

UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ

FACULTADES DE CIENCIAS QUÍMICAS, INGENIERÍA, MEDICINA

Y CIENCIAS SOCIALES Y HUMANIDADES

PROGRAMA MULTIDISCIPLINARIO DE POSGRADO EN CIENCIAS AMBIENTALES

AND

TH KÖLN - UNIVERSITY OF APPLIED SCIENCES

FACULTY SPATIAL DEVELOPMENT AND INFRASTRUCTURE SYSTEMS

INSTITUTE FOR TECHNOLOGY AND RESOURCES MANAGEMENT IN THE TROPICS AND

SUBTROPICS

**AN ALTERNATIVE LIVELIHOOD FOR A MINING COMMUNITY IN THE
SIERRA GORDA DE QUERÉTARO, MEXICO. A SUSTAINABILITY
ANALYSIS.**

THESIS TO OBTAIN THE DEGREE OF

MAESTRÍA EN CIENCIAS AMBIENTALES

DEGREE AWARDED BY UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ

AND

MASTER OF SCIENCE

NATURAL RESOURCES MANAGEMENT AND DEVELOPMENT

DEGREE AWARDED BY TH KÖLN – UNIVERSITY OF APPLIED SCIENCES

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**LA MAESTRÍA EN CIENCIAS AMBIENTALES RECIBE APOYO A TRAVÉS DEL SISTEMA
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An Alternative Livelihood for a Mining Community in the Sierra Gorda de Querétaro, Mexico. A Sustainability Analysis. © 2024 by Miguel Angel Moreno Martinez is licensed under Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International. To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc-sa/4.0/>

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Abstract

This thesis investigates the sustainability of proposed alternative livelihoods for the mining community of Camargo in the Sierra Gorda of Querétaro, Mexico. With the impending ban on mercury mining under the Minamata Convention, the community faces the urgent need to transition to sustainable livelihoods. Utilizing the Sustainable Livelihoods Framework (SLF) as a guiding theoretical model, this study assesses the current state of the Five Capitals—human, social, natural, physical, and financial—within the community. It also examines the community's perceptions and attitudes toward these alternative livelihoods and evaluates the external influences, such as government and academic institutions, that impact their sustainability.

Data were collected through semi-structured interviews with community members, miners, and external stakeholders, and analyzed using qualitative coding in MAXQDA. The findings reveal a complex interplay between the Capitals of the community and the role that external stakeholders play, highlighting both opportunities and barriers to follow a path of sustainability.

The study concludes that the livelihoods with most potential for a sustainability path are the cultivation of regional species and the installation of a touristic point in the community. A holistic approach that integrates economic, social, and environmental dimensions, while at the same time considers a tailored natural resources management, is essential for ensuring the path of sustainability of the livelihoods. Points of leverage for change are presented for policy and advocacy, infrastructure development of the community, and considering local resource management in the design and implementation of sustainable livelihood strategies.

Keywords: Sustainable Livelihoods Framework (SLF), Mining Communities, Social Capital, Community Perceptions, Rural Livelihoods

Resumen

Esta tesis investiga la sostenibilidad de los medios de vida alternativos propuestos para la comunidad minera de Camargo en la Sierra Gorda de Querétaro, México. Ante la inminente prohibición de la minería de mercurio bajo el Convenio de Minamata, la comunidad enfrenta la necesidad urgente de transitar hacia medios de vida sostenibles. Utilizando el Marco de Medios de Vida Sostenibles (SLF, por sus siglas en inglés) como modelo teórico guía, este estudio evalúa el estado actual de los Cinco Capitales—humano, social, natural, físico y financiero—dentro de la comunidad. También examina las percepciones y actitudes de la comunidad hacia estos medios de vida alternativos y evalúa las influencias externas, incluyendo instituciones gubernamentales y académicas, que impactan su sostenibilidad.

Los datos se recolectaron a través de entrevistas semiestructuradas con miembros de la comunidad, mineros y actores externos, y se analizaron utilizando codificación cualitativa en MAXQDA. Los hallazgos revelan una interacción compleja entre los Capitales de la comunidad y el papel que juegan los actores externos, destacando tanto las oportunidades como las barreras para seguir un camino hacia la sostenibilidad.

El estudio concluye que los medios de vida con mayor potencial para un camino de sostenibilidad son el cultivo de especies regionales y la instalación de un punto turístico en la comunidad. Un enfoque holístico que integre dimensiones económicas, sociales y ambientales, y que al mismo tiempo considere una gestión adaptada de los recursos naturales, es esencial para asegurar el camino hacia la sostenibilidad de los medios de vida. Se presentan puntos clave para el cambio para políticas y abogacía, desarrollo de infraestructura de la comunidad y la consideración de la gestión local de los recursos en el diseño e implementación de estrategias de medios de vida sostenibles.

Palabras clave: Marco de Medios de Vida Sostenibles (SLF), comunidades mineras, capital social, percepciones comunitarias, medios de vida rurales

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List of Abbreviations and Acronyms

- CONANP: Comisión Nacional de Áreas Naturales Protegidas, National Commission of Natural Protected Areas
- ECLAC: Economic Commission for Latin America and the Caribbean
- GEF: Global Environment Facility
- INECC: Instituto Nacional de Ecología y Cambio Climático, National Institute of Ecology and Climate Change
- NPA: Natural Protected Area
- PRONAFOR: Programa Nacional Forestal, National Forestry Program
- SDG: Sustainable Development Goals
- SEDESU: Secretaría de Desarrollo Sustentable, Secretariat of Sustainable Development
- SEMARNAT: Secretaría de Medio Ambiente y Recursos Naturales, Secretariat of Environment and Natural Resources
- SGM: Servicio Geológico Mexicano, Mexican Geological Service
- SLF: Sustainable Livelihoods Framework
- UASLP: Universidad Autónoma de San Luis Potosí
- UAQ: Universidad Autónoma de Querétaro
- UN: United Nations
- UNDP: United Nations Development Programme
- UNEP: United Nations Environment Programme

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1 Introduction: When a Livelihood is no Longer Viable

1.1 Problem statement

Livelihoods of rural communities are being threatened by global changes such as economic transitions, migration, forced displacements, climate change, or international agreements. These situations have several consequences, from diversification of livelihoods (Peng et al., 2022), to adaptation of the previous livelihood to the new conditions (Stacey et al., 2021), or the search for a new alternative livelihood compatible with the new set of dispositions (Arondekar & Murthy, 2017).

Rural communities are always adapting to new sets of environmental, economic, and political conditions, with or without the active involvement of the government. Being the construction of a dam and, therefore, the relocation of the community (Castro-Diaz et al., 2023), the adaptation to a new set of climate conditions or natural disasters (Kaiser, 2023; Tora et al., 2022), or a legal ban of productive activities (Osei et al., 2021; Wekesa et al., 2023), most of times the community has no saying in the process of alteration, it just adapts.

An example of such cases, where communities need to adapt to rulings, is the Minamata Convention on mercury which comes into the conversation due to its restricting nature of banning mercury mining and transforming small-scale and artisanal gold mining. The convention seeks to protect human health and the environment from anthropogenic releases of mercury and their compounds, since mercury has adverse effects on humans and the environment (UNEP, 2019).

Mexico possesses one of the richest reserves of mercury in the world, where a big part of the mineral is found in the Sierra Gorda Biosphere Reserve, a Natural Protected Area (NPA), in the northern part of the State of Querétaro (Castro Díaz, 2013). Around the traditional mines in this NPA, occupational communities work to obtain metal mercury for its commercialization (INECC, 2020b).

Mining tradition in the Sierra Gorda dates back since pre-colonial times, though there is a lack of official records. According to registries from the Mexican Geological Service, in the 1970s the municipalities of the region made Querétaro

the first national producer (Martínez Arroyo et al., 2017). Ten years ago, mercury represented around 30% of the mining activity of the State.

Despite its strong economic importance, or perhaps due to it, many families in the region depend solely on this economic activity as their source of income (Martínez Arroyo et al., 2017). In that same category, some of the miners work clandestinely in abandoned mines or mining waste scavenging for leftover ore. These men are known as “gambusinos” in Spanish, and work in the informal sector under precarious conditions.

Even if mercury mining provided a strong economic sustain for the state economy, these mining communities are still characterized by a high degree of social and economic marginalization and are vulnerable to climate change according to local and federal authorities (INECC, 2020a). Mercury mining provides employment for around 1,415 people in the region (INECC, 2021) who need to diversify and find alternative livelihoods to subsist in a post mining ban society. Said activities must be socially accepted, economically profitable and in accordance with the applicable environmental regulations for their ecosystem.

But alternative livelihoods, as opposed to the restriction, must be concerted by working directly and side by side with the people affected, since the problem will not and cannot be adequately addressed without the active engagement of key stakeholders (Fritz et al., 2016). The importance of discussing potential plans in the face of closing mercury mines and providing alternative livelihoods is highlighted in a study case (Spiegel et al., 2018) where, long-term community-based approaches are needed to transition to a mercury free economy.

To aid the transition to alternative livelihoods, the Global Environment Facility (GEF) and the United Nations Environment Programme (UNEP) have co-financed the GEF ID 10086 Project “Reducing global environmental risks through the monitoring and development of alternative livelihood for the primary mercury mining sector in Mexico” (UN Environment Programme & Global Environmental Facility, 2022) together with the Mexican federal Secretariats of Environment and Natural Resources (SEMARNAT), and Well-being (BIENESTAR), the state Secretariat of Sustainable Development (SEDESU) of Querétaro and the Universidad Autónoma de Querétaro (UAQ).

The main objective of the project is “to prevent the risks to environment and human health from mercury through the control of primary mercury mining and enabled environmentally and socially sound alternative economic activities and livelihoods in the state of Querétaro.” (Global Environment Facility, 2020) It has two components, of which the second is the subject of this study as it deals with the introduction of alternative livelihoods by providing technical assistance to miners in Querétaro to adopt alternative income-generating activities. The expected outcomes of the mentioned component are that alternative economic activities and livelihoods for miners and local communities are identified and that the awareness of miners and local communities of the Minamata Convention obligations is enhanced.

The main executive agency of the project is the National Institute of Ecology and Climate Change (INECC, Instituto Nacional de Ecología y Cambio Climático, in Spanish) a decentralized public organism sectorized to the SEMARNAT. Other relevant partners are the mentioned Secretariats and their respective undersecretariats, as well as the local governments of the Sierra Gorda municipalities and academic institutions like the Universidad Autónoma de San Luis Potosí (UASLP).

It is also worth noticing that the proposed alternative livelihoods must also be in accordance with the management plan of the NPA, since it is the guiding ordainment plan for the region. Fortunately, Camargo is not located in the core zone of the NPA, but in the buffer zone which has less restrictions for economic activities. Nevertheless, the NPA adds an extra layer of complexity to the matter in question.

Thus, efforts to support the transition to alternative mercury-free livelihoods for mining communities in the Sierra Gorda region of Querétaro have already started and are supported by local, national and international agencies. This study involves the institutions and stakeholders mentioned above and is constantly referring to, but independent of, GEF project 10086. Since the project covers a wide spectrum both spatially -the mining communities of the Sierra Gorda- and temporally -until 2027-, the focus of the present study is the sustainability of the new alternative livelihoods for the community of Camargo in Peñamiller, Querétaro.

1.2 Justification

When talking about threatened rural livelihoods due to international agreements or national policies, there have been experiences in some parts of the world where mining restrictions have been imposed. In Goa, India, the government implemented a mining ban in 2012 (Arondekar & Murthy, 2017), whereas in Northeast India, tribal communities have resisted mining bans from 2014 (McDuie-Ra & Kikon, 2016). Similarly, Kenya implemented a charcoal ban in 2012 (Wekesa et al., 2023), and in 2017 in Ghana, artisanal and small-scale mining was banned (Osei et al., 2021; Zolnikov, 2020). In these countries, there has been a variety of research on the social or environmental impact of the restriction, but rarely has attention been paid to alternative livelihoods, especially from a sustainability approach.

The livelihood that the members of a community choose to implement in their day to day lives ought to be environmentally, socially, and economically sustainable (Tora et al., 2022). This means, that the livelihood must be compatible with the natural resources and the ecosystem where the community is located, accepted by all or most of the members of the community and profitable so everyone can make a decent living.

The search for alternative livelihoods is a collateral effect of the Minamata Convention on mercury, which banned primary mercury mining by 2032, 15 years after its approval in 2017. Parties of the Convention are also encouraged to “promote the development and implementation of strategies and programmes to identify and protect populations at risk, particularly vulnerable populations, and which may include adopting science-based health guidelines relating to the exposure to mercury and mercury compounds” (UNEP, 2019). Since Mexico is a signing Party, these responsibilities must be applied in the national territory, by the public sector, to the mining communities which are exposed to mercury from mining.

There is where the GEF project comes into play, which seeks to aid the implementation of alternative livelihoods for mining communities in the Sierra Gorda de Querétaro that are affected by the ban on primary mercury mining (UN Environment Programme & Global Environmental Facility, 2022). The focus of the project is to reduce the environmental risks through the introduction of

alternative livelihoods. But the sustainability aspect of the livelihoods must also be taken into account, so they are not subject of another restriction, hence the need to evaluate and assess the sustainability factor.

Among the previous projects funded by the GEF, there is a similar case titled “Reducing global and local environmental risks from primary mercury mining in Khaidarkan, the Kyrgyz Republic” with Project ID 4985. Component 1 contained activities to help the community’s economy switch from mercury production to other mining and non-mining alternatives. The findings of the project report that “the [first] long-term outcome 'Community reliance on mercury mining reduced through identification of alternative diversified employment opportunities' has been assessed as not achieved. The mine production stopped due to external factors but is expected to resume operation again.” (UN Environment, 2018)

This sets an important background regarding internationally funded efforts directed to livelihood conversion from mercury mining to other activities. However, as often happens in development related projects, each case must be analyzed individually to determine the conditions under which it will be carried out to satisfy the expected outcomes which should be tailored to the context.

When an external force imposes itself on a community’s primary livelihood and source of income, which is then forced to find a new livelihood or livelihoods, a framework can be useful to explore the possibilities these people have. Frameworks have worked to explore the evolution of a livelihood over time and once it is settled, but whether it can help to assess a new set of livelihoods for a community, is the question posed as the purpose of this investigation.

Therefore, an opportunity is presented to study the sustainability of future livelihoods at this specific time, the Minamata Convention mining restriction under Article 4, and place, a mining community in the Sierra Gorda de Querétaro. The members of this community, and many other mining communities worldwide, see their livelihoods threatened by the legislation but are also facing a transition process, which may be an opportunity to migrate to a more sustainable livelihood, with the appropriate support from legal framework and technical expertise.

To sum things up, this study is focused on evaluating the sustainability of alternative livelihoods for a mining community in Querétaro, using the

Sustainable Livelihoods Framework as a guide. By doing so, this research aims to provide actionable insights for community development by identifying and assessing alternative livelihoods, while also offering a critical assessment of the SLF's applicability and effectiveness in this context.

1.3 Objectives

General

To analyze the sustainability of proposed alternative livelihoods for a mining community in the natural protected area Sierra Gorda of Querétaro.

Specifics

- Assess the current state of the Livelihood Capitals of the Camargo community, according to the Sustainable Livelihood Framework.
- Identify community perceptions and attitudes toward sustainable livelihoods.
- Evaluate external factors influencing livelihood sustainability, such as assistentialism, government policies and academic studies.
- Analyze the potential barriers and opportunities for the implementation of sustainable livelihoods.

1.4 Overview of the content

The Second Chapter introduces the concepts which are employed in the analysis and discussion of the findings. The Conceptual Framework provides a guidance of theories and definitions, along findings of previous research, to get familiarized with the case of study of the document. It also sets the territory for the employed SLF, its precedents and the relationship with other concepts.

In the Methods Chapter, a description on the community of Camargo is redacted and depicted to familiarize with the focus of the research and the regional context. Furthermore, the process of brainstorming, creating and curating the questions used for the semi-structured interviews, and to satisfy the objectives, is clarified. Additionally, a report of the field trip and the performed interviews is presented.

Finally, the link between the results and the SLF is explained through the qualitative analysis of coding the data.

Throughout the Results and Discussions Chapter, the outcomes of the Methods are analyzed according to the SLF into two categories: the Capitals of the community of Camargo and the inputs of the interviewed external stakeholders. This Chapter provides a profound discourse regarding the roles that the miners, the community and the external stakeholders play in the transition to sustainable livelihoods. To facilitate the analysis and refresh the reading, a summary of key findings is done at the end.

Finally, in the second-to-last chapter, the Conclusions of the study are presented regarding the satisfaction of the objectives with the used methods and the analysis performed in the text. A series of key leverage points to ease the transition to a sustainable path with the proposed livelihoods is offered according with the outcomes of the analysis. Lastly, the final thoughts of the thesis together with its limitations and further research possibilities, are presented.

2 Conceptual Framework: What Makes a Livelihood Sustainable

In this Chapter, key concepts are developed and explained to establish the theoretical foundations of the research. The choice of methodology is also justified, delving into its limitations and advantages for the case of study. The concepts also help to identify the relationships between the different variables of the research, particularly during the discussion of the results.

2.1 Sustainability

As Ruggerio points out, “the concept of sustainable development is often associated with the concept of sustainability and thus both terms are used as synonyms, even in the academic and scientific fields” (2021). Therefore, both concepts are used interchangeably in this section, though throughout the present study, the term “sustainability” is preferred.

When thinking of sustainable development, the “Our Common Future” report, also known as the Brundtland report, comes to mind. This official discourse published and accepted by the United Nations talks about a development that “ensure[s] that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987).

This report from the World Commission on Economic Development initiated the debate of what sustainable development and sustainability are. Some authors like Mebratu, stated that “the highly instrumental political expediency that has resulted from the vagueness of the WCED definition of sustainable development has led to a diverse spectrum of definition and interpretation” (1998). Therefore, since the 1990s there have been several attempts to define what sustainable development is.

According to Harris (2003), sustainable development has three perspectives: economic, ecological, and social. In his work, he synthesizes the economic, ecological, and social perspectives into a coherent framework for sustainable

development, and he argues for new guidelines in development processes and the importance of integrating all three dimensions for true sustainability.

Other authors, such as Bolis et al. (2014) have proposed a model for defining sustainability which emphasizes other three key dimensions:

- Satisfaction of human needs (including social and economic aspects)
- Natural resources (considering Earth's limitations)
- Decision-making perspective (from an axiological, value-based point of view)

By doing so, the authors offer a structured model that integrates the axiological perspective to sustainability, placing focus on the actions, decisions and core values behind them (Bolis et al., 2014).

More recently, the Agenda for Sustainable Development, or Agenda 2030, has played a prominent role dictating what sustainability is. In the document, the United Nations envisions a world where sustainable development includes “sustained and inclusive economic growth, social development, environmental protection and the eradication of poverty and hunger.” (United Nations, 2015)

The Agenda 2030 includes the 17 Sustainable Development Goals (SDG) each with its own set of objectives. For this investigation, Goal 8 has a special meaning since it deals with promoting sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all. Particularly, the following objectives are of interest:

- 8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high value added and labour-intensive sectors
- 8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity, and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services.
- 8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment.

- 8.9 By 2030, devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture and products.

These concepts and strategies are dictated by the UN and were ratified by Mexico in 2015. Furthermore, the national commitment has been established in the most recent report of 2021 (Secretaría de Economía, 2021).

However, Henderson and Loreau have shed a light on the potential disadvantages of guiding projects and taking decisions based solely on the SDGs. Although they recognize that "the 17 UN Sustainable Development Goals (SDGs) and 169 targets represent a major achievement in the development of sustainable practices on a global scale" (2023), they also argue that current population size and resource use are unsustainable under any one goal or combination of goals.

Furthermore, they find that social progress occurs faster than environmental progress, suggesting the need to prioritize socio-ecological policies. Therefore, the authors recommend focusing on these policies that promote well-being and sustainability, particularly in lower-income countries (Henderson and Loreau, 2023).

