage with deep leverage points by seizing on the shocks and disruptive events that bring windows of opportunity for niche configurations to emerge. Finally, relevant insights for transformative innovation policy research could be developed from the study of a) the conditions under which different DGAs and DSAs have the capability to jointly introduce directionality in IS towards sustainability, b) how changes in power dynamics

can help/hinder DGAs and DSAs capabilities, and c) the patterns of involvement of DSAs and DGAs over the various phases of the transformation processes towards sustainability.

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Appendices

Appendix I - Interview script

General guidelines: This interview guide should be applied to Grassroot Dedicated Actors (GDAs) and members of local communities of Ejido Verde (EV) /Red Tsiri (RT)/ the Security Council (SC). It is aligned with the objectives and the framework proposed by the research, and may undergo changes because it is exploratory research. Each question should be adapted to the corresponding case study (EV/RT/SC)

At the beginning of the interview:

- I. Request authorization to record the interview. Emphasize that it will be transcribed;
- II. Seek consent on the use of the names of organizations and respondents when publishing;
- III. Collect personal data about the interviewee (organization to which she belongs, position, time in the position and previous experiences in the same branch, when applicable);
- IV. Present the research objectives:
 - General objective of the research: To understand the role of dedicated actors in the process of developing collective capacities in social innovations.
 - Specific guiding objective of this interview: Empirically analyse the framework for the development of collective capacities in social

General knowledge issues

- Describe your involvement with EV/RT/SC and the communities where you work?
- According to you, what is the perception of local communities concerning EV/RT/SC?

Group 1: Resources (assets)

1.1 Assessing individual values, motivations and responsibility

GDAs

- EV: How did you become aware of the problematic of deforestation in Michoacán, and why is it important for you?
RT: How did you become aware of the value of maize diversity conservation (deforestation) in Basins of Lakes Pátzcuaro-Zirahuén (BLPZ) and why is it important for you?
SC: How did you become aware of the problematic of violence and deforestation in Tancítaro, and why is it important for you?
- What was the main motivation for the creation of EV/RT/SC?
- What is the social responsibility of EV/RT/SC?
- How is EV/R/SC fostering sustainable development at the local level?

Local Community Member

- Why is it important to you and your community to support the conservation of forests/ different varieties of maize/ peace?
- How can supporting the conservation of forests/different varieties of maize/peace have an impact in your production/income level?
- Who should be responsible for supporting the conservation forests/different varieties of maize/peace?
- Do you feel that you can do something (individually) to support the conservation forests/different varieties of maize/peace?

1.2 Assessing financial, social and economic resources

GDAs

- From the following, which would you say are the most important assets that EV/RT/SC has to implement strategies to reduce deforestation/ conserve maize diversity/ reduce violence?
 - Human capital (personal skills, practical expertise, experience, know-how, etc.)

- Social capital (networks of trust and reciprocity)
- Financial capital
- Others (please specify)

Local Community Member

- Which would you say are the most important reasons that constraint/enable your capability to act upon deforestation/ conservation of maize diversity/violence:
 - Financial resources
 - Knowledge
 - Community network
 - Other (specify)

Group 2: Conscientisation

2.1 Create awareness and foster critical reflection about alternatives to perceived feasible possibilities

GDAs

- What are the main goals of EV/RT/SC? How do they contribute to community development?
- Do you consider that before the creation of EV/RT/SC, there was awareness about the problematic (deforestation/maize diversity conservation/violence) and the impacts to livelihoods?
- Which strategies did you use to create awareness? (groups discussions, community meetings, participatory workshops or informal conversations)

Local Community Member

- What is EV/RT/SC?
- How do you engage with EV/RT/SC? (workshops, group discussions, meetings)
- Perceived feasible possibilities: Before collaborating with EV/RT/SC, how did you use to work? What were the benefits?

2.2 Inspire desire to improve life

GDAs

- Which strategies do you use to engage with local communities? How do you reach out to communities?
- What kind of support do you provide to communities? (financial, training, other)

Local Community Member

- Why did you decided to be part of EV/RT/SC? (skills, training, financial resources, stop deforestation?)
- How has this (working with EV/RT/SC) improved your life? And the life of the community?

Group 3: Conciliation

3.1 Linking individual needs with communal goals

GDAs

- Does EV/RT/SC contribute to any of the following local needs?
 - income generating activities,
 - job creation
 - reduction of migration
 - health and food security
 - reduction of violence and insecurity
 - reduction of deforestation
- If yes, how?

Local Community Member

- Which of the following issues would you consider the most pressing ones in your community?
 - reduction of violence and insecurity
 - income generating activities,
 - job creation

- reduction of migration
- health and food security
- reduction of deforestation
- Do you think that Red Tsiri has helped in any way to address these issues?

3.2 Coordinating community participation and active voice

GDAs

- Does EV/RT/SC facilitate groups discussions, meetings, participatory workshops or informal conversations?
- If yes, who is normally involved in the meetings and how do you ensure that all participants express their ideas?

Local Community Member

- Have you attended groups discussions, meetings, participatory workshops or informal conversations organized by EV/RT/SC?
- If yes, did you have the opportunity to express your ideas?

3.3 Knowledge exchange and skills acquisition

GDAs

- How do participants develop their skills when working with EV/RT/SC?

Local Community Member

- What new skills or knowledge have you acquired through EV/RT/SC?

Group 3: Collaboration

3.1 Facilitating collaboration with regional actors: other communities, local initiatives, local government

GDAs

- Does EV/RT/SC facilitate exchanges among communities supported?

- With which local actors has EV/RT/SC built partnerships?

Local Community Member

- Do you collaborate with other actors from other communities in Michoacán that are working with EV/RT/SC?

3.2 Facilitating collaboration with external actors: state, donors & NGOs

GDAs

- How is Red Tsiri scaling-up its impact?
- With which actors has EV/RT/SC built partnerships (state, donors, NGOs, international cooperation)?