Sustainability is one of the pillars of the present study, and in combination with the concept of livelihoods, guides its main objective. It is used in the application of the Sustainable Livelihoods Framework in Camargo, and it guides the analysis of the results. The study also aligns with the SDGs in the context of the GEF project, though it is independent from it.

2.2 Livelihoods and Sustainability

According to the United Nations Environment Programme, the Green Climate Fund, and the Institute for International Development "a livelihood is a means of making a living. It encompasses peoples' capabilities, assets, income, and activities required to secure the necessities of life. A livelihood is sustainable when it enables people to cope with and recover from shocks and stresses (such as natural disasters and economic or social upheavals) and enhance their well-being and that of future generations without undermining the natural environment or resource base." (DFID, 1999)

Linking the term with the present research and although not mentioned as sustainability, the approach is mentioned in the project of the Global Environmental Facility titled “Reducing global environmental risks through the monitoring and development of alternative livelihood for the primary mercury mining sector in Mexico”. The goal of the project is to “prevent the risks to environment and human health from mercury through the control of primary mercury mining and enabled environmentally and socially sound alternative economic activities and livelihoods in the state of Querétaro.” (Global Environment Facility, 2020)

It is worth mentioning that a livelihood may exist without being sustainable and against all the principles of environmental protection (Access information on Multilateral Environmental Agreements, n.d.). However, the goal of several projects of government agencies is to promote the creation, migration and/or transition to sustainable livelihoods in accordance with the 2030 Agenda and the SDG (United Nations, 2015).

The subject of study, in this case, is the sustainability of a livelihood, and “a livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base” (Chambers & Conway, 1992). In this small, yet precise definition, key concepts, which will be further developed in the present chapter, are included.

2.3 Sustainable Livelihoods Framework (SLF)

As mentioned before, livelihoods and sustainability are usually coupled together. Some authors have created frameworks to assess the sustainability of a livelihood, which may be applied to real life cases to proof its validity. From the already cited Chambers and Conway in 1992, to Scoones in 1998, the imminent arrival of the new millennium was a fertile ground for development theories.

Thus, the Sustainable Livelihood Approach and Framework (SLF) arose thanks to two working papers of the above-mentioned authors of the Institute for Development Studies. In these papers, the authors not only defined sustainable

livelihoods, but also proposed methodologies to assess them, and showed how the variables for the assessment may change in the following years.

One of the results of the Approach was published as the Sustainable Livelihoods guidance sheets by the Department for International Development (DFID, 1999), which focuses on capitals. The working framework is displayed in Figure 1 with the pentagon including all 5 capitals: human, social, physical, financial, and natural.

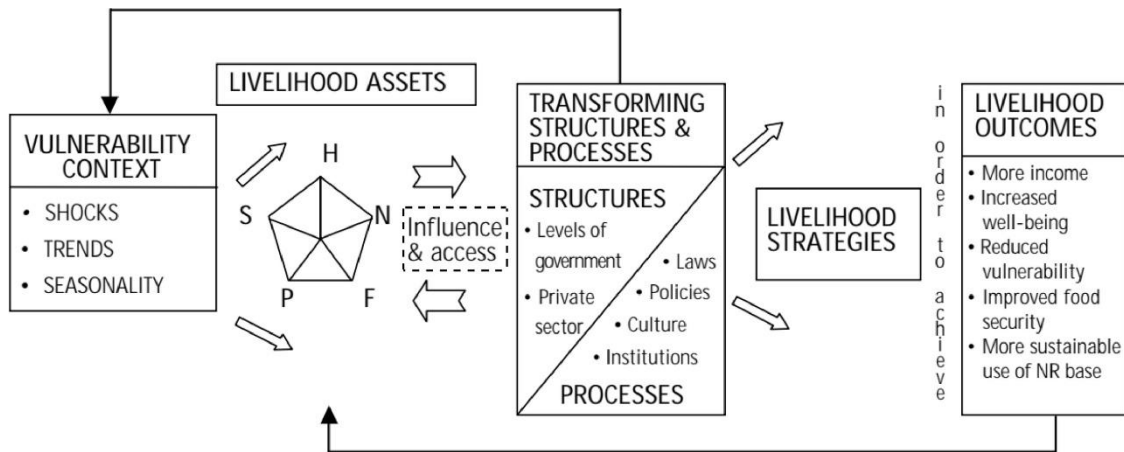


Figure 1. The Sustainable Livelihoods Framework by the DFID

Like all frameworks, it acknowledges its limitations by recognizing that it is a simplification, and that the full diversity of livelihoods can only be understood by qualitative and participatory analysis at the local level (DFID, 1999). This is further strengthened by a critique by Batterbury (2008), ten years after the presentation of the SLF. He emphasized the need for an integration of the traditional social, economic, and environmental dimensions while, at the same time, maintaining the focus on the local context of the analysis.

The SLF is considered “an example of a genuinely transdisciplinary approach produced, disseminated, and applied in the borderland between research, policy, and practice” (Knutsson, 2006). It has, therefore, been used in some studies dealing with mining with findings varying from livelihood generation activities and Corporate Sustainability in India (Narula et al., 2017), or the formalization of informal activities in Colombia (Delgado Jiménez et al., 2022).

However, the SLF has also received some criticism such as its focus on micro-economy and household analysis which is not useful when trying to analyze a

national policy (Mensah, 2012) or its insufficient attention to history and politics, and the need to decolonize knowledge (Natarajan et al., 2022). There have been attempts to modernize the SLF and adapt it to the 21st century, particularly by Natarajan et al. (2022) who proposed the integration of relational power and climate/environmental context to provide a more comprehensive understanding of rural livelihoods.

The main guiding document for the present study, however, is the Guidance Note on the Sustainable Livelihoods Framework created by the United Nations Development Programme (2017). This Note was specially created after an analysis of GEF funded projects in Latin America and the Caribbean. It defines the Five Capitals while providing examples for its application in real life projects. Furthermore, it places an emphasis on participatory approaches and the involvement of local communities in assessing and enhancing their livelihoods, illustrating how stakeholders prioritize various forms of capital differently based on their perspectives and roles.

The integration of participatory approaches is highlighted by Levine (2014) as he stresses the need for disaggregated analysis to capture the diversity of livelihood strategies and outcomes. He also highlights the importance of integrating gender and identity perspectives to fully understand the complexities of livelihoods. Therefore, the discussion of results of the present study is guided by this line of thought and acknowledges that “understanding livelihood outcomes should not be confined to assessing or measuring people’s economic success: it can and should encompass all the dimensions of livelihoods which are most important to the people concerned” (Levine, 2014).

In the context of this study, a livelihood encompasses the capabilities, assets (both material and social resources), and that individuals and communities utilize to sustain their living. It is influenced by socio-economic and environmental factors and requires a balance between immediate needs and long-term sustainability.

Drawing on the work of Chambers & Conway (1992), Scoones (1998), and the United Nations Development Programme (2017), this definition can help guide the principles of a sustainable livelihood for Camargo. Among these, decisions must be made that are responsive and participatory, multilevel, conducted in

partnership with the public and private sectors, dynamic, and, above all, sustainable (Serrat, 2017).

In essence, this study aims to address the critical question posed by Scoones in his working paper: “In a given context, which combination of livelihood resources enables the pursuit of which livelihood strategies, and what are the resulting outcomes?” (Scoones, 1998) This analysis seeks to assess the sustainability of alternative livelihoods for Camargo, with the mentioned considerations.

2.4 Social Capital

Though it might be confused with the Five Capitals in the SLF, this Social Capital is a separate concept from the Framework, with some similarities and differences that are explored in the following paragraphs. This concept has been defined by authors like Bourdieu (1986), Coleman (1998) and Putnam (1993).

Bourdieu (1986) emphasizes that social capital is not just the sum of the resources available to individuals through their networks, but also the quality and structure of those networks. However, he also argues that social capital provides individuals with a competitive advantage and can perpetuate social inequalities. This is of aid when analyzing the transition to new livelihoods in Camargo, as the social capital may facilitate or hinder the access to resources and support.

In his work, Coleman (1988) expands the definition of social capital by including other forms of it such as obligations, expectations and trustworthiness, information channels, and norms and effective sanctions. He complements this by adding that social capital may have an impact on human capital, playing a role in education and development of the individual. These forms of social capital are used in the analysis of the findings regarding the community.

Civic engagement and participation foster social capital and enhance democratic governance, according to Putnam et al. (1993). In the community of Camargo, strong traditions of civic engagement and social networks are essential for fostering cooperation, resilience, and sustainable development in this transition period to a new livelihood.

A solid social capital is often the product of participatory approaches, especially in the design or establishment of livelihoods. A strong community participation and organization leads to address and adapt to extreme events driven by the community's own vulnerability to changes (Metcalf et al., 2020). Furthermore, the principle of local participation may be used to define the resilience among communities (Frausto et al., 2016).

Citizen participation is a key factor in solving environmental problems, since the activity allows communities to incorporate their opinions in the decision-making process so they can contribute to the prevention and resolution of environmental conflicts (Alfaro, 2005). In sustainable coastal livelihoods projects, participatory and adaptive co-management approaches should be introduced to engage communities, build trust, and adapt project or policy objectives to sustainable development and community based natural resource management (Stacey et al., 2021).

In her findings, Broska (2021) suggest that social capital and social norms are crucial in motivating members to adopt wide-ranging sustainable measures and behaviors. She also highlights the importance of group settings and community projects in promoting sustainable lifestyles and behaviors.

However, if participatory approaches are not well designed and are just taken as a mere administrative requirement by the authorities, the results of the exercises are mixed or are not existent in the public policy process (Díaz Aldret, 2017). This is often the case for NPA. For instance, a study (Coria et al., 2019) argues that the CONANP (Comisión Nacional de Áreas Naturales Protegidas, National Commission of Natural Protected Areas, in English), creates spaces for participation, such as councils and committees, that should work as a linking factor; but instead, their resolutions are seen as suggestions without real implications.

The concept of social capital plays an important role in the SLF but also serves as a stand-alone aid for comprehending the case of the community of Camargo, which is immersed in a NPA and, due to the nature of the ecosystem, is dependent of the (co-)management of natural resources. The networks that the community has, its organization structures, and the social tissue might be the first and vital step to initiating the transition towards a sustainable livelihood.

2.5 Perceptions & Attitudes Toward Sustainable Livelihoods

How we perceive the world shapes the attitude we decide to assume in life; therefore, it is important to know how people perceive livelihoods and the attitudes they have toward them. These factors are critical to the success or failure of sustainable livelihood initiatives, together with community participation and the effectiveness of local institutions (Qin et al., 2017).

When determining the success of sustainability programs, Skutsch et al. (2015) emphasize the importance of community perceptions, in this case, for the REDD+ initiative. Their findings show that the lack of clear information and past experiences with similar projects can lead to skepticism and mistrust among community members, which in turn affects their willingness to participate in such initiatives. The researchers concluded that understanding these perceptions is crucial for designing interventions that are both effective and acceptable to the communities involved.

Capturing the nuanced and context-specific perceptions of community members when evaluating or implementing sustainable livelihood strategies was the focus of the research of Qin et al. (2017). In their findings they align with the idea that perceptions and attitudes are not just individual traits but are shaped by the broader community context. This aspect can be linked to the Ejido system of Camargo who both manages the natural resources and is responsible for shaping the community's perceptions and attitudes to new projects, due to its communal nature.

The role of perception management in sustainable development is underscored by Chen & Cai (2025) in their study about rural tourism initiatives in China. The study provides a clear example of how the perceptions of risk among villagers can influence their willingness to invest in or continue with tourism-related livelihoods. This, in turn, affects the sustainability of these livelihoods, with the phenomenon of a self-fulfilling prophecy where the villagers would take cautious or counterproductive measures believing that their livelihoods were at risk.

As discussed, perceptions and attitudes of the members of a community are crucial for the implementation of sustainable initiatives and can be decisive in

their outcomes, whether they are a success or a failure. This also speaks about the importance of knowing the community members and working along with them from the initial stages of a sustainability project, like a livelihood implementation, listening to their wishes, concerns, needs, as to curate the outcomes accordingly.

2.6 External Influences on Livelihood Sustainability

When considering external stakeholders that influence the sustainability of livelihoods, immediate institutional links come to mind such as the funding agency, local government offices and maybe an academic institution. However, a broader spectrum of forces and structures must be considered when analyzing rural livelihoods, to have the complete picture.

Government interventions are common when discussing influence of external actors. The aid coming from the authorities is usually in the form of economic and physical support; but, as Ma et al. (2024) mention, social and psychological integration of the communities must also be part of a comprehensive approach. In their research about community resettlement in China, the authors found out that government policies play a crucial role in determining the success of livelihood strategies by impacting the availability and effectiveness of different types of capital.

Additionally, the authors discussed that, while social, physical and financial capital exhibited robust positive effects on the resilience of farmers' livelihood, the impact on human capital was primarily indirect. As a matter of fact, their research "underscores the importance of not only investing in livelihood capital but also prioritizing coping behaviors, such as skill training and policy support, to enhance resilience." (Ma et al., 2024)

On the other hand, we can find academic institutions as other common external agents influencing the sustainability of livelihoods. In their research, Heikkinen et al. (2022) provide a strong argument for the need to bridge the gap between academic research and practical applications in vocational and adult education. Universities are, therefore, a critical actor when shaping the expertise required to address environmental, social and economic crises.

Integrating local contexts and needs into educational programs comes into the discussion of making meaningful contributions to sustainable development. The sustainability of a livelihood is influenced by the relationship between academic and non-academic actors, such as industries and communities, yet it remains undeveloped in many contexts. (Heikkinen et al., 2022)

The influence of public policies, statistical definitions and international development agendas for rural development in Latin America are the subject of discussion of a report commissioned by the ECLAC and performed by Gaudin & Padilla (2023). The report makes an emphasis on the need for new measurement and classification systems for rural contexts and how they can shape the sustainability of the livelihoods. The authors further argue that by redefining rurality and adopting new analytical tools, policymakers can better design and implement strategies that support sustainable livelihoods.

In conclusion, external influences in sustainability projects may come from government agencies, academic institutions, international offices or any other relevant agents that may have a saying in some aspect of livelihood sustainability for the community. What is important, as mentioned by the cited studies, is that the agents take a holistic approach, keeping a close contact with the community members, their context, needs and desired outcomes of the project.

2.7 Assistentialism

Also known as welfarism, welfare or charity dependance, assistentialism is a direct translation from the Spanish term “asistencialismo” which talks about a phenomenon born in Latin America. The concept refers to the dependance on welfare policies or “políticas de asistencia social” in Spanish, given by the government to low-income populations so they can better their living conditions.

The definition and impacts on the Mexican society are discussed in the essay of Vite Pérez (2014), where he further develops the conversation regarding merit-based policies and equality of opportunities for economic development in low-income population. He further argues that those same policies may have contributed to an increase in vulnerability for the communities because of the misdirected efforts.

Another case study in Chile by Codoceo & Muñoz Sougarret (2017) discusses how welfarism (*asistencialismo*) impacts the perception and effectiveness of public policies in vulnerable communities, similar to the context of Camargo. It highlights the importance of understanding local perceptions and the need for holistic and long-term approaches rather than fragmented and short-term solutions. Therefore, this context is of aid when analyzing the relations between the external stakeholders, particularly the government, and the community of Camargo.

Successful strategies to overcome this dependence on welfare policies are the focus of a study sponsored by the ECLAC, in which the authors Correa & Dini (2019) discuss the evolution of local economic development policies beyond traditional welfarism, highlighting how municipalities in Chile integrate welfare actions into broader development strategies. It provides a context for understanding the shift from passive welfare provision to active economic development, which should be the main goal of the GEF project that aids the transition towards sustainable livelihoods.

Due to its links to the region of Latin America, the concept is addressed as assistentialism, which is of aid when discussing the findings, particularly under the Human and Social Capitals of the community of Camargo, and the role that external stakeholders play in the transition. This concept also supports the thematic analysis of local economic policies in Camargo, emphasizing the need for innovative approaches to sustainable development.

3 Methods: Navigating the Journey of Livelihood Transformation

This chapter outlines the research design and methodology employed in this study, including a report about the data collection and analysis procedures.

3.1 Type of study

This study employs a qualitative research design to explore the sustainability of alternative livelihoods for former mercury miners in the Camargo community. A qualitative approach was chosen to capture the rich, contextualized experiences and perspectives of the community members and the external stakeholders that have an influence on the livelihood transition (Flick, 2015).

A summary of the methods employed to retrieve data for the study is depicted in the following figure.

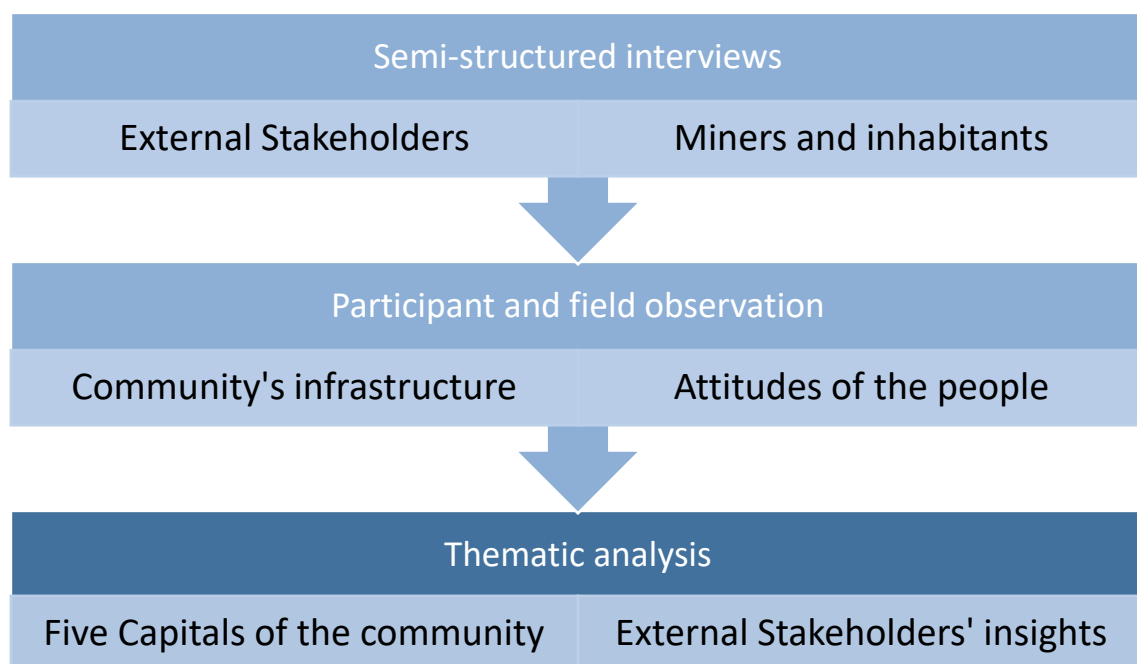


Figure 2. Summary of the employed methods

3.2 Camargo in the Sierra Gorda

Since 1997 the Sierra Gorda de Querétaro is a Natural Protected Area (NPA) in the State of Querétaro located in Central Mexico. As an NPA, it has a Management Program that allows the existence of mining operations provided that they have the necessary authorizations from the competent authorities (INE, 1999). However, it also acknowledges that, when not executed properly, mining activities can generate pollution and health problems for communities, ecosystems and to the workers.

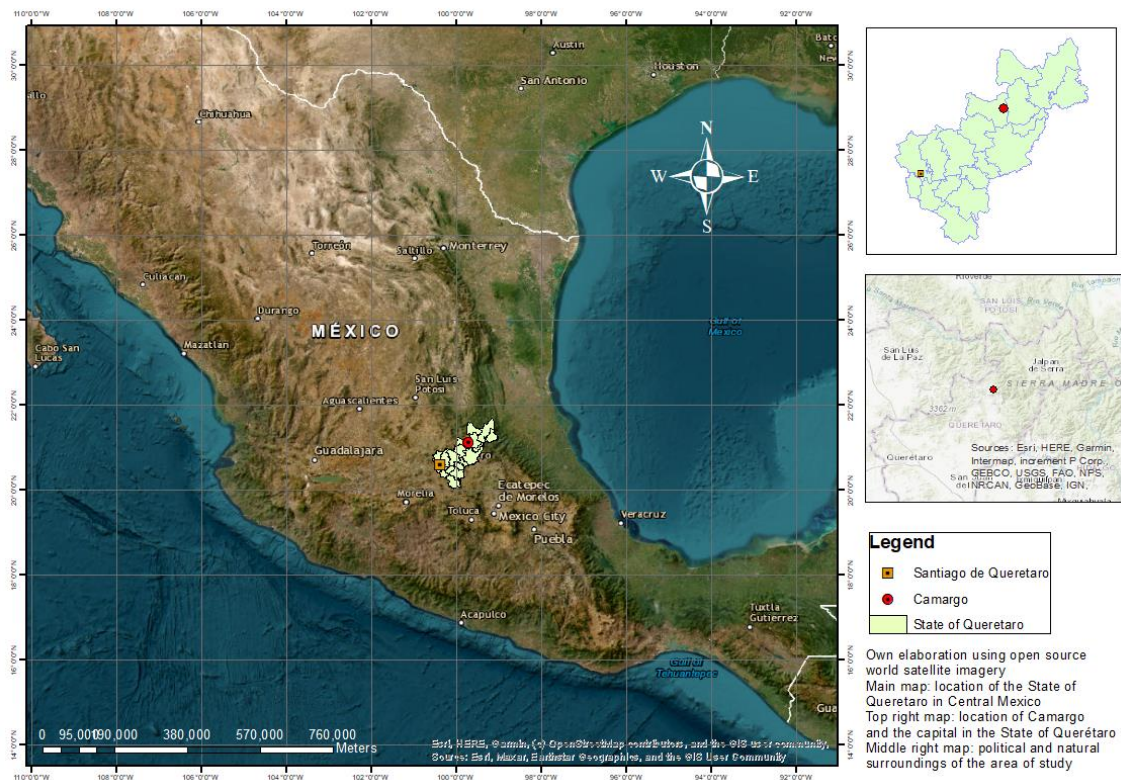


Figure 3. Location of Querétaro in Central Mexico

The NPA Sierra Gorda de Querétaro comprises 5 municipalities of the state of Querétaro that cover a wide variety of ecosystems such as mesophile and medium forests, pine and oak forests and xerophilous shrublands (INE, 1999). The mercury mining regions are in the latter two, a set of unique and different environments where different natural resources can be found.

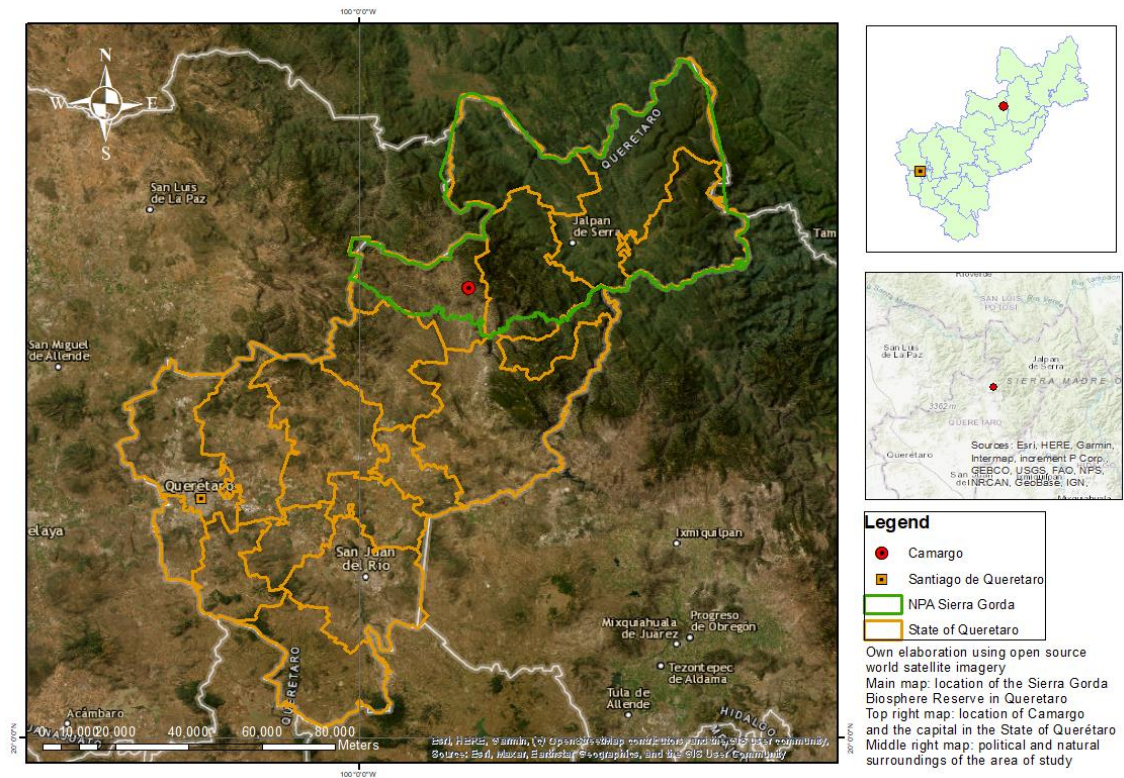


Figure 4. Location of the Sierra Gorda Biosphere Reserve in the State of Querétaro

The focus community of the study is Camargo, a community located 30 km away from the seat of the municipality of Peñamiller. It has around 1,028 inhabitants who are dedicated to agriculture, livestock, and mining (INEGI, 2020). The latter of which is the main economic activity of the people of the community, where they “feel at home” (Saldívar, 2021). A map of the location of the community is displayed in Figure 5.

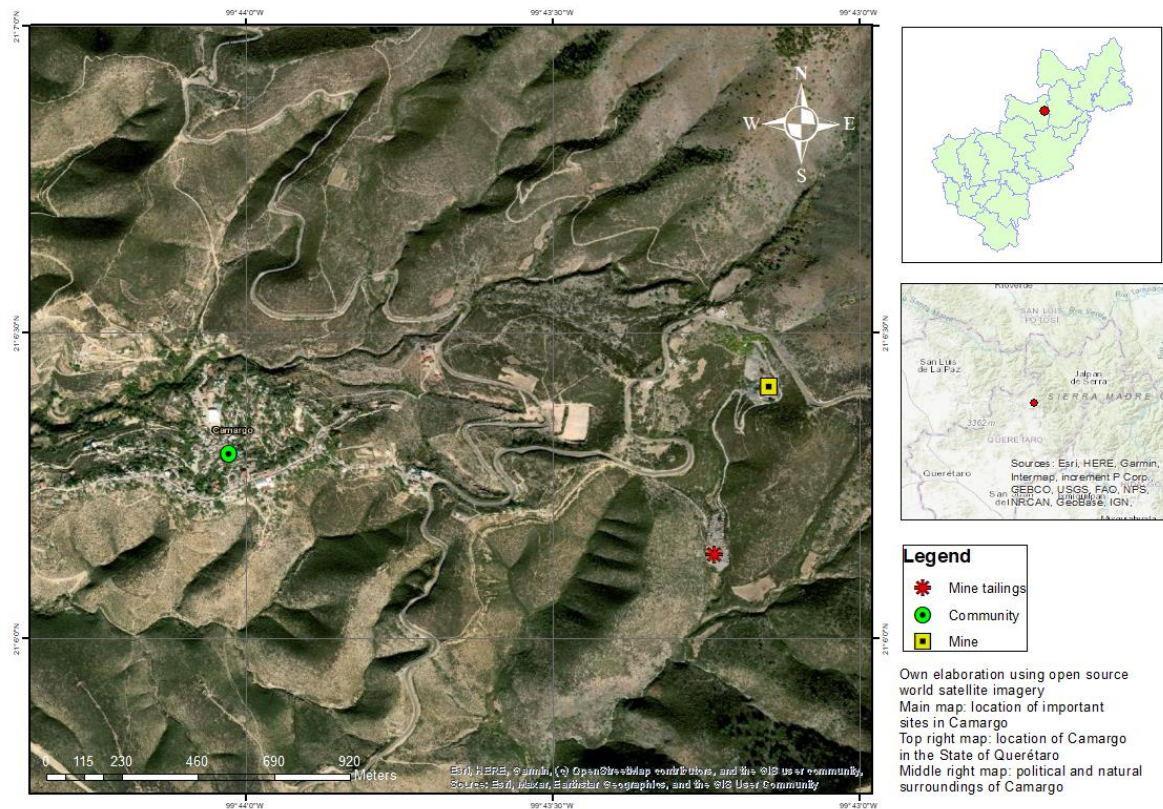


Figure 5. Map of the Camargo community and its surroundings

According to the National Institute of Statistics and Geography, INEGI in Spanish, (INEGI, 2015) Camargo is immersed in a submontane scrub ecosystem, which is present in altitudes between 1,500 and 1,700 MASL, in this case, developed in the southwestern hillside of the Sierra Madre Oriental mountain range. The vegetation is characterized by a variety of shrubs, small trees, and herbaceous plants that are adapted to the specific climatic and soil conditions of mountainous areas, where the climate can be dry and the soil relatively poor.

The Instituto Nacional de Estadística y Geografía (2015) also mentions that the vegetation is composed by armature plants that have evolved to develop defensive structures such as thorns, spines, or prickles. These features serve as a protection mechanism against herbivores and other potential threats. Inermous plants are also present which are the opposite type, meaning, plants that do not possess defensive structures. Another characteristic is the deciduous aspect of the vegetation, losing its leaves from November to May, which is the dry season.



Figure 6. Landscape surrounding the community of Camargo

The territory in the vicinity of the mine has no nearby permanent bodies of water, meaning they are intermittent and only appear during the rainy season. Air and soil quality monitoring has been conducted by public institutions. The results of characterization studies show that most of the air has average mercury levels of $21.8 \mu\text{g m}^{-3}$, which are far above the World Health Organization recommended limit of $0.2 \mu\text{g m}^{-3}$ (INECC, 2020b).

Furthermore, more than half of the soil samples show mercury contamination levels higher than 310 mg kg^{-1} , the limit for industrial soil, allowed by the Mexican standard NOM (Norma Oficial Mexicana, Official Mexican Regulation in English) (INECC, 2020b). It must be noted that although the mine does not have an approved industrial land use, it is the closest level of comparison available in the Mexican regulation system.

During the visit to the mine and the community, the leader of the miners commented that there were around 60 people working on the three levels of the mine. Levels are how the miners refer to the different heights of the mine, the upper level is known as “La Tranca” and it is the smallest and where least people work. The middle level “La Laja” is where the interviews were conducted. It is the main workplace of the mine and where most miners work. The lower level is called “La Estrella” where some miners work. The numbers vary through the season, depending on the price of mercury and the availability of the mineral inside the mine.



Figure 7. Mine of Camargo seen from the Federal Highway

Mercury extraction is a rather simple process that takes time and effort to perform, as explained by both government authorities and journalists (INECC, 2020c; Mota Reyes, 2015; Saldívar, 2021) and mainly, by the miners themselves. The process is done on a weekly calendar. First, the miner enters deep into the mine and searches for the mineral called cinnabar, of a bright red color. This activity is done the first two days. The mineral is then extracted from the mine and taken to the artisanal furnaces in the designated area. When chopped into little pieces, the cinnabar enters the furnace fed by wood and the burning occurs, when the mercury evaporates and then is condensed into plastic bottles. This activity is usually performed by the end of the week on Thursdays and Fridays.

However, as the leader and the miners commented, in recent years not as much ore is found inside the mine as in the past, during the bonanza years. And the few rocks they found, contained little to no mercury inside, further discouraging the mining activity. Therefore, the number of miners has steadily decreased, even though the price of mercury was high, at the time of the visit.

Due to their labors which expose miners to mercury vapors, all the studied miners reported mercury levels in urine above the occupational guidance of 23 ppm

(INECC et al., 2019). The land surrounding the mine of Camargo is considered a contaminated site with negative effects to the health of the population (Huerta Colosia, 2020).

Remembering that the main objective of the Minamata Convention on Mercury is the reduction of risks to human health and the environment from the release of mercury and its compounds to the environment, it has been noted that the inhabitants of mining communities, plants and animals are and have been exposed to mercury due to the mining activity (INECC, 2020c). This information is of public knowledge and has been disclosed to the people of the communities, who are aware of the problem and work together to find alternative livelihoods.

3.3 Research techniques

3.3.1 Semi-structured interviews

Semi-structured interviews were chosen as the main method of primary data collection since they allow to gain deeper insight into the perspectives of the people involved in the alternative livelihoods process and retrieve data from the variables from each component of sustainability (Kvale, 2011).

Semi-structured interviews have been applied in similar contexts regarding a mining restriction such as in Ghana where the authors described the effects of the mining ban on women and youth livelihoods (Osei et al., 2021; Zolnikov, 2020), in Kenya where the value chains and livelihoods of people impacted by the restriction were the focus of the research (Wekesa et al., 2023) and in Goa where the socioeconomic impact to people's lives was studied (Arondekar & Murthy, 2017).

To assess the livelihoods of the community according to the SLF 3 groups of people were chosen: the external stakeholders, the miners and the inhabitants of the community. The interviews took place from late March to early June 2024 both in situ in Camargo and in Querétaro city, and virtually with those stakeholders who were not available locally.

3.3.1.1 Interviewing the External Stakeholders

Before the visit to the community, the first group of people interviewed were the external stakeholders. A salience analysis comprising urgency, legitimacy and power was used to know who to contact first and was available for the interviews (Mitchell et al., 1997; van Dijk et al., 2021). Due to the 2024 electoral process of Mexico, both at the local and federal level, certain precautions were taken so as not to interfere with the ban on promoting social programs by the government. This means that all interviews were performed either before or after the electoral ban.

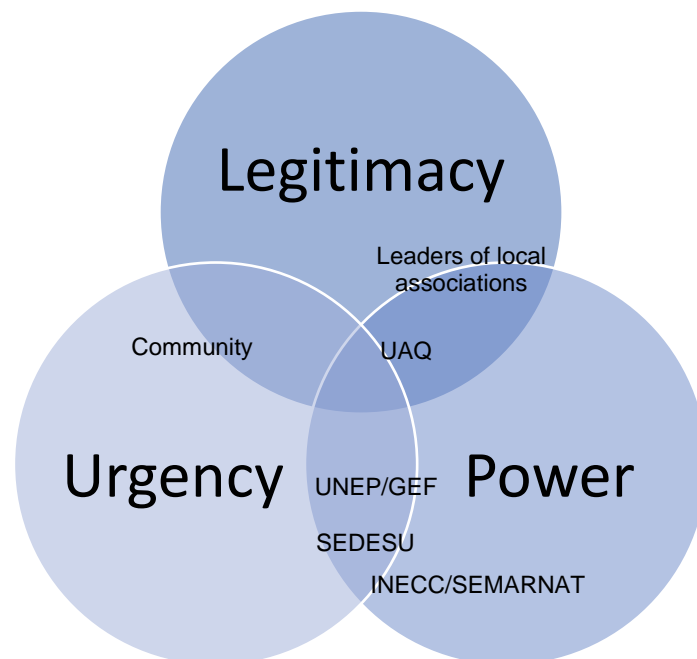


Figure 8. Venn Diagram of the Salience of Stakeholders

Multistage sampling was employed in the study involving purposive, snowball, and convenience sampling techniques. Through purposive sampling, the study approached the key external stakeholders known to be of importance for the research who have a saying or a ruling in the potential alternative livelihoods for the mining community (Czernek-Marszałek & McCabe, 2024).

Once the external stakeholders were identified, the objectives of the interviews were outlined to identify the information needed for the analysis as well as the set of questions that might aid to retrieve the data. The purpose of the interview with each external stakeholder is displayed in the following table.

Table 1. Purpose of the interviews with external stakeholders

External Stakeholder	Purpose of the interview
SEDESU Environment Undersecretariat	Analyze the environmental policy of the agency towards alternative livelihoods in the NPA and climate change context, and the relationship with other stakeholders.
SEDESU Economic Development Undersecretariat	Explore the current efforts of the Office to transition to alternative livelihoods, obstacles for their implementation and the relationship with the community and other stakeholders.
SEMARNAT Querétaro Office	Discuss the role of the agency in the livelihoods transition progress, its influence, existing barriers and the relationship with the community and other stakeholders.
UAQ Camargo Campus Coordination	Explore the current implemented efforts in the community, social approaches and goals of the academic sector and the relationship with other stakeholders.
INECC Executive Office	Discuss the prominent role of the agency in the livelihoods transition, the efforts made and to be made, existing obstacles. and the relationship with the community and other stakeholders.

With the purpose of the interviews a set of questions was created to satisfy specific objectives 3 and 4, regarding their influence, the role they play and the efforts they make in collaboration with other stakeholders to implement alternative sustainable livelihoods in the community. An outline of the questions and the expected outcomes is presented in the following table.

Table 2. Expected outcomes of the questions for the stakeholders

Question	Expected Outcome
What are the main objectives and priorities of your agency regarding sustainable development and natural resource management in the region?	The policy by which the institution works and implements its efforts.
How does your agency currently support or promote alternative livelihood initiatives for communities in or around the biosphere reserve?	Current efforts made by the institutions to implement alternative livelihoods.
How do you measure the effectiveness or impact of your agency's interventions in promoting sustainable livelihoods and conservation in the region?	Whether alternative livelihoods were already implemented and the level of implementation.
What are the main challenges or obstacles your agency faces in implementing sustainable	The barriers the institutions face when implementing

development initiatives, and how do you address these challenges?	the alternative livelihoods and the solutions to them.
How does your agency collaborate with local communities, NGOs, or other stakeholders to address environmental challenges and promote sustainable livelihoods?	The synergies and joint efforts made in cooperation with other institutions.
What role do you see for your agency in supporting the transition to alternative livelihoods for communities affected by environmental regulations or resource depletion?	The prognosis of the alternative livelihoods with areas of opportunity and recommendations.

Snowball sampling was of aid when discussing with the external stakeholders their involvement with the community and who else might be available and willing to participate in the interviews (Czernek-Marszałek & McCabe, 2024; Yakovleva et al., 2022). This sampling also gave contact information of a key agent who provided access to the mine in Camargo.

The following table displays the information of the interviews.

Table 3. Interviews performed to the external stakeholders

Stakeholder	Date	Modality
UAQ Institutional link with the communities	22/03/2024	In person at the office of the stakeholder
SEDESU Chief of Internal Commerce	04/04/2024	
SEDESU Environment Undersecretary	04/04/2024	
SEMARNAT Head of Local Office	17/04/2024	
UAQ Camargo Campus Director	30/05/2024	Virtual
INECC Executive Officer	11/06/2024	

During the interviews all the representatives of the institutions answered with candor and provided information with the best disposition. The interviews lasted between 30 to 60 minutes with the questions serving as a guideline for the discussion of the topic. All the interviews were conducted in Spanish and then translated by the author of the study to English for the analysis.

Consent was always required, and the context of the interview was expressed ensuring the anonymity, privacy and voluntary character of the interviews. Consent forms were signed by the actors of the government agencies who asked

for one. If approved, the interviews were voice-recorded to ensure the content of the information provided. Key notes were taken using a smart tablet.

3.3.1.2 *The Visit to the Camargo Community*

Another series of questions was designed to address specific objectives 1 and 2, assess the state of the capitals in the community and identify perceptions about alternative sustainable livelihoods. A set of guiding questions was used to ensure consistency across interviews but with room for each participant to express their feelings and opinions freely. The questions were designed to extract information regarding the Five Capitals from the community and their perceptions about the transition to new livelihoods. An outline of the questions and the expected outcomes is presented in the following table.

Table 4. Questions and expected outcomes for the miners and the community

Question	Target	Expected Outcome
How do you perceive the current access to health services and facilities in the community, and what improvements would you like to see?	Miners and community members	The opinions of the infrastructure and the needs of the population.
Apart from mining, do you work in something else or what experience do you have in other jobs?	Miners	Information about the abilities and skill of the mining population.
Could you describe the existing social networks and relationships within the community?	Miners and community members	Insight about the day-to-day life of the community.
What types of partnerships or collaborations exist with government agencies and academic institutions?	Miners	The existing relationships with the external stakeholders.
How do you perceive the current state of natural resources and ecosystems in the area?	Miners and community members	The knowledge of their ecosystem and its status.
What do you see as the main threats or pressures on these resources?	Miners and community members	The current problems their ecosystem is facing.
How would you assess the current infrastructure and basic services available in the community, such as roads, electricity, water supply, and sanitation?	Miners and community members	Whether the existing infrastructure is enough for their lives and if their specific wishes.

What are the main challenges or barriers you face in terms of accessing essential services and infrastructure?	Miners and community members	The reason the community members do not receive all the services they need.
What are the main sources of income and livelihoods for community members?	Miners and community members	How the community makes a living.
What would you need to implement and alternative livelihood?	Miners	The desires and needs of the community to migrate to alternative livelihoods.

On April 25, 2024, the community of Camargo and the mine were visited to perform the interviews with the members and to perform a structured observation. The journey started in the state capital of Querétaro to the Camargo community to also check the travel time of community members to speak and meet with the authorities.

The total time to reach the community was about 2 hours, the first hour was driven in a mostly straight well-maintained road, but as soon as the NPA limit was passed, the ascension to the mountain range began with sinuous close curves which took about another hour to transit through. Although the road has closed curves and must be driven at a slow speed, the overall conditions seem good enough for private cars and buses, and commercial trucks to transit. In the following figure the entrance to the NPA Sierra Gorda de Querétaro can be seen and, in the background, the mountainous landscape of the semi-desert.



Figure 9. Entrance to the Sierra Gorda NPA through the Federal Highway

At first, the mine was visited where convenience sampling was used to approach miners for interviews due to the flexibility of this technique to recruit respondents, the availability of miners during their working hours, and their willingness to participate in the research. The interviews ranged between 10 to 20 minutes with the miners so as not to deprive them of their working hours.

Consent was always required, and the context of the interview was expressed ensuring the anonymity, privacy and voluntary character of the interviews. For this, a declaration of commitment was handed out to the leader of the miners when asking for permission to enter the place of work and perform the interviews.

The interviews with the miners were performed in the mine area, more specifically in the area where the mined mineral is broken and cooked for the extraction of mercury. Even though they were working, the people involved in the process participated willingly and with the entire disposition of providing their points of view, inputs and experiences for the research.

Although neither the name nor the age of the miners was asked, by observation all of them were over 18 years, the legal working age, and some were in their early 60s. The undertone of their answers was also registered when discussing certain subjects. It must be noted that not all the prepared questions were asked

so as not to further disturb their working hours and to not tire them in the exercise. The questions served as a general guideline for the interview, but the most important part was to listen to the miners and their thoughts.

A key interviewee was the leader of the miners who was interviewed separately and provided key information regarding the GEF project of transition to new livelihoods, the relationship with the academic institutions and government authorities and the overall status of the daily life of the miners in the mine.

Similarly to the mine, during the visit to the community, convenience sampling, social networks and snowball sampling techniques (Czernek-Marszałek & McCabe, 2024; Yakovleva et al., 2022) were used to gain access to the community members, leaders and business owners who could provide valuable information regarding the community, their insights and perceptions regarding the transition to new livelihoods. The interviews lasted between 10 to 20 minutes, consent was always required, and the context of the study was expressed ensuring the voluntary character of the interviews.

Since the visit took place in the community, the interviews were performed inside the people's businesses, such as miscellaneous stores, mini markets, restaurants and stationery stores. At the beginning, a statement was done to assure the interviewees that the exercise was not part nor was affiliated to any political party since, as mentioned, it was a local and federal election year in Mexico.

As in the case of the miners, the names and ages of the participants were not taken, to ensure anonymity and privacy. Nevertheless, from observation, the interviewees were women of ages ranging between early 20s to late 50s. Their tones and attitudes to certain subjects were also registered to analyze them in their answers (Kvale, 2011). Not all the planned questions were asked, but they served more as a general guideline for the interview to feel more as a conversation.

Among the community inhabitants, a prominent member was interviewed who provided key insights from both the mine and the community, its relations and dynamics. She is a female "miner" (women are not allowed in the mine) who

mainly deals with the supply of tools for the people in the mine and with the negotiations with the buyers of mercury.

Following a recommendation from both the UAQ and the SEMARNAT, the interviews with both the miners and the community members were not voice recorded and the notes were taken using a simple notebook and pen. From previous experiences the stakeholders have noticed that miners and inhabitants tend to respond better when the total attention is given to them.

The use of “new technologies”, such as smartphones, laptops and smart tablets, is perceived by the community as if the interviewer is not paying attention to the conversation. This is part the spectrum of cultural sensitivity, which is critical when conducting research respecting the cultural context and norms of the participants. Furthermore, a comparative study on conducting interviews with and without voice recorders found that interviews conducted without recording devices often resulted in more genuine interactions and detailed observations, as participants were less self-conscious and more engaged (Liamputtong, 2010).

After a certain number of performed interviews with both the miners and the community inhabitants the phenomenon of data saturation (Rahimi & khatooni, 2024) was noted, meaning that no matter with whom the interview was carried, little to no new information could be extracted. This could speak to the unity and coherence of the mining community and its inhabitants as in or due to previous interventions made by other academic or governmental institutions that have shaped the way the community thinks and expresses itself.

Although probably new insights from other miners or inhabitants could have been retrieved, , the interviewing exercise was stopped to both save human efforts (Rahimi & khatooni, 2024) and not to further disturb the people who generously provided their working and free time to answer the prepared questions. The opportunity was used, nevertheless, to the fullest extent of the study’s capabilities and resources.

A summary of the data collection is presented in Table 5. In this case, the last column outlines the outcome rather than the purpose of the interview since spontaneous results arose during the visit to the community when talking to the population.

Table 5. Interviews with the miners and the community

Group of participants	Number and particulars	Outcome of the interview
Miners working in the Camargo mine	12, all male of different age groups but in working age	Collect information regarding the process of livelihood transition, their opinions, desired new livelihoods, relationship with external stakeholders and gauge the sentiment of community.
Inhabitants of the Camargo community	9, all female of different age groups but within working age	Gather information of the state of the community and their opinions, needs, concerns, sources of income, social cohesion and relationships.
Leader of the miners	1, key role of assembling the miners	Interviewed to procure key information regarding the status of the transition project and the relationship with external stakeholders.
Female miner	1, supplier of tools for miners, business owner and wife to the delegate	Interviewed to collect information of both in and outside the mine as she deals with the miners and the buyers of mercury, and of the relationships of the community, their sources of income, infrastructure needs and the sentiment among the members.

3.3.2 Participant and field observation

In addition to conducting the semi-structured interviews, participant observation and field observation were employed to gather comprehensive data on the community of Camargo, according to Bernard (2011). Through participant observation, an immersion in the community was performed, engaging in daily activities and interacting with community members to gain a deeper understanding of social dynamics and behaviors (Angrosino, 2012). This was also done to compare the current reality with the available information provided by the government and other researchers.

On the other hand, field observation involved systematically observing and recording behaviors, events, and interactions, focusing on body language, tones, expressions, and the physical environment (Emerson et al., 2011). Photographs of the current state of the community, the existing infrastructure and the natural and physical landscape were taken to help illustrate the atmosphere of the site of

study. The findings were annotated to be later analyzed and incorporated into the discussion section.

3.4 Thematic analysis

Qualitative data tends to increase when analyzed rather than being simplified, this is explained due to the purpose of qualitative research, which is to explain what people and situations have in common and to do so referring to the existing theories and concepts (Gibbs, 2012). Therefore, a thematic analysis was performed to keep track of all the relevant topics for the research.

After becoming familiarized with the audios and the notes taken during the interviews, they were transcribed, translated from Spanish to English, summarized and then uploaded to the qualitative data analysis software MAXQDA for a thematic analysis. In this interface, codes were created to extract relevant information for the five Capitals of the SLF and the external stakeholders' section.

3.4.1 Coding the Five Capitals

For the analysis of the Five Capitals codes were created by extracting key points from the definitions of each Capital from the document of the UNDP Guidance Note on Application of the Sustainable Livelihood Framework in Development Projects (United Nations Development Programme, 2017).

Additionally, and after being familiarized with the information of the interviews, new codes arose when analyzing the data (Czernek-Marszałek & McCabe, 2024) which were then categorized in each capital and corresponding question. This speaks of the flexible nature of the Framework as a tool to aid the analysis of cases with their own particularities, in space and timeframes, such as this one.

Furthermore, the results of the tour around the community and the observations were also coded and included in the discussion of the results of the analysis. The set of questions to the corresponding Capital and with the codes created for analysis are displayed in Table 6.

Table 6. Set of questions applied to the miners and the community about the Five Capitals of the community

Capital	Questions	Codes for analysis
Human	How do you perceive the current access to health services and facilities in the community, and what improvements would you like to see?	<ul style="list-style-type: none"> • Health
	Apart from mining, do you work in something else or what experience do you have in other jobs?	<ul style="list-style-type: none"> • Education and skills • Motivation
Social	Could you describe the existing social networks and relationships within the community?	<ul style="list-style-type: none"> • Community support • Migration
	What types of partnerships or collaborations exist with government agencies and academic institutions?	<ul style="list-style-type: none"> • Assistentialism • Relationship with external stakeholders
Natural	How do you perceive the current state of natural resources and ecosystems in the area?	<ul style="list-style-type: none"> • Resource Management • Environmental Conditions
	What do you see as the main threats or pressures on these resources?	
Physical	How would you assess the current infrastructure and basic services available in the community, such as roads, electricity, water supply, and sanitation?	<ul style="list-style-type: none"> • Infrastructure
	What are the main challenges or barriers you face in terms of accessing essential services and infrastructure?	<ul style="list-style-type: none"> • Access to services
Financial	What are the main sources of income and livelihoods for community members?	<ul style="list-style-type: none"> • Income sources • Diversification
	What would you need to implement and alternative livelihood?	<ul style="list-style-type: none"> • Need for investment

3.4.2 Creating the Codes for the External Stakeholders

On the other hand, since the Framework focuses on the Five Capitals and not so much on the influence and roles of the external stakeholders, codes needed to be created for the analysis of their section. Through the original purpose of each interview and the process of familiarization with the extracted data and summaries of the interviews (Czernek-Marszałek & McCabe, 2024), the information was separated into five main categories, as a parallelism with the original Five Capitals, each with specific codes for that supported the analysis.

The set of questions to the corresponding Capital and with the codes created for analysis are displayed in Table 7.

Table 7. Set of questions applied to external stakeholders about their insights and influence on the community

Category	Question	Codes for analysis
Policy and Governance	What are the main objectives and priorities of your agency regarding sustainable development and natural resource management in the region?	<ul style="list-style-type: none"> • Policy Implementation • Regulatory Frameworks
	How does your agency collaborate with local communities, NGOs, or other stakeholders to address environmental challenges and promote sustainable livelihoods?	<ul style="list-style-type: none"> • Governance Structures • Public Awareness, • Collaborative Efforts
Community Engagement	How do you measure the effectiveness or impact of your agency's interventions in promoting sustainable livelihoods and conservation in the region?	<ul style="list-style-type: none"> • Stakeholder Participation
Support and Resources	How does your agency currently support or promote alternative livelihood initiatives for communities in or around the biosphere reserve?	<ul style="list-style-type: none"> • Technical Assistance • Financial Support
Barriers and Challenges	What are the main challenges or obstacles your agency faces in implementing sustainable development initiatives, and how	<ul style="list-style-type: none"> • Social Barriers • Environmental Challenges

	do you address these challenges?	<ul style="list-style-type: none"> • Economic Barriers
Opportunities and Recommendations	What role do you see for your agency in supporting the transition to alternative livelihoods for communities affected by environmental regulations or resource depletion?	<ul style="list-style-type: none"> • Opportunities for Improvement • Recommendations

After applying the codes to the texts of the interviews, summaries of the codes were created using the tool of MAXQDA and the coded segments were extracted to aid with the discussion of each code. The results of each code, from both the Five Capitals of the Camargo community as well as the five categories curated for the analysis of the external stakeholders' roles and insights, are discussed in the following chapter.

4 Results and Discussion: Unearthing the Realities and Potentials of Livelihoods

In this Chapter the results of the Five Capitals of the community of Camargo are addressed alongside the stakeholders' insights and roles, according to the coding system developed for the research. The results are, therefore, divided into two subsections, one for the Capitals and one for the Stakeholders, each with their own codes that aided to categorize the data for analysis.

It must be noted that even though the information was separated into the categories and codes, during the discussion process, sections continued to be tangled, intertwined and referenced between each other due to the nature of the analysis. This speaks of the cohesion of the case of study and the network of connections between the community, the mine, the government authorities and the academic institutions around the subject of this study.

4.1 The Capitals

As a visual reminder of the capitals, the following figure serves to illustrate the used codes for the analysis.

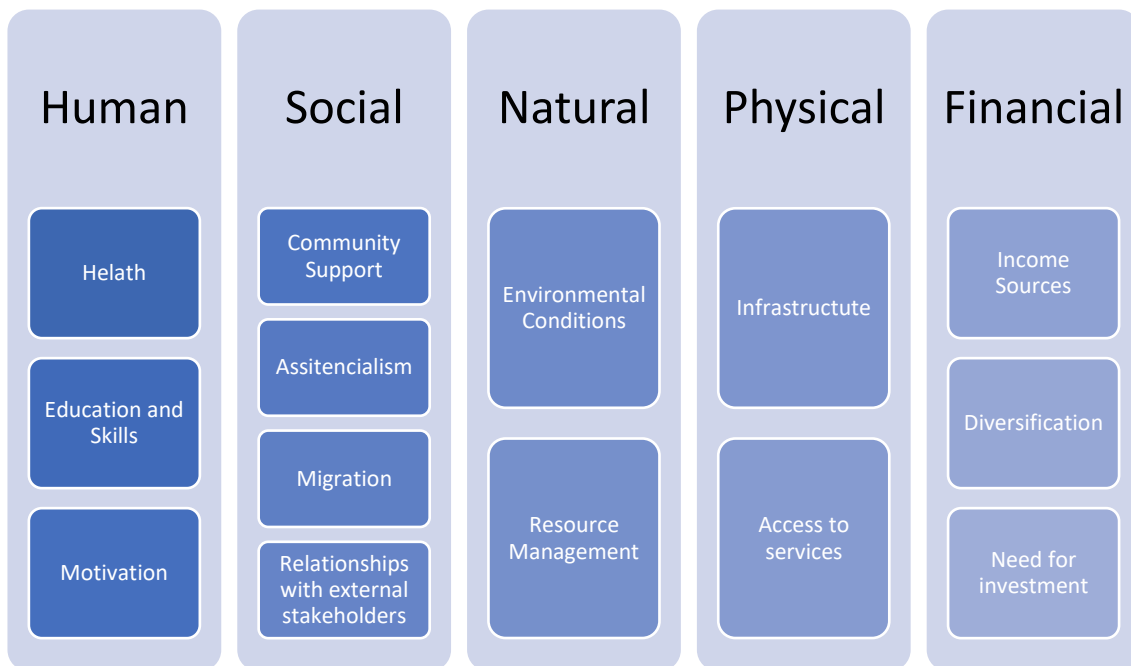


Figure 10. The Five Capitals and the Codes used for analysis

4.1.1 Human Capital

According to the UNDP “human capital encompasses the abilities, experience, work skills and the good health that, when combined, allow populations to engage with different livelihood strategies and reach their own objectives.” (2017: 4) Therefore, a set of 3 codes were used to identify data related to this capital: Health, Education and Skills, and Motivation.

4.1.1.1 Health

The community of Camargo, and the miners there, face challenges of significant relevance to their health. The most important issue that was detected during the interviews was the operation of the local health center operated by the state government, which is not a clinic nor a rural hospital.

Many interviewees mention that the center is only open till 2 pm and has problems with medicine stock. “One must not get sick at night or at weekends” (Miner 5, personal communication, April 25, 2024) sarcastically stated by one miner. Another one said: “they don’t have enough medicines; we have to look for them somewhere else” (Miner 6, personal communication, April 25, 2024).

This results in demands for a 24-hour operating health center or clinic with enough personnel to cater to the population. Moreover, some inhabitants expressed their desire for an ambulance for cases of emergency when a person must be transported to the nearest hospital.

This is of the utmost importance since both the miners and the community members are aware that the mining activity results on affectations to their health and that of the environment. However, despite this, people continue to work in the mines, which suggests the existence of a cultural, social or economic barrier to migrate to other livelihoods.

4.1.1.2 Education and Skills

The community possesses a good foundational educational infrastructure with an elementary school, a rural middle school (“telesecundaria” in Spanish), a vocational technical high school and the recently installed campus of the

Universidad Autónoma de Querétaro (UAQ). The latter institution is developing a higher educational program catered to the needs of the people and the region.

Aside of the mining skills and knowledge, several community members have successfully leveraged their skills to start local businesses such as grocery stores, hair salons or even a screen-printing workshop. Some miners mentioned activities such as farming, cattle raising or construction services, as skills among their possibilities. This indicates the willingness of some members to learn new skills, or use what they already know, and apply them in a small business.

A remarkable aspect of the working population is that those who are not in the mine, often work in greenhouses in other towns or migrate to the United States to work as agricultural workers. This highlights both the reliance of migratory working opportunities and the agricultural skills of the population, which is strengthened by the fact that there is a group of women who are dedicated to growing and selling medicinal herbs. The small entrepreneurship started with training from the UAQ but now runs on its own.

Most skills that arose during the interviews have to do with agriculture, which speaks of a deep relationship with their natural surroundings. However, at the time of the visit to the community, there was an extended 2-year period of drought, and the inhabitants expressed their concern about the lack of water for basic needs. The conditions were not ideal for agriculture, farming or related activities. Therefore, this set of skills is restrained by the availability of natural resources.

There is an evident need and demand for learning new skills and crafts as expressed by a miner during his interview: “I would like an educational or training center to learn a new trade” (Miner 9, personal communication, April 25, 2024). This call for technical knowledge and resources speak of the willingness to seek alternative livelihoods. By addressing these demands, the community could enhance its capacity for sustainable livelihoods and reduce its dependence on migratory labor and mining activities.

4.1.1.3 *Motivation*

This specific part of the Human Capital reveals a complex picture of the community's willingness and readiness to embrace alternative livelihoods. On one hand, the members of the community are open and receptive to foreigners as corroborated in the field visit. But, on the other hand, there seems to be a resistance to change the mining activities and transition to new ones, even when people are aware of the damage to their health and that of the environment, and the fact that there are unidentified intermediaries that buy the extracted mercury.

This resistance may be related to the presence of external entities, such as government agencies or the university, and as a misconception that the community has of them, in that the agencies should provide everything they need for free, indicating a dependency mentality. This will be further explored in the Social Capital section, particularly under the Assistentialism code.

Since some members of the community, usually the young, have migrated either to other towns or cities or to the USA, the remaining population is characterized for being older, and, more reluctant to change. As one community member expressed: "The old members of the Ejido want things to remain the same. It's difficult to change their minds and let them see that things must change" (Community Member 2, personal communication, April 25, 2024) which talks about how different generations view livelihoods in the community.

Motivation among the other miners and inhabitants is mixed with some being enthusiastic to explore new livelihoods, and others being hesitant, lacking clear ideas or technical knowledge to pursue alternative work. The latter was commented by a miner during his interview when asked about what other jobs or activities would he like to develop: "I don't know, maybe tourism or working with crops" (Miner 6, personal communication, April 25, 2024).

Overall, the miners know that, even though mercury prices were high at the time of the field visit, "the time of the mercury bonanza is over" (Miner 1, personal communication, April 25, 2024). There is not much ore left in the mine or it is too expensive to extract and make a profit of it. This, together with targeting the younger population, shows promising signs of potential to develop and adopt alternative livelihoods for the community members.

4.1.2 Social Capital

The UNDP refers to the Social Capital, in the context of sustainable livelihoods, as “the social resources which individuals rely on in order to achieve certain objectives relating to their livelihoods” (2017: 5). The following codes and findings are presented related to the community, its social ties and relationships with the external agents: Community Support, Assistentialism, Migration, and Relationships with External Stakeholders.

4.1.2.1 Community Support

This code reveals a community characterized by strong solidarity and mutual assistance. Community members frequently help each other in times of need such as “when someone’s sick they ask to their neighbors or the delegate for a car to bring the person to the nearest clinic or hospital” (Miner 6, personal communication, April 25, 2024) as expressed by miners and inhabitants. Other occasions of organized support include the exploration study performed for finding subterranean water, where all the families cooperated to finance it.

Despite of this, constituting a formal society as a moral person or a cooperative to set a new business faces some challenges, as expressed by some miners and government agents. This might be due to the bureaucracy and unfamiliarity of the population with the norms and rules, but this will be further explored in the External Stakeholder’s section.

Since it is a rather small community of around 400 families, as stated by the leader of the miners, most people know each other and maintain a good relationship with their neighbors. During the field visit and observation, a lively social environment of the community was noted, with people going out to buy stuff, chitchatting, visiting friends, or picking up their kids from school.

This unity of the community may have something to do with the fact that Camargo is organized in an Ejido, a form of communal land established following the Mexican Revolution to distribute land to landless peasants. As Thorns & Betters (1998) suggest, the collective nature of ejidos promotes strong social bonds and

community cohesion, essential components of social capital that can drive sustainable development and resilience.

Such cohesion is exemplified in the community's religious celebrations. The visit to the community had to be scheduled after the Holy Week and Easter festivities (late March 2024) due to the inhabitants' deep devotion to the church and its celebrations, as noted by the researcher acting as the social link from UAQ to the mining communities.

On the other hand, the ejido system tends to overlook women, who have been historically excluded from governance structures and collective decision-making scenarios (García-Morán & Yates, 2022). Furthermore, this exclusion goes beyond the land management decisions into the daily life, as women usually adopt the housewife role in the community, noted during the interviews. It is good to remember that women are not allowed to enter or work in the mine.

Overall, the community shows a significant social capital in this sector through its supportive and cohesive networks. With the correct support and leverage, particularly in the fields of gender equality, female empowerment and collective decision-making scenarios, may contribute to build formal organizations that could help establish alternative livelihoods.

4.1.2.2 Assistentialism

Also known as welfare dependence culture, this code describes a barrier to the community's transition to alternative sustainable livelihoods since it deals with the prevalent mentality of the population that external agents such as government agencies or the universities should give them everything for free. It hinders, therefore, the capacity of people to go out and seek new alternatives for themselves as they rather wait for the solution to arise from outside.

Though only mentioned by a few community inhabitants and one external agent, "assistencialism" is deemed relevant to the social capital since it is understood as an inhibitor of novelty and initiative. As one person stated "The people here [in the community] are used to receiving everything as gifts. We could pay \$60 or \$80 pesos [MXN] (approximately \$2.50 USD) a year for the water and even then,

people would think it's a lot of money" (Community Member 2, personal communication, April 25, 2024).

An external agent mentioned that they were ready to provide a first aid course for the miners and some members of the community, but they expected it for free, and felt that the agent should cover the costs. This could speak of the precariousness of the incomes, since it is a zone with low socioeconomic indicators, and/or that people do not want to put an extra effort for receiving a benefit.

With this in consideration, addressing the issue of assistentialism is a relevant factor when thinking of strategies to promote of alternative livelihoods among the community. It is an area of opportunity for both external agents and the population to improve their collaborative efforts into designing programs that consider the needs of the population, their cultural background and that have a clear long-term objective and that provide the needed tools (Codoceo & Muñoz Sougarret, 2017). All of these, of course, without creating a dependency of the community to the government or other agencies, but rather that contributes to the process of emancipation.

4.1.2.3 Migration

The findings of this code reveal a trend of community members migrating to the USA, either legally or not, to seek new job opportunities. Young people are the ones who usually migrate, leaving behind fewer young members and an older population which is more resistant to change, as explored under the "Motivation" code of the Human Capital.

This migration comes with another effect, this time in the income sector, which will be also mentioned in the Financial Capital. Migrants send remittances to their families, contributing to the economy of the locality. This financial support is crucial for some families of the community.

Additionally, migration patterns are often temporary, which corresponds with the Seasonality of Livelihoods factor of the SLF. This means that some members return to the community with new skills, usually in the agricultural sector, as explored in the "Education and Skills" code in the Human Capital. This cyclical

migration influences both the local labor markets and the social dynamics of the community.

Though migration is a reality of the community, so is returning to it. For instance, a miner mentioned that “here [in Camargo] I have my wife and kids, there [in Querétaro city] I have no one” (Miner 8, personal communication, April 25, 2024). Therefore, a strong sense of belonging to the locality, to the area, to the ecosystem even, is present in the mentalities of the inhabitants. They regard it as a home, a safe place, and they think of it fondly.

In conclusion, migration plays a key role in the demographic composition, the labor market, the set of skills and the adaptability to change of the community to new sustainable livelihoods.

4.1.2.4 Relationships with External Stakeholders

The contents of this code are intertwined with those of the corresponding External Stakeholders section of the Framework. However, here are expressed the sentiments and opinions of the miners and other community members towards the external government agencies and other stakeholders, rather than the other way around which will be addressed in the corresponding section of the analysis of external stakeholders’ influence. In the following paragraphs a complex web of interactions is revealed with some positive and some negative perceptions of agencies from different levels of government or the academic sector.

To begin with the main negative perception of state and federal level government agencies is towards the bureaucracy and the so-called red tape or “tramitology” (tramitología, in Spanish, regarding the extensive series of steps of paperwork one must follow to obtain a service or an answer from the government). This becomes relevant when trying to establish a society for an enterprise or a collective society. Other challenges for these specific examples are also explored under the Motivation code of the Human Capital.

Secondly, there is also a feeling of deception from the people. They are fed up with some government agencies because they have visited them for over 10 years and yet no real result has appeared: “They always come and ask questions, they do workshops, and they promise they will come back with the results or the

money, but nothing” (Miner 2, personal communication, April 25, 2024). Regarding the money factor, more information is explored under the “Assistentialism” code of this Capital and in the External Stakeholders Section.

A particular negative sentiment is expressed towards the local municipal government with statements like “the current mayor promised an antenna, and it fell” (Miner 6, personal communication, April 25, 2024) or “they always come, make promises, but once they’re on office, they forget about us, about everything” (Miner 7, personal communication, April 25, 2024) coming up in the interviews. It is worth reminding that at the time of the interview local and federal election campaigns were held.

Despite the mentioned challenges and negative perceptions, there are some programs such as the PRONAFOR (Spanish acronym for Programa Nacional Forestal, National Forestry Program in English) aimed at providing payment for environmental services for taking care of forests and improving forest cover in the region. Limitations of such initiatives are explored under the Education and Skills code in the Human Capital, and the Natural Capital.

There is certainly room for improvement regarding the relationship of the community with some government agencies, but it is also worth highlighting that the interactions between other levels of government and the academic sector, with not only the UAQ but also with the Universidad Autónoma de San Luis Potosí (UASLP), have always been recognized as positive and fructiferous by the miners and the inhabitants. An open channel of communication must be cultivated between the community and the external stakeholders that allows the flow of not just ideas, but of resources and assistance.

4.1.3 Natural Capital

The UNDP says Natural Capital “is the term used to describe the stocks of natural resources from which further resources and services can be developed which may prove useful to livelihoods. Within the framework for sustainable livelihoods, the relationship between natural capital and the Context of Vulnerability is especially close. Their timing is also often the result of seasonal changes in the value of different natural capitals.” (2017: 7) Therefore, it has close relations with

other aspects of the SLF, such as the seasonality and vulnerability, and is intertwined with other Capitals, particularly with the Social one, as it has been discussed in the respective section. Two codes were created to analyze the findings of this capital: Environmental Conditions and Resource Management.

4.1.3.1 *Environmental Conditions*

This code highlights significant environmental challenges facing the community of Camargo. Although it is known that the ecosystem is in a semi-desertic area with sparse vegetation and water scarcity, for the last two years (2022-2024) there has been an important drought phenomenon that has struck the livelihoods of the people, as stated during an interview with an external stakeholder.

Without doubts, water scarcity is the most pressing issue that concerns the community, since it was the topic that arose in every single interview. Due to its vital importance for both human health and economic activities, water limits the potential alternative livelihoods that may be applied in the community, as stated and discussed in both the Health, and Education and Skills codes of the Human Capital.

Some examples of this include a miner who has “sowing plots but I can’t currently plant anything because there’s no water, it’s all going to dry up” (Miner 9, personal communication, April 25, 2024). When talking about aromatic plants and its potential as an alternative livelihood a miner stated that “oregano (*Origanum vulgare*) and damiana (*Turnera diffusa*) occur naturally here around, with the first drops of rain they sprout, but in the last season they all dried up because there was no rainwater” (Miner 7, personal communication, April 25, 2024). Even when discussing some farming activities another miner commented that he would like to “fatten some animals, but if there’s not water even for us, how are we going to give it to the animals?” (Miner 1, personal communication, April 25, 2024).

It must be noted that no mention was made during the interviews of the potential and proved contamination of the environment. This could mean that either the miners do not regard it as important, even if they plan to cultivate some plants on possibly contaminated soil, or that the efforts in risk communication from the

responsible authorities have not been enough and have not been assimilated by the inhabitants.

There is no question that the environmental conditions create a huge barrier for the implementation of alternative livelihoods and that they send a clear message on the urgent need of water infrastructure. However, the interviews shed a light on the potential alternative livelihoods that may be followed by the community provided a good incentive is given and a sustainable resource management is applied.

4.1.3.2 Resource Management

Information under this code reveals how the community organization plays a role in the management of natural resources, particularly water and land, through communal systems such as the Ejido. It is, therefore, highly intertwined with the Community Support, and Relationship with External Stakeholders codes of the Social Capital.

Unlike in other parts of the State of Querétaro, water is not supplied through the Comisión Estatal de Aguas, CEA (State Water Commission, in Spanish), the parastate organism responsible for water extraction, distribution, collection and treatment; but rather the Ejido is responsible for providing this service. As a matter of fact, it was explicitly told in two interviews that people are not keen of the CEA in the community. This means the community relies solely on the Ejido for water access.

As mentioned during the Social Capital analysis under the Community Support code, efforts have been made by the community to organize themselves and pay for an exploration study for underground water. And discussions of carrying out the plan and drilling a well were mentioned in a couple of interviews. This shows how important and urgent the subject of water is.

When talking about agriculture and farming plans, besides the already mentioned scarcity of water, another subject arose during the interviews which is land property. Since the community is based on an Ejido, meaning a communal system, this leaves little room for growing crops unless one possesses parcels of land. Otherwise, communal land is used if an agreement is reached by the Ejido.

For instance, the current campus of the UAQ was possible because of the land use change from communal use to educational infrastructure (González, 2017) given by the members of the Ejido, the ejidatarios, and certified by the National Agrarian Registry (Registro Agrario Nacional, RAN, in Spanish). With this precedent it is possible to find solutions for the subject of land use and property in benefit of the community members, miners and the ejidatarios.

Some alternatives mentioned by the miners were pine nut plantations and growing aromatic plants. Both occur naturally in the region, meaning they are adapted to the extreme conditions and can make a profit for the people, since there are examples of it in other communities. The already mentioned PRONAFOR strategy may come in handy if leveraged well by the community or the Ejido in cooperation with the competent authorities.

This whole section of the Natural Capital with both its codes cannot go by without mentioning the already present scenario of climate change. As stated, the effects of this phenomenon are seen, felt and suffered by the population of this specific region which is particularly vulnerable to it. A study about the NPA of Mexico mentions that all areas are expected to exhibit severe impacts due to rising temperatures and decreased annual rainfall by 2050, particularly those in mountain regions, like the Sierra Gorda (Esperon-Rodriguez et al., 2019).

There have been some efforts led by Civil Society Organizations, like the Grupo Ecológico Sierra Gorda which have developed climate action tools, strategies and guidelines together with the State Government (WEForum, 2023). Their focus areas are soil and forest restoration with a regenerative economic perspective. Similarly, the new alternative livelihoods will have to adapt and prosper in a new set of natural rules product of climate change. This is further addressed in the External Stakeholders section.

4.1.4 Physical Capital

Physical capital, according to the UNDP, comprises the basic infrastructure and producer goods needed to support livelihoods (2017: 8). The infrastructure looks at changes in the environment which affect communication and access to basic services. Production goods are the tools and equipment which increase

productivity. Hence, two codes were created to cater to this definition: Infrastructure, and Access to Services.

4.1.4.1 Infrastructure

The information codified in this section provides important information regarding the context of the physical environment surrounding the community of Camargo. It is accessible by the Federal Highway 120 San Juan del Río-Xilitla, although road would be a better name for it since it crosses the mountainous landscape of the Sierra Gorda. The access to the community is directly on the Federal Highway and the main avenue is made of concrete pavement.



Figure 11. Access to the community (left) and to the mine (right)

As mentioned in the Education and Skills code of the Human Capital, the community has educational infrastructure like an elementary school, rural middle school, technical high school and the recently installed university campus, equipped with essential amenities. In addition, the community consists mainly of private homes, various businesses, a health center and a church. It must be noted that during an interview a miner stated his desire for more green areas “like a little park, for fun and being with the family” (Miner 11, personal communication, April 25, 2024).



Figure 12. Existing infrastructure of the community, clockwise the church, the elementary school, the health center and the access to the main road

All the basic services can be found in the community, such as electricity, internet, mobile phone service, and gas for cooking, although access to water remains the main limitation. Water scarcity affects not only human health, but also hinders the new alternative livelihoods that may arise to bring economic opportunities to the population, as discussed in the Human and Financial Capital.

This deficiencies in infrastructure may have to do with two facts that arose during the interviews: a distance, both physical and political, from the municipal capital, and a lack of trust with the municipal government. The distance factor answers

to “geopolitical reasons” (Participant UAQ Camargo Campus Coordinator, personal communication, April 25, 2024) as stated by an external stakeholder, since Camargo is closer to the Federal Highway than to the State Highway that leads to seat of the municipal government of Peñamiller. And the lack of trust is linked to the same distance, since there is a feeling that once the people are in the government, they forget about the needs of the community and the promises they made during campaign. It must be remembered that the field visit occurred during election times.

Camargo is only 29.5 km away from the capital of Peñamiller, the seat of the municipal government. The trip by car takes around 45 minutes on a sinuous road in normal conditions. A map of the route the community inhabitants must follow to reach Peñamiller is displayed in the following figure.

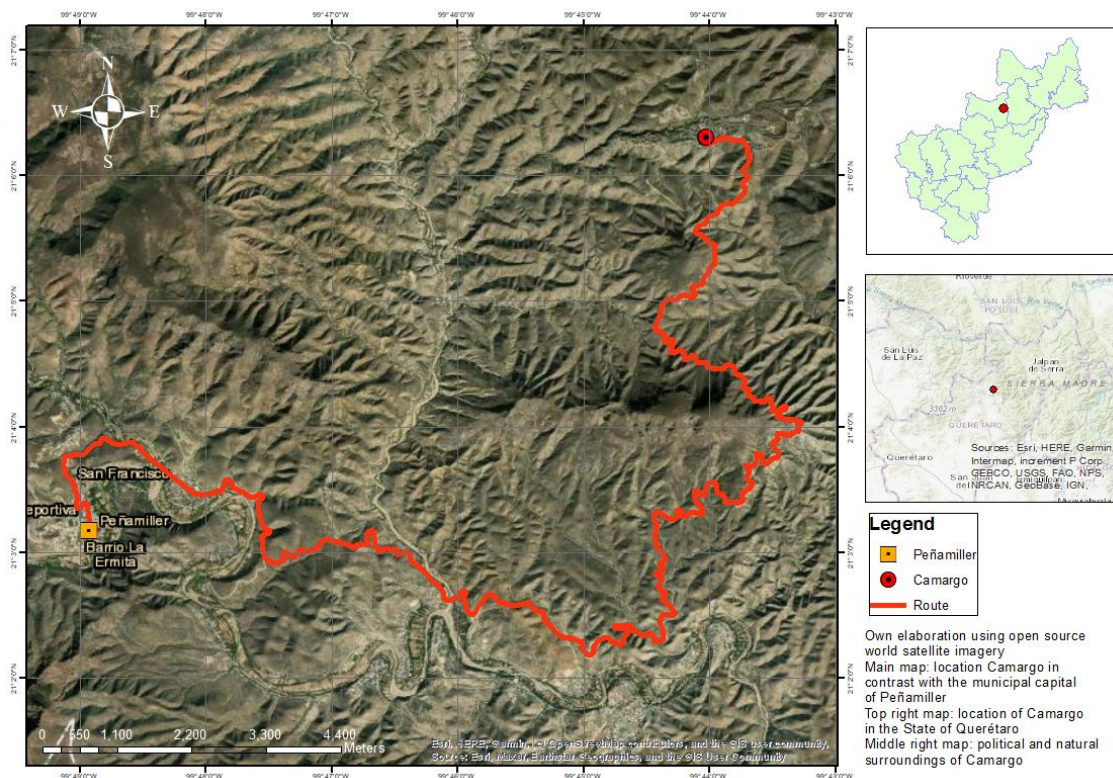


Figure 13. Route from the municipal capital to the Camargo community

Therefore, the main areas of improvement for the existing infrastructure of the community are the access to drinking water and the relationship with the municipal government. The latter should oversee helping the community with the

issue of water, but the link between Camargo and the municipal government is not as strong as it should.

4.1.4.2 Access to services

This specific section deals with the challenges faced by the population when accessing essential services. Two main pressing issues arose during the interviews with the inhabitants, the operation hours and overall state of the health center, and the access to drinking water.

As stated in the discussion of the Health code in the Human Capital and the Community Support under the Social, people seek alternatives to access health services such as recurring to private practices and pharmacies. Furthermore, when the health center is not open, the inhabitants ask their neighbors for a ride to the nearest town or clinic where they can get medical attention. This is further developed under the Community Support code of the Social Capital.

Another claim for improving the access to health and security services, was the expressed need for both an ambulance and patrol cars. A miner said, “we need patrols and police to watch over and ambulances to take sick people to nearby hospitals, lives can be saved” (Miner 4, personal communication, April 25, 2024).

As for the drinking water access, there is a campaign for the collection of funds for the drilling and operation of a water well, directed by the committee of the construction. The issue was already mentioned by a couple of miners and community members in the performed interviews. This speaks of the community’s own social organization, support and initiative to seek solutions for the problems. The initiative is approved by the Municipal Delegation of Camargo, which is the form of local government in representation of the municipal authority of Peñamiller.

There is a solid foundation for the communication between the community and other population centers, since the Federal Highway was expanded a few years back (López, 2018). However, dealing with steep curves is always risky, especially when one does not know the area.

Provided that the government authorities of all levels, as well as other external agencies, support the advantages that the community of Camargo has in terms of the Physical Capital, there is potential for the improvement of life conditions for

the population. It may as well be that they seek for alternative livelihoods help the community even more than the mining once did.

4.1.5 Financial Capital

According to the UNDP, “this capital refers to the financial resources that people use to achieve their livelihood objectives. The definition used here includes flows as well as stocks and it can refer to consumption as well as production. This definition has been adopted to capture an important livelihood building block, namely the availability of cash or equivalent that enables people to adopt different livelihood strategies” (2017: 9). So, this section will focus on what are the population’s Sources of Income, how they have changed through Diversification and the Need for Investment to start new livelihoods in the present time.

4.1.5.1 Income Sources

Before the fieldwork, the notion held was that the main and, if not, only source of income for the inhabitants of Camargo, was artisanal mercury extraction from the nearby mines. However, once the in-situ interviews were performed it was discovered that mercury mining is not the main economic activity of the community anymore. Out of necessity, the working population has diversified their incomes and found new jobs both elsewhere and within the community.

Many factors play a role in this shift of economic activities, such as the depletion of mercury ore to climatic conditions or the need from external markets for workers. If they do not work in the mine, most people nowadays work in the greenhouses of agrobusiness parks in other localities about an hour away from the community. The company provides the round trip from and to the community, so they do not need to buy a vehicle. “It is a [physically] demanding activity, but it helps them make ends meet” (Miner 9, personal communication, April 25, 2024) expressed one of the miners who does not work in the greenhouse but knows people who do. If not greenhouses, in other cities there are factories that require labor hand and where some inhabitants have found a job to provide for their families.

For some other people, another source of income, sometimes considerable, are the remittances their family members send them from abroad, mainly the USA. A

deeper analysis of the migration phenomenon can be found under the Migration code of the Social Capital.

During the visit to the community, a high number of small grocery stores was observed called “misceláneas” in Spanish (miscellaneous in English, meaning they sell various things). Many of the interviewed people from the community either own a store of these or visited them while chatting with the people. A business owner expressed concern over the saturation of the market with so many stores, stating “if people put more stores, what are we going to do? Buy from each other only?” (Community Member 3, personal communication, April 25, 2024).

Still, the mine plays an important role in the identity of some members of the community, since for many years it was a population of miners who lived there. However, with the mercury bonanza being over, as commented by one of the business owners, concerns over what to do next are ever present. This shares a link to the problem with mercury prices and existing ore supplies, as it is discussed under the Motivation code of the Human Capital.

To sum things up, it seems that with the mine providing less and less income for the families, they have turned to look for other sources on their own. With no mention of government or social programs applied, the private sector is the main source of new jobs for the working population with active efforts of recruitment. Further discussion on the search for alternative livelihoods can be found in the Human and Social Capital sections.

4.1.5.2 Diversification

This code underscores the community’s efforts to diversify its income sources and economic activities. Overall, there is a recognition that diversification is essential for making the community more prosperous and less dependable on a single economic activity, such as mining, as stated in several interviews where miners and community members expressed their opinions on the subject.

Furthermore, external stakeholders also regard diversification as a positive action with outcomes that go beyond the economic benefits of it and deepen into the resilience of the community to both external market factors and climate change’s

effects on the ecosystem. More on this is explored in the External Stakeholders section where opinions from agencies are collected.

As the Income Sources code explains, nowadays the community does not depend exclusively on the mining activity for the entirety of its incomes. People have migrated to other localities and even to the USA in their seek for a better salary to provide for their families. An outstanding case of diversification comes from a member of the community who explained “I took a course of screen-printing in the city and now I installed my workshop right next to my grocery store. I even told my sister to do a nail course, or something like that, to seek other sources of income” (Community Member 2, personal communication, April 25, 2024).

Moreover, some examples of diversification and new livelihoods come from the management of natural resources. As mentioned in the corresponding code in the Natural Capital section, forestry and agricultural projects with focus on local plants are playing a role as ongoing activities that provide inhabitants with alternative activities to mining.

Nevertheless, this activities regarding natural resources in the ecosystem may become vulnerable in the current water scarcity situation and in the ongoing and future climate change scenarios. Therefore, a strong collaboration is needed with the external stakeholder’s agencies may aid addressing these challenges.

Since diversification is no strange concept to the population, it may be used as a factor that favors the transition to alternative livelihoods. Additionally, resilience to climate change and the market are factors that are considered in the sustainability aspect of the SLF.

4.1.5.3 Need for investment

Under this code the need for financial resources to support various initiatives of alternative economic activities to mercury mining and for the improvement of infrastructure of the community is highlighted. There is, hence, a connection with the Infrastructure code of the Physical Capital section.

One claim came from a miner who said that “there should be an industry that gives us jobs here” (Miner 9, personal communication, April 25, 2024). This might

sound simple to say and to imagine, just setting up a small factory near the population center and there are jobs for everyone. But the reality is that given the current conditions of infrastructure to reach the community and the state of the environmental conditions, the installment of a company is rather difficult to achieve.

Another miner said that he knew how to operate a gravel machine and there are rocks nearby, so all he needed were the funds to buy the machinery. Similar claims for other ideas of start-up businesses emerged not just from miners but also from community members who would like to set up a business in the town. While these claims demonstrate the people's willingness to seek for alternative ideas, for now they are just that, ideas.

To implement said ideas a business plan must be produced, and this can be accomplished by the population themselves or with the help of external stakeholders like government agencies. A deeper analysis of the role of these agencies into the creation of new business is further explored in the corresponding section. For the challenges and barriers faced when attempting to form a society, a discussion is presented under the Motivation code of the Human Capital section.

And, finally, as expressed in several Capitals of the analysis, the pressing need for water also arose in the needs for investment. An exploratory study for underground water has been performed with the support of members of the community, but more funds are needed to drill the well and extract the water. To achieve this, a collection campaign is coordinated by the respective committee that aims to retrieve cash the inhabitants of the community who are now living in the state capital, the city of Querétaro (Cheluis Serrano & SOY CAMARGO (Peñamiller Qro), 2024)

The need for investment is recognized by the population, with a significant barrier being the lack of a continuous organized action of the members. As the Chief of Internal Commerce at SEDESU and the UAQ Camargo Campus Coordinator mentioned, they have struggled to maintain an ongoing channel of communication to conclude projects in the community. An area of opportunity is the relationship of the community with external agents that may provide with the necessary funds for executing the projects, with the appropriate previous studies.

4.2 External Stakeholders

Part of the SLF is the influence of external stakeholders who may have power over the five Capitals of the community and may ease or impede the transition towards an alternative livelihood. In this part of the analysis, the coded results of the interviews are presented and discussed in their relations, influences and points of view of the government agencies and academic sectors involved in the case of study.

The following figure serves as a visual representation of the categories and codes generated after the review of the interviews with external stakeholders, and that served for the thematic analysis of this section.

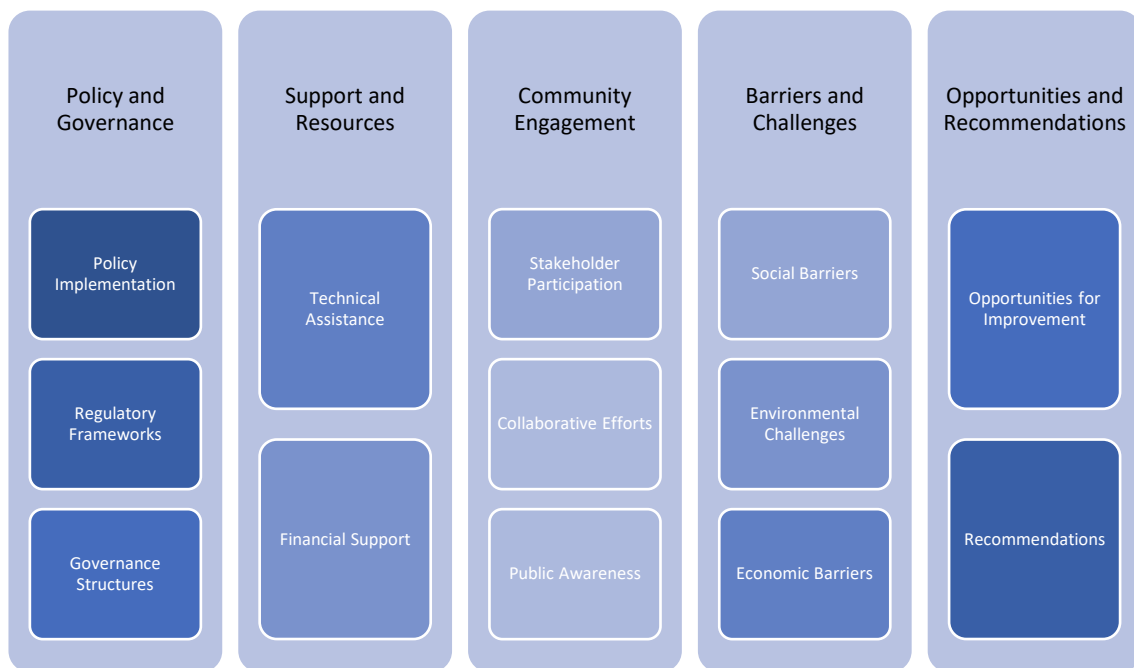


Figure 14. Codes created for the thematic analysis of the insight of external stakeholders

4.2.1 Policy and Governance

This part of the analysis will describe the points of view of how the interviewed stakeholders, particularly the government agencies, develop and Implement their Policies, execute their Regulatory Frameworks and contribute with each other in the existing Governance Structures. All of this, of course, under the context of the case of alternative livelihoods and their sustainability in Camargo.

4.2.1.1 *Policy Implementation*

This code highlights how new policies are developed, and existing ones are implemented for the community, regarding the alternative livelihoods. It is important to remember that a policy is not just designed and implemented, but it also must be monitored and evaluated (Bardach, 1998). At these initial stages of the larger project, such efforts of overseeing and assessing the impact, have not yet been initiated.

From the State Secretariat of Sustainable Development, SEDESU, two main general lines of policies are followed, environmental ones, supervised by the Undersecretary of Environment, and economic strategies, by the Undersecretary of Regional Development.

Beginning with the environmental strategies, a main project exists which is the reforestation program funded by a tax so that “there are benefits that the private sector is directing to the Sierra Gorda [...] particularly to its forest zone which has a greater carbon sequestration capacity” (SEDESU Environmental Undersecretariat, personal communication, April 4, 2024) as expressed in the interview. These benefits are mainly seen in places where there are mining communities, like in the municipality of Pinal de Amoles, but not so much on Camargo, due to the arid conditions.

However, as the results of the Natural and Financial Capitals mention, there is a desire from the community to plant and cultivate pine tree seeds on the slopes of the mountains. Of course, this project is limited by the environmental conditions of the ecosystem and the funding from the agencies, but these are two entities where a link may be constructed.

On the side of economic strategies, the respective office mentions the existence of a State Program for the reconversion of mining activities which operates yearly and provides with money or tools for groups of people or individuals who want to set up a workshop, a small business or any other project in the area. Other aspects of this project are explored in the Support and Resources and Barriers and Challenges categories of the section. Nonetheless, it was mentioned that, to the date the interview was held, no miner or group of them from the community has used this program, and therefore, there is no monitoring of it.

The SEMARNAT office in Querétaro stated that the project is coordinated from their central offices and the executive institution which is the INECC. However, the acting policy they implement is to serve as a link for these central agencies and the mining communities of the Sierra Gorda, as well as with the academic sector. This means they provide logistic, administrative support, and letting the authorities into the mines and communities.

The UAQ's policy is to promote the improvement and wellbeing of the population through the sustainable development in the region. This means that they act also as a link between the communities and executive agencies but with a separate agenda, which is the implementation of their own projects and the educational programs they offer.

It seems that, overall, the main goals of the policies that are implemented by the government and the academia are mostly the same, although targeted through different fronts. There is a link between them, and channels of communication opened and working which are further explored in the Governance Structures section.

4.2.1.2 Regulatory Frameworks

Under this code the role of management of natural resources within the context of sustainable development and in a Natural Protected Area is discussed. This is because the area of study is ruled by the Management Program of the NPA and some activities require previous authorization, according to the law.

Since 2009 the SEMARNAT office in Querétaro has been working with the communities to explore the existing mines in the Sierra Gorda region and helping them with the corresponding process of getting an Environmental Impact Assessment. However, to the date of the interview “none of the authorized mines have fulfilled the imposed conditions for operation established by the SEMARNAT office [then delegation] in Querétaro” (Participant SEMARNAT Head of Local Office, personal communication, April 17, 2024) as the local office of the SEMARNAT commented.

The coordination and compliance with the existing regulatory frameworks are emphasized, including the need for roundtables with the miners of the

communities to seek common points and work towards the transition to sustainable livelihoods. In this process authorities play a crucial role in linking the communities and ensuring that the activities comply with the regulations.

Through all the interviews with the government agencies, mentions of a match between the new proposed alternative livelihoods and the existing regulatory frameworks were highlighted. It must not be overlooked that Camargo is in a Biosphere Reserve, therefore the livelihoods should be compatible with the management plan and rules of it. This could be both seen as a restriction or an opportunity for new pathways to be built.

4.2.1.3 Governance Structures

Collaboration and coordination between stakeholders, government agencies of all levels and the community is a critical role of the stakeholders. Joint efforts can take advantage of the synergy to make a positive impact with the correct allocation of resources. But when no channels of communication exist, the risks of a double action with double the efforts, not efficient at all, are high.

A paraphrased quote from the Undersecretariat of Environment of SEDESU may state the importance of this code: “an important obstacle is that projects must be generated in a comprehensive manner, considering priorities and characteristics in terms of social, educational, touristic, and economic development, and environmental protection [...] and that another agency is working in the same direction but with a different approach that affects the current project” (Participant SEDESU Environment Undersecretariat, personal communication, April 4, 2024). This indicates that communication between agencies plays a key role in efficiently managing the time, human, financial and material resources of a project to achieve its goal.

A concern expressed by both state and federal agencies is that municipal governments usually last for only 3 years, 6 if they are reelected, therefore a continuity with local authorities is difficult to reach. As expressed by the SEDESU “Every three years there is a new administration, so we have to restart all over again” (Participant SEDESU Local Commerce Office, personal communication, April 4, 2024).

There is an established steering committee where federal and state authorities, SEMARNAT (both central and local offices) and SEDESU, INECC, and UNEP/GEF meet and communicate of their advances in the execution of the project. This flow of information between them has always been and cordial because of the years they have worked together. It must be noted that neither the UAQ or any other academic institution, nor a Civil Society Organization take a part in the direction of the executive project, although own agendas in the same direction are followed.

Finally, it is worth mentioning that the agencies look for “who is or are the actors in charge of the continuity of a social rural sustainable entrepreneurship” (Participant SEDESU Environment Undersecretariat, personal communication, April 4, 2024) and said actors must also be in an ongoing communication line with the authorities. When mentioning a person or group of people who are leaders or actors of change, one cannot help but wonder if there should be such a group who is fully dedicated to the transition project instead of the group being composed of people who do not only focus on the project, but that have other sectorial priorities in their respective fields.

4.2.2 Support and Resources

Once established on which line of policy are the authorities working, the available resources to support the search and transition for alternative livelihoods are to be explored. These available resources are classified in two categories: Technical assistance and Financial support.

The first category focuses on the efforts made by the external stakeholders to provide knowledge, tools and training to the inhabitants, therefore there is a strong link between this code and the Education and Training one in the Human Capital.

As for the second category, it reports the existing funds to directly provide the community with money or other financial assets to transition to other livelihoods. Similarly to the previous category, a strong link between this code and the one of Need for Investment in the Financial Capital is noted.

4.2.2.1 *Technical Assistance*

Under this code, various forms of support provided to the community to develop new skills and engage in sustainable activities are highlighted. It was noted that skills for developing activities mostly fell under the area of natural resources management in accordance with the surrounding ecosystem, meaning, the natural vocation of the region. These efforts also have in consideration diversification to strengthen resilience in the population.

Among the sustainable activities that arose during the interviews, the management of natural resources stood out as one of the most preferable options for the authorities to support. From timber harvesting to the use of aromatic species like oregano (*Origanum vulgare*) and damiana (*Turnera difusa*), the external stakeholders may provide logistic and administrative assistance in setting up the businesses. Particularly, the UAQ has already provided support by consolidating a group of women who have a small business selling the herbs.

Furthermore, it was mentioned that the UAQ has also provided training for orchards, beekeeping and the cultivation of medicinal plants. However, it must be remembered that most of the activities relying on the management of natural resources depend on the water availability to prosper. Therefore, there is a strong link between the skills needed and the environmental conditions of the area.

This need for a so-called regional specificity was mentioned in a couple of interviews. “The people must seek and find the natural vocation of each region with respect to the activities that they can have and that can be viable in the medium and long term” (Participant SEDESU Environment Undersecretariat, personal communication, April 4, 2024). Sustainability implies that the activities are to be sustained for a long period of time.

Throughout the performed interviews it was stated that the government agencies and the University are in the entire disposition to help the people of, not only Camargo, but the rest of the mining communities to transition to alternative livelihoods in the sustainability framework. Mentions were made that some attempts have taken place to set up a cooperative society or people simply showing up to ask for instructions or assistance.

Finally, an interesting phenomenon discussed with the UAQ is worth mentioning. Although the younger generations are the focus of the efforts made by the government agencies, this sector of the population seems to be disinterested in taking part in traditional agricultural and farming activities. “They want to study accounting or business administration, but there are no businesses in the community, so they have to migrate” (Participant UAQ Camargo Campus Coordinator, personal communication, May 30, 2024) was stated in an interview. A new perspective on more viable and attractive alternatives for young people must be considered if a successful transition is expected.

4.2.2.2 Financial Support

Though only mentioned in one interview, the financial assets that may be transferred from a government agency directly to the population in need is of great importance to the transition. It displays the crucial role of government programs in providing financial resources to support the transformation of traditional activities and the development of new businesses.

Specifically, SEDESU has an ongoing program where financial assets are directly transferred to the individuals or groups of people that collectively ask for funds to convert from mining activities into new livelihoods. The program is meant to be a kickoff step in the creation of a new business or a setup of a small workshop.

The mentioned program is called PASE which stands for Programa de Apoyo a Sectores Económicos (Support Program for Economic Sectors, in Spanish) and is managed by the Direction of Regional Development. Under Category 2 Mining and Brick Producing there is a special section destined to the “Reconversion of activities to people dedicated to mercury extraction”.

Although the program exists and it is available to very person who is a mercury miner in the Sierra Gorda area, there have not been any direct beneficiaries of it who are miners and applying to this specific section. A review of the possible causes is discussed in the Human and Social Capital as well as in the Barriers and Challenges section.

4.2.3 Community Engagement

Like the Relationship with Stakeholders code under the Social Capital, this code gathers inputs from the actors' relationship with the community of Camargo and within themselves. From attempts to form a link with the miner group through Stakeholder Participation, to the Collaborative Efforts or synergies that arise when different agencies work together for a common goal with different perspectives and resources and emphasize Public Awareness, all are discussed and analyzed as follows.

4.2.3.1 Stakeholder Participation

Under this code, findings related to the importance of the process of engaging the community by the different external stakeholders are described. Greater community involvement is essential for identifying and supporting new activities, addressing the vulnerability of these regions, and ensuring that projects meet local needs.

Since different external actors are engaged in the transition project, diversity of inputs and a wide variety of resources are available to the population who need to find alternative livelihoods. Among the involved participants who have a seat on the directive committee of the larger GEF funded project, the federal and local offices of SEMARNAT can be found as well as the SEDESU, UNEP Mexico, of course the GEF managerial office and the executor of the project, the INECC.

Since it is an internationally funded project, the direction of it is handled by a public official institution, in this case the INECC. In one of the interviews, it was expressed that due to the nature of the project and the funds, Civil Society Organizations and the Academia take part in other activities but do not form part directly of the Executive Committee.

This may be a topic of consideration since some local organizations and academic institutions hold an important position of respect and management of resources in the Sierra Gorda region, such as the Grupo Ecológico Sierra Gorda, who did not answer back the petition for an interview. Others, like the UAQ, have been ever present in the region, particularly in the community of Camargo, where ongoing projects take place daily.

In every interview it was mentioned that a strong collaboration between government agencies and academic institutions is maintained since the early stages of the transition to alternative livelihoods. Each interviewee was aware of the ongoing efforts of the other institutions and talked about the importance of synergy and collaboration, which is further discussed under the Collaborative Efforts code.

4.2.3.2 Collaborative Efforts

As mentioned before, the agencies and stakeholders are in touch with each other to seek synergies and areas of action where they can collaborate in the framework of community development and sustainable projects. A significant focus is on inter-institutional collaboration between governmental and academic institutions to achieve common goals.

Project coordination and synergy play an important role in the implementation of new livelihoods. Coordinating projects to avoid conflicts and duplication of efforts is crucial (Matross Helms & Griffin, 2017), placing a strong emphasis on considering the priorities and impacts of each agency (Soler, 2021) and achieving synergies to work towards common goals. The involved agencies in the study were familiar with each other and have proven to work well together, in some cases for over a decade, which contributes to the efficiency of the action of each stakeholder (Domínguez, 2001).

All levels of government in Mexico are involved in the transition project to the extent of their competences. For instance, SEMARNAT, through the INECC as the executive agency, together with the Health and Welfare Secretaries deal with addressing the needs of the population and channeling resources. Whereas the Energy Secretariat is involved in a photovoltaic project in the communities of the Sierra Gorda. The State and Local governments play each a role directly in contact with the community in the reach of their jurisdiction. The list includes also international agencies, mainly the UNEP and GEF which act as the funding partner.

Among the exceptional cases mentioned of collaboration between government agencies the feasibility of other types of mining alongside the Mexican Geological

Service, SGM (Servicio Geológico Mexicano, in Spanish), can be found. In this case both authorities, the INECC and SGM, directed efforts to assess the possibility of exploiting other minerals according to the existing reserves in the area, which was a claim of the miners.

Even if at the beginning not all the competent institutions were aware of the efforts made by their partner agencies towards a reconversion of mining activities, those lack of cooperation was quickly corrected so the flow of information could be as smooth as possible. The steering committee has played an important role in assuring the participation of all the corresponding institutions to the extent of their possibilities.

And these efforts have proofed their value since the interviewees in both the mine and the community mentioned the past visits of academics from the UAQ and the UASLP, as well as government authorities from both local and federal levels. They even noted that international agencies, like the UNEP, visited their mine and committed to the project.

In sum, both the INECC and the SEDESU recognize the importance of collaborative efforts to effectively address the challenges before them, the reconversion of mining activities. These efforts require institutional partnerships, coordination to avoid duplication of efforts, training and capacity building, and addressing specific challenges in project awareness and coordination. It is worth noting that Camargo is not the only community that has the focus of the government agencies, since other mining communities are in the Sierra Gorda region.

4.2.3.3 Public awareness

This code underscores the critical aspects of raising public awareness and engaging the community in development projects regarding the reconversion of mining activities. During the interviews all institutions mentioned that working with the community is considered the foundation of development, and that equitable access to the projects is essential.

It is worth noting that since 2009, thanks to the local office of the SEMARNAT in Querétaro, there has been an existing link between the local government

agencies and the mining communities of the Sierra Gorda region, link that has been useful when introducing federal and international agencies to the area. Since then, a series of interventions with the communities have taken place before, during and after the Minamata Convention's existence.

At the core of this interventions is communication, the nerve center of the process, as stated by a government agent. All the interviewed government institutions recognized the labor of the UAQ and UASLP in being one of the strongest links with the miners of all the involved communities.

Furthermore, the UAQ plays another role in offering educational opportunities to the population in sustainability related programs in their Campus of Arroyo Seco and Pinal de Amoles. The latter has an important presence of miners who have demonstrated an interest in sustainable construction since their ecosystem plays in their favor, a pine and oak forest.

However, and despite the excellent communication efforts done by all institutions, somehow the flow of information from the communities to the authorities regarding the economic alternatives encounters obstacles. The Undersecretary of Economic Development of SEDESU notes that when checking on the progress of installing a small business or asking for machinery, the miners tell them that everything is going fine or that later they will contact them. There is a sense of discontinuity in the chain of efforts made towards the transition in the state government.

In the end and in the words of SEDESU's Undersecretary of Environment, what is most important is "to consider the interests, traditions, and culture of communities when seeking economic alternatives" (Participant SEDESU Environment Undersecretariat, personal communication, April 4, 2024). Establishing social links and understanding the community's historical relationship with various activities, such as mining, are important for effective public awareness and engagement. Understanding and respecting these factors are essential for gaining community acceptance and support for new projects.

4.2.4 Barriers and Challenges

This specific section will recover the hindering factors explored during the interviews with the external stakeholders. These factors are further categorized into Social, Environmental, and Economic. The segments discussed in this code come from the external point of view and experience that each actor has from their own agency. Several of these factors are also mentioned and discussed in all the Capitals, particularly under the codes Motivation, Assistentialism, Environmental Conditions, and Need for Investment.

4.2.4.1 Social Barriers

Significant challenges faced by the community of Camargo in the external observations of the stakeholders are described under this code. One of the most prominent barriers is the community's resistance to change, despite being friendly and receptive, due partly by the migration of young people, leaving behind an older population more resistant to adopting new practices. Therefore, several government agencies stated that they would like to focus their efforts on the younger remaining generation.

Various other issues which have also arisen in the Five Capitals discussion such as, migration, lack of technical knowledge, and social resistance to change hinder the community's ability to implement alternative sustainable livelihoods. But other factors emerged during the interviews with the external stakeholders, particularly alcoholism and gender inequality. Social indicators and previous interventions with the community performed by the INECC and the UAQ have shown that gender inequality still plays a significant role in the social relations of the community.

As mentioned, the role of women in both the ejido and the community does not include decision-making positions. However, there is evidence in other ejidos in where women are increasingly taking leadership in local land management (García-Morán & Yates, 2022). If targeted correctly, policies may help with the empowerment of women and providing them with the tools and skills they need.

Another issue that arose when discussing the subject with the stakeholders is that of alcoholism. As suggested by Brulotte (2017), alcohol use in rural communities

often reflects deeper socio-economic issues and cultural dynamic. Additionally, alcohol consumption is a public health issue in Latin America and reports suggest a link between it and various social health challenges, which can be worsened by economic hardships and lack of job opportunities (OECD & The World Bank, 2020).

A notable sense of frustration and distrust towards authorities, often due to a lack of clear and specific information, further exacerbates these challenges. In words of the local office of the SEMARNAT “unrealistic expectations may have been [unintentionally] generated about the project [...] there was an issue of interpretation of how a project was managed” (Participant SEMARNAT Head of Local Office, personal communication, April 17, 2024) referring to the sentiment of the miners thinking they would get money directly from the GEF project.

Overall, addressing these mentioned social barriers requires a multidisciplinary approach that considers the roots of the issues and possible solutions. This includes increasing awareness of health and environmental impacts, improving communication and trust with authorities, addressing gender-specific barriers, and considering the community's cultural and traditional context in planning and implementing new initiatives.

4.2.4.2 Environmental Challenges

Obstacles regarding the environmental natural conditions of the ecosystem surrounding Camargo as well as the new conditions imposed by climate change are focused under this code. It has already been stated, but worth remembering, that the region's arid, semi-desert climate with sparse vegetation and limited natural resources makes it unsuitable for traditional agricultural plantations. This is a particular issue of Camargo not faced by the mining communities of other municipalities such as Pinal de Amoles, which is immersed in a pine and oak forest ecosystem.

Furthermore, prolonged droughts exacerbate water scarcity, severely impacting the little existing agricultural and livestock activities and “reducing the attractiveness of the area for tourism” (Participant SEDESU Environment Undersecretariat, personal communication, April 4, 2024) according to the state

authorities. Climate change significantly affects the region, modifying natural conditions and reducing river flows. This makes regions dependent on natural resources particularly vulnerable (Arenas-Wong et al., 2023), highlighting the need for sustainable rural development and resilience to climate change.

Although not the focus of the study, is worth mentioning that mining activities and the associated pollutants pose additional environmental challenges, affecting the community's health and environmental conditions. Adding another layer to the existing pollution is the fact that the community is also immersed within the boundaries of the NPA Sierra Gorda de Querétaro, a biosphere reserve. According to state and federal authorities, the alternative economic activities must be compatible with the management plan of the NPA.

Therefore, the management of natural resources in arid ecosystems in the context of climate change presents unique challenges compared to forest ecosystems, requiring careful and tailored approaches. This was highlighted by the SEDESU when discussing the tourism potential as well as the sustainable rural development of the region.

The environmental aspect of sustainability is a multilayered component comprising arid ecosystems, climate change and natural resources management in the context of a federal NPA. This multilayer system is depicted in Figure 15.

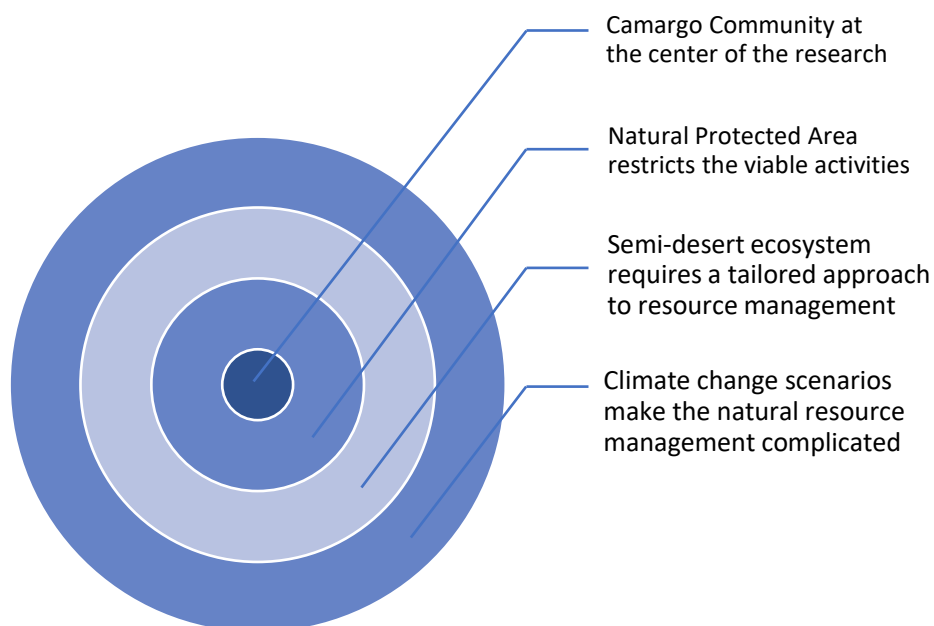


Figure 15. Multilayered system regarding the environmental aspect of Camargo

The possible lines of action mentioned by the authorities are sustainable development practices, tailored management of natural resources, and efforts to mitigate the impacts of climate change and water scarcity.

4.2.4.3 Economic barriers

Financial challenges that affect the community of Camargo are highlighted under this code. One of the most prominent barriers is the lack of financing and economic resources, which hinders the transition to sustainable activities. Limited financial resources impede development and economic growth which has an effect in the quality of life, health and social aspects of the population (Zhang & Zhao, 2024).

As mentioned by the Undersecretary of Environment “if a community lives from just one [economic] activity, despite it being sometimes rewarding, it is a vulnerable community since all economic activities have moments of opportunity and of threat” (Participant SEDESU Environment Undersecretariat, personal communication, April 4, 2024). It is well known that communities that depend on a single economic activity, such as mining, are particularly vulnerable to business cycles and economic fluctuations. This vulnerability underscores the need for diversification and the development of alternative income-generating activities (Metcalf et al., 2020; Ruiz-Mallén et al., 2015; Salas et al., 2011).

This fluctuating nature of the mining activity, reflecting the instability and unpredictability of income, together with the lack of job opportunities and broader social conditions, such as climate impacts have forced some community members to look for other sources of income. This phenomenon is further developed in the Income sources code of the Financial Capital. It seems that it may be a key point of entry for authorities to intervene and start the process of transition to new livelihoods.

Although the new alternative livelihoods that the community have already implemented and will implement may not be as economically rewarding as once was the mining of mercury, they must become more secure regarding the stability of the income. Provided a safe and regular income, the population will have time

to dedicate to other activities or be able to take care of themselves, since, as stated by the interviewees themselves and supported by Moore et al. (2021) part of the Latin American culture is to take care of each other as a family and community.

Policies directed to rural communities must have a different understanding of what rurality is to reflect the diverse and dynamic nature of rural areas, as stated in a report by Gaudin & Padilla (2023) commended by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC). The authors also highlight the importance of understanding rural transformations, like Camargo is experiencing, to design policies for sustainable development and well-being beyond economic benefits.

On a more focused case study of Mexico Hannan et al. (2021) discuss the effectiveness of social programs and the need for better targeting social spending to mitigate the adverse effects of external factors such as the COVID-19 pandemic. Therefore, sustainability policies in rural communities must look beyond obtaining economic benefits to better the living conditions and investigate how to improve the well-being of the population.

4.2.5 Opportunities and Recommendations

This final group of the External Stakeholders section gathers the insights of the participants from their own perspectives, experiences and positions of power to influence the progress of transitioning to alternative livelihoods, and particularly, to ensure their sustainability. Though each actor speaks for their own agency, with their own policy, resources and field of expertise, several similarities are found since they all reach for a common goal.

4.2.5.1 Opportunities for Improvement

This code highlights several areas where the community of Camargo can enhance its development and sustainability efforts, according to the external stakeholders. Streamlining administrative processes and reducing bureaucratic delays are essential to accelerate progress, particularly in accessing funds to alternative economic activities. Additionally, improving the clarity and specificity

of information provided to the community by the government agencies and programs can reduce frustration and foster understanding.

Enhancing infrastructure and providing education and training opportunities are critical for adopting new technologies and overall community development towards sustainable livelihoods. Developing viable economic activities, such as cultivating aromatic species or nopales, which are suitable for the region's natural conditions, can provide alternative livelihoods and support the local economy, provided they come with the adequate skills training and financial support.

As mentioned by the local office of SEMARNAT, the community's proximity to major roads and highways offers logistical advantages for transporting materials and accessing markets to the south of the state and the northern part of the Sierra Gorda, which can be leveraged to support economic activities. The community is within the borders of the most touristic part of the Sierra Gorda Biosphere Reserve which received over 200,000 visitors each year before the COVID-19 pandemic (Redacción Bajío, 2019) and it is recovering in the number of tourists in recent years (Estrella, 2021). Capturing the visits into the community is a key factor for the government institutions regarding tourism as a potential economic alternative.

Challenges related to reconversion, such as prolonged droughts hindering agricultural and livestock activities, as stated by the UAQ, points out the need for resilient alternatives in the frame of climate change. That is where concepts of sustainable rural development and tailored management of natural resources come into play by helping the population to perform activities in accordance with their natural surroundings, since there is no established industry or company that provides jobs to them.

When discussing the opportunities of other communities with the INECC, it was mentioned that their ecosystem plays a major role in the transition to new livelihoods. For instance, although not easy to access from a major highway, miners of the Bucareli mine in Pinal de Amoles have clearly defined their trajectory towards sustainable cattle raising due to the abundance of natural resources which can sustain the activity. However, the existing natural resources of Camargo make the decision towards a clearly defined alternative more difficult.

This absence of a clearly defined alternative makes the terrain fertile for multiple livelihoods which are, in fact, desirable, since it contributes to the resilience of the community. Together, paired with the ease of access to the community via the federal highway, and the efforts already made by some community members by diversifying their sources of income, can set the bases for a transition towards sustainable rural livelihoods in Camargo.

4.2.5.2 Recommendations

According to the expertise and knowledge of the external stakeholders, this code highlights several key strategies for enhancing the community's development and sustainability. A significant focus is on increasing community involvement to identify and support new activities, as well as providing more information for the effective integration of new initiatives.

Developing sustainable economic activities that are suitable for the region's natural conditions is a major recommendation. Since the semi-arid landscape is not suitable for traditional farming and agriculture, tailored forms of resource management must be implemented. According to the UAQ, this includes the production of pulque from maguey and agave, the introduction of resilient livestock like goats, and the cultivation of aromatic crops such as gobernadora (*Larrea tridentata*), damiana (*Turnera difusa*), and oregano (*Origanum vulgare*). These activities have the potential to provide alternative livelihoods and support the local economy in accordance with their ecosystem.

Leveraging educational and technical resources from educational institutions like the UAQ is crucial for supporting community development. The University plans to offer educational programs focused on sustainability and has already developed technical activities that have proven useful for the cultivation of aromatic species of plants. Training programs provided by the INECC, and the Undersecretary of Economic Development might also help to develop the capacities of the population that wishes to pursue another economic activity.

The community's access to the federal highway and educational institutions, as well as its strategic location at the gates of the touristic part of the Sierra Gorda, provide logistical advantages that can be leveraged for economic development.

Together with environmental policies that impact the community through the emissions tax, authorizing special timber harvesting, and exploring productive opportunities in ecotourism, may contribute to the consolidation of alternative livelihoods.

Overall, recommendations made by the external stakeholders provide a comprehensive approach to enhancing the community's development, focusing on sustainable economic activities, educational and technical resources, the strategic location of the community, and innovative strategies for environmental and economic benefits in the context of the natural landscape. The actors stated that the transition is a challenge, one that has not been and will continue to be not easy, but they have confidence that with the synergies and cooperation of all levels of government and academic institutions, the transition to sustainable alternative livelihoods in Camargo is possible.

4.3 Summary of Key Findings

4.3.1 Current State of Capitals

To facilitate the reading and interpretation of the current state of the capitals of Camargo, the following diagram serves as a visual aid. This was done in accordance with the definitions of the Guidance Note by the UNEP and the thematic analysis performed in Chapter 4. It is worth noting how some of the factors are mentioned in more than one capital, or they seem to link and be referenced. This speaks of the coherence and integrity of the analysis and is further stated in the Integration of Findings.

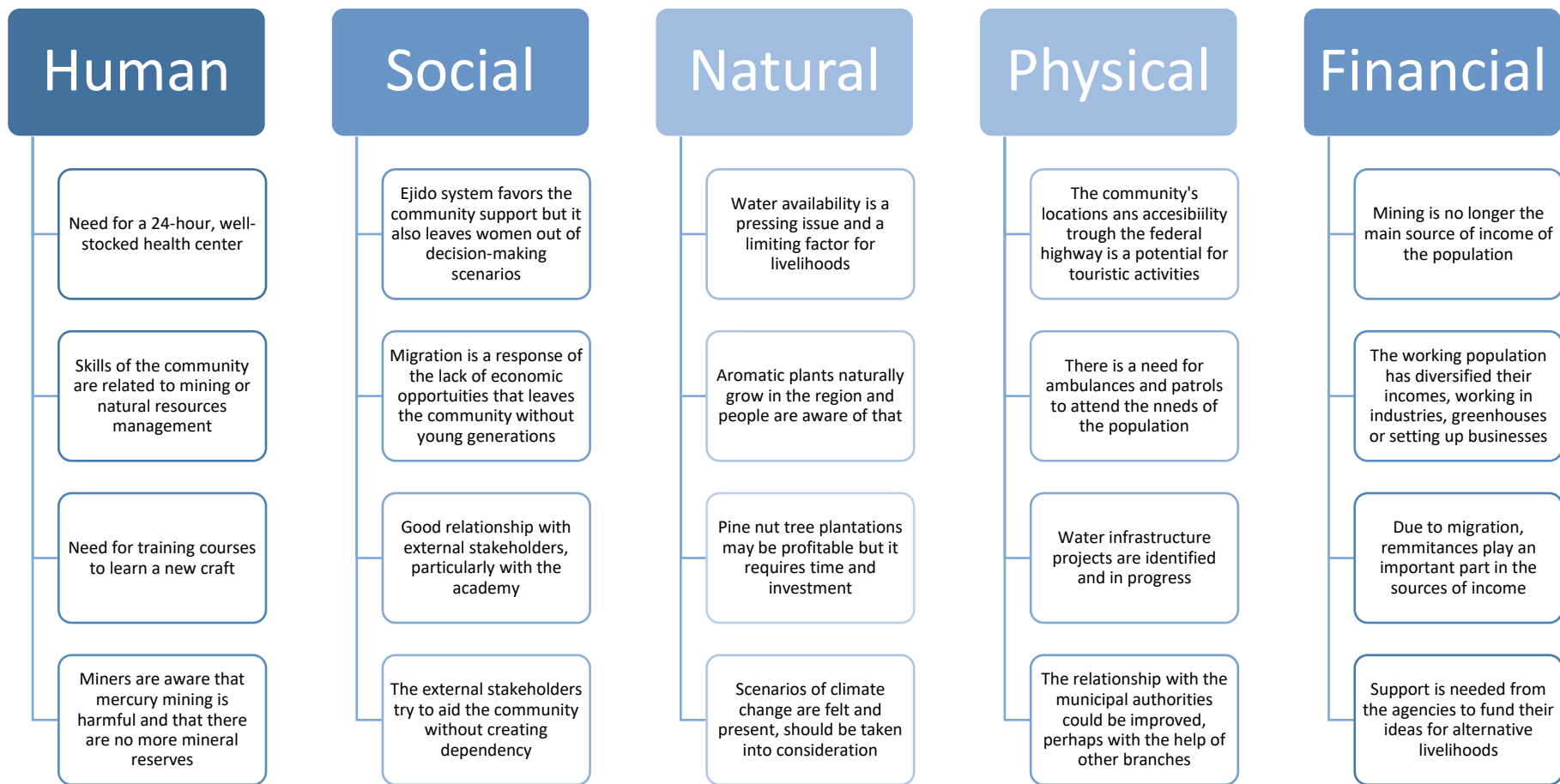


Figure 16. Summary of the Five Capitals of Camargo

4.3.2 Community Perceptions and Attitudes

At first glance, it appears that the community has a strong social capital which may be due to the ejido system (Thorns & Betters, 1998) and to the fact that the population is rather small, and most people know each other. Previous studies and interventions made by government and academic agencies seem to support this notion.

As a matter of fact, Camargo was chosen as the area of study due to these previous interventions and openness of the population. They are aware of the mining problematic and are no strangers to the pressing issue of seeking alternative livelihoods. This was confirmed in the visit to the community, where the people were happy to help with the investigation.

However, upon a closer look at the social capital and the current inputs of external stakeholders, the social tissue of Camargo is just superficially strong. Yes, people support each other in situations of need, yes, people cooperate to build a well to extract water; but, so far, no real association or collective group has emerged to implement an alternative livelihood, such as installing a cooperative to extract non-timer resources of nearby forests or organize ejidatarios to set up touristic activities in the locality and the mine.

This lack of organization may be due to both internal and external factors. From the former, it is known by the government and academic agencies that issues of gender inequality and alcoholism are present in the community. And programs to combat these problems should be implemented in agreement with the population and the corresponding agencies.

The winds of change are ever present and felt in the community, where some members are aware of the problems that, once far, are now of pressing urgency. Sometimes a noted person of the community may be the igniting spark that triggers the change, but that person is not usually alone, they have a group that backs them. This could come from either the ejido authorities or from the women who are the business owners of the visited shops.

4.3.3 External Factors

As mentioned, the lack of organization within the community may be due to internal and external factors. As for the latter it must be noted that the relationship between the community and the local authorities from the municipality has not always been the best, with sentiments of deception prevailing. Somehow the same atmosphere of cooperation that exists with the state and federal government must be replicated or at least mirrored with the municipal government.

However, things are not as easy to implement as they sound, with a municipal government that changes every three years or that may be reelected and serve for 6 years, stability is not the rule. And on top of that, Camargo is not the only community with the need to seek an alternative livelihood. As mentioned by the INECC and the Office for Local Commerce of SEDESU's Economic Undersecretariat, they must serve other communities and mining associations in the Sierra Gorda region as well.

Leaving the community aside and focusing on the external stakeholders, overall, it seems that the steering committee of the GEF project works well and has a good channel of communication. Since all the government authorities involved in the committee know each other and know the actors of the UAQ, it makes the decision-making process easier.

However, if more agencies contribute to the GEF project, because it is large scale and resource-consuming, communication may be interrupted or lose its good qualities. Therefore, a good project management must be the directive to keep up the rhythm of the list of tasks to be done (Domínguez, 2001). As mentioned, this is a multidisciplinary project that requires environmental, social, economic, and technical expertise.

Finally, and coming back to the community, there seems to be a lack of results when conforming and actual project or idea for an alternative livelihood, because the population has not organized yet into a collective group. This may also be because the environmental conditions are not ideal for what a traditional resource management is considered. Therefore, working on developing a tailored approach to the natural conditions is vital.

4.3.4 Barriers and Opportunities

Among the detected barriers for the implementation of alternative livelihoods in the study, three have arisen as the most prevalent. From these, other problematics derive and branch for specific issues. It is also noted that the opportunities that exist may also help address the barriers, as depicted in the following figure.

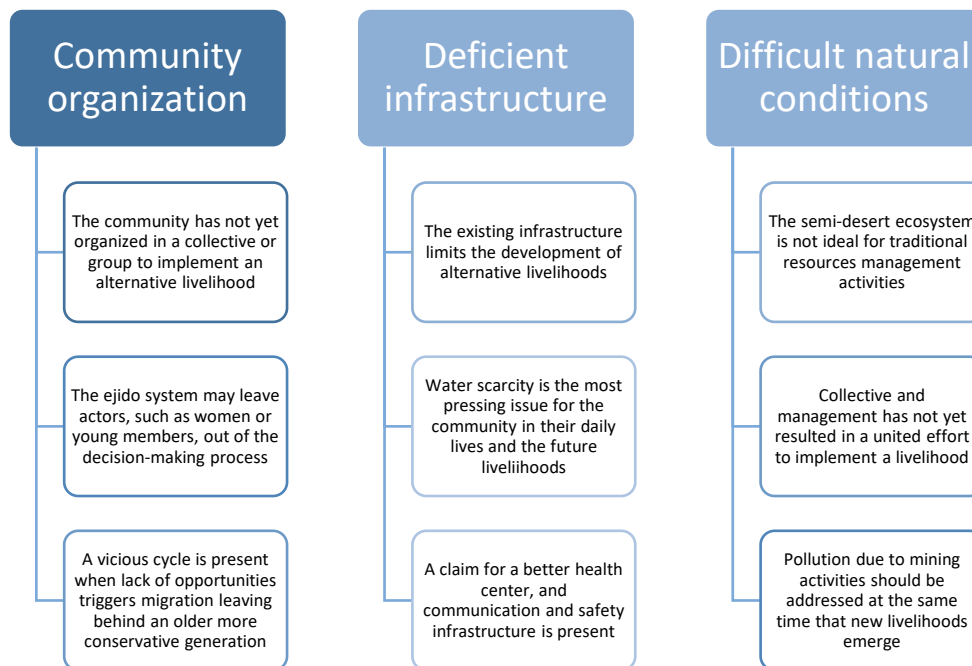


Figure 17. Main challenges identified in Camargo

Since traditional techniques of agriculture may not be apt for the territory of Camargo, an opportunity is presented to explore new economic activities under a tailored management of natural resources for arid semi-desert areas. The new paradigms are discussed in Chapter 4 and include the cultivation of regional aromatic herbs, growing pine nut trees in the slopes of the mountains, raise cattle adapted to the ecosystem, like goats, and develop an agriculture of local species. Furthermore, these possible livelihoods may also trigger a new system of natural resources management within the ejido, as a collective association of miners or community members, or as individuals that decide to pursue the economic activities that align the best with their realities. Being within the ejido or outside of the system, external stakeholders could provide capacity building trainings to implement the livelihoods and empower the individuals or collectives. Providing

material resources is important, but so is the transfer of knowledge and the accompanying process of setting up a new business.

Finally, these livelihoods ought to transit in a path of sustainability considering the elements discussed in Chapters 2 and 4, providing the community with local economic opportunities to work and, thus, generating new sources of income. This could possibly put an end on the vicious cycle that deprives the community of its younger members and fosters an environment for creativity and social entrepreneurship among the individuals.

5 Conclusions and Leverage Points: Paving the Way of Sustainability

In this Chapter the key findings are linked and weaved into the conclusions, which include the sustainability of the proposed livelihoods, the integration of findings and the implications for the community. Additionally, a set of leverage points for change is issued, considering the findings and conclusions, to build a path for a sustainable livelihood in the mining community. Lastly, some final thoughts of the study are shared along with its limitations and the potential for further research.

5.1 Conclusions

This section contains the outcomes of the analysis of sustainability of the proposed alternative livelihoods, the integration of findings with other sections of the study and the implications for the community in terms of following the path to the sustainable livelihoods.

5.1.1 Sustainability of Proposed Alternative Livelihoods

The analysis of sustainability with the Sustainable Livelihoods Framework was of very helpful to gather the desired outcomes for the study. After the analysis, the proposed alternative livelihoods who proved to have the most potential for being sustainable path are the cultivation of native species such as the aromatic plants and pine nut trees, and the implementation of a touristic point in the route of the Sierra Gorda.

Regarding the cultivation of native species, it is safe to say that it is not a foreign activity for the population since there have been previous efforts to implement the activity. As a matter of fact, the local group of women who dedicate to the cultivation of aromatic species started with the support of the UAQ and now runs on its own. Furthermore, several miners and community members stated during the interviews that the species, like (*Origanum vulgare*) and damiana (*Turnera difusa*) and gobernadora (*Larrea tridentata*), sprout naturally in the region with the first drops of rain.

As for the pine nut trees, even though the growing of the plants takes time, once the tree gives the fruit it can be a profitable activity. The trees grow naturally on the mountain slopes around the community, a fact that locals are aware of and some even have dedicated to this activity in the past in times of economic hardship.

Moving on to the touristic point, several interviewees from both the Camargo and government agencies, stated that the community was in a good location in the route to the Sierra Gorda's most popular destinations in Pinal de Amoles and Jalpan de Serra. Since both the mine and the community are accessible by the Federal Highway, miners said that seeing particular cars and 4x4 motor vehicles is not uncommon. Therefore, the location of the community could be used in its favor to implement a tourist stop for travelers coming to and from the northern part of the Sierra Gorda.

However, for both livelihoods, further studies need to be performed such as capacity studies for a touristic stop in the route of the Sierra Gorda so as not to oversaturate the resources of the community, or economic feasibility analysis for the cultivation of aromatic herbs and the plantation of pine nut trees, among others. And, above all, the decision lies completely in the members of the community if they choose to pursue one of them

Of course, the mentioned livelihoods are not the only ones that could potentially be a sustainability path. Others may emerge coming from the population itself or implemented by an external agent. As a matter of fact, diversification is not just needed but it should be encouraged as a mean of resilience-building strategies. If there is something that this study has detected, is that livelihoods are not constant, they change, adapt and respond to the needs of the population, the availability of natural resources and the effects of external forces.

Sustainability is, therefore, time-dependent, and every livelihood that emerges will have to prove how resilient is to the shocks that come from inside and outside the community. If the Minamata Convention was thought to be the end of a mining community, it may also be the opportunity to seize the wave of change and use it in the population's favor to improve their living conditions.

5.1.2 Integration of Findings

The performed sustainability analysis is based on the Guidance Note on the created by the United Nations Development Programme, specifically curated for the Latin American region. The framework proved to be helpful in organizing the different inputs of information gathered from the community and the external stakeholders, and in providing a layout for identifying barriers and challenges, but also opportunities and recommendations for achieving the desired outcomes.

The framework provided enough room for adding a personal touch to the study as well as adapting the concepts to the specific case of focus. For instance, taking concepts of the SLF and transforming them into codes for the thematic analysis or using the definitions of the capitals to formulate the questions in accordance with the objectives.

It was noted that codes in the capitals kept referencing each other, as well as the capitals of the community and the inputs of the external stakeholders. This speaks of the cohesion of the case of study and the utility of the framework to provide a map for analyzing each component separately, while, at the same time, seeing how all the concepts work together in achieving a common goal.

For instance, the analysis of the migration aspect of the community in the Social Capital could not be possible without mentioning its effect on the sources of income in the Financial Capital. Other examples include how motivation in the Human Capital was influenced by the assistentialism phenomenon discussed in the Social Capital or the health aspect being bonded to the Physical Capital of the community.

Furthermore, there is a profound link between the community and the external stakeholders, due to their historic relations that go back over a decade in some cases. The community has been shaped by the external actors and, in return, the actors know are aware enough of the situation of the community to emit their own judgements and recommendations.

Additionally, the defined objectives helped in providing a holistic view of the community's state at the time of the study, considering its historical background and different contexts surrounding them. The role that external stakeholders play in this process is underscored in its respective analysis and discussion as the

provider of not just material resources, but also transfer of knowledge and policies that ease the transition and monitor the progress.

5.1.3 Implications for the Community

In the comings and goings of the process of defining this document, there was always a foundational rock that pulled concepts and methodologies together like a magnet: the lives of the people of Camargo. Miners and inhabitants were at all times kept in consideration as the center of this investigation, from which everything revolved around.

Sustainability is usually treated as a goal, something to reach and achieve. However, in this study sustainability is also seen as a path that guides the well-being of the community of Camargo. Thus, this study echoes the call of the ECLAC of the new rural narrative for a balanced approach that includes economic, social and economic sustainability (Gaudin & Padilla, 2023).

The decision to apply a certain livelihood could be taken as a group in the form of the ejido or as a collective association. Examples of managing natural resources through an ejido exist in both northern forest regions, (Segura-Millán & Perez-Verdin, 2023) and in tropical diverse regions (Reyes-Hernández, 2023) of Mexico where the Payment for Ecosystem Services (PES) has been applied.

On the other hand, what this study has also uncovered is that decisions are also made at the household level. Each household has decided to continue to work on the mine, to set up a small business, to work in the greenhouses, or to do their own combination that best serve their needs. This means that the members of the community have multiple paths to follow according to their economic, social, cultural and land-property background.

Lastly, in short term the members of the community will have to decide the strategies and livelihoods they decide to pursue or continue doing. But in the long term, a further analysis will be helpful to determine the outcomes of the decisions made by them. For both analyses, the ideal scenario is to develop livelihoods that build resilience for internal and external shocks, that reduce welfare dependency,

and that encourage emancipation of the community to decide on their own terms their future.

5.2 Leverage Points

To implement these livelihoods focalized interventions from the external stakeholders are needed, as well as some actions from inside the community. In this section a set of leverage points for change to apply in their respective fields of action, is issued to improve the living conditions of Camargo.

5.2.1 For Resource Management

The issue of organizing the members of the community who would like to implement either one, two or more livelihoods, should be managed by themselves with the help of government and academic agencies. As mentioned, the decision to implement a livelihood could be taken collectively or at a household level.

The stakeholders may provide with resources such as training sessions on sustainable management of natural resources, tailored to the specific ecosystem that surrounds the community. These courses should also consider the scenarios of climate change that already affect the natural resources found in the region.

Both the academic and the government sector may aid in the transition to alternative livelihoods using the programs that already exist like the PASE from SEDESU or the Sustainability Corridor from the UAQ, but that incorporate a holistic perspective, and the new rural development paradigms mentioned in the discussions section. If the population decides to pursue one or more of the mentioned livelihoods or another economic activity, organization is key in the agencies to avoid the duplication of efforts and finding synergies for an efficient resource distribution.

This goes hand in hand with conforming an association in the community, a collective society or a group within the ejido system that manages the natural resources. To achieve this, external stakeholders would ideally accompany the people in the process of creating such figures, avoiding the bureaucratic

obstacles and facilitating times due to the distance between Camargo and the state capital.

5.2.2 For Infrastructure Development

Firstly, the community's call for a better health center is something that will benefit the population, but also the potential travelers using the tourist stop, and workers in the cultivation of regional species. This is something to be addressed by the competent authorities, initiating from the community's own form of organization and escalating to higher levels of government.

The bettering of the health center could also address the issue of disruptions in the social tissue of the community with awareness campaigns about the consumption of alcohol, the importance of annual checkups, the benefits of healthy leisure activities and a good diet in accordance with the regional products.

Secondly, although the community possesses a good amount and quality of infrastructure, some aspects require the attention for an improvement or an addition. For instance, the main access road is the only one with concrete pavement, it would be worth considering the pavement of other secondary streets within the community. Another claim that could potentially address issues of social distress is the installation of communal recreational spaces, like parks, playgrounds or sports courts.

The infrastructure additions or improvements should not be randomly performed, but rather arranged with the population according to their needs, cultural background, and the feasibility of implementation. And once implemented, they should be accompanied by a continuous campaign to promote their use and preservation, so that each member of the community is able to benefit from them.

Lastly, and probably the most pressing problem is water infrastructure. Identified as the limiting factor, this issue goes hand in hand with a tailored management of natural resources. Since Camargo is in a semi-desert ecosystem, it is not safe to assume that water has and will always be available by the standards of a tropical rainforest. Therefore, livelihoods should be aligned with the availability of water,

and its preservation, distribution and use must be agreed with the authorities and the population.

An area of opportunity also arises related to water management, to explore other sources of water beyond and in addition to the known method of underground extraction. Two or more ways of extracting water may coexist, like rainwater collection, and storage. The goal is not to set up a water park as a touristic attraction, but to provide enough water for tailored livelihoods to prosper in perhaps a new paradigm of rural development in arid areas.

5.2.3 For Policy and Advocacy

Since the first interviews with the government institutions took place, it became clear that the scope of the GEF project and the search of alternative livelihoods to mining, was too big for a single institution to handle. Therefore, the presence and need of the steering committee is reinforced as the leading group of coordination of efforts towards the common goal.

As the good relationship between the government agencies and the academic institutions between themselves and the community of Camargo was proven, the potential to expand this success to other levels of government and institutions became evident. Mainly the case with the municipal government as the first link with Camargo. The momentum of cooperation should be reinforced so it can grow beyond the community and maybe form a group with other mining communities in the Sierra Gorda.

However, the need for a continuous link between government agencies and the community of Camargo is also noted. As stated in the discussions, government agencies are commanded to serve all the municipalities and localities in their jurisdiction, like the case of SEDESU. And even the executive agency, the INECC, has other projects nationwide, beyond the ongoing GEF project.

Therefore, a person or group of people who are solely dedicated to serve as a link between the community of Camargo and the steering committee and other relevant institutions, such as the UAQ, could be of aid to swiften the channel of communication and speed up things. This group could either come from the

government agencies, the academy, the community itself or as a mixture of one or more sectors.

Additionally, further policies that are to be designed or are in process of evaluation, should support integrated rural development where economic initiatives are coupled with efforts to enhance social and environmental well-being (Gaudin & Padilla, 2023). While economic development is important, it ought to be treated as a mean together with sustainability, not as an end.

As a note of caution, the efforts made by the government and the academic institutions ought to be careful to not replicate models of assistentialism where the community is used to get everything they need from the agencies. Instead, the current of thought of emancipation could be applied so a synergy between external stakeholders and the population is the rule of work.

5.3 Final thoughts

When first designing and conceptualizing the study, a simple comparison of two proposed alternative livelihoods in a mining community of the Sierra Gorda de Querétaro was set to be the main purpose. Focusing on the three pillars of sustainability, the early proposal wanted to assess if two alternatives were environmentally compatible, socially acceptable and economically profitable.

However, as the course of the investigation continued, new inputs were added to the proposal which made it more complex. From deepening in what a livelihood is and what makes it sustainable, to the internal and external forces that influence the path of sustainability; concepts and theories contributed into the conformation of this study. A factor was always kept in mind during the process, keeping the community and the population at the center.

At the end, the goal was not to impose livelihoods to the community and deeming them as the path to follow to success from an external point of few in accordance with the ecosystem and decision of stakeholders. The aim was rather to elucidate the different paths of sustainability that the members of the community could decide to pursue, according to their surroundings, thoughts and cultural background, while at the same time providing tools from external stakeholders that could help them in the time of transition.

5.3.1 Limitations

This study is not exempt of limitations and issues that could have been done differently to improve the quality of the conducted investigation. Beginning with the first encountered limitation, the sample size of interviewed miners, and community members. It could be considered too low, leaving a variety of voices out of the research, that could have provided more diversity and enriched the analysis of sustainability. Additionally, the reliance on self-reported data may subject of biases when reporting and discussing the findings.

Secondly, and related to the first limitation, a deeper knowledge of the community dynamics could had been pursued. This means to spend more time knowing the existing social structures of the community to have a better picture of how these structures may aid or hinder livelihoods. Furthermore, due to temporal limitations, the study represents a snapshot in time, perhaps not fully considering the changes in livelihoods, environmental conditions and external influences.

Thirdly, there is a limited scope of economic analysis, meaning that the study may not have fully explored broader economic factors influencing the community such as market access, regional economic policies or external economic pressures. This could hinder the economic analysis and its implications for sustainable livelihood strategies, particularly in understanding how broader economic trends might impact local sustainability efforts.

Finally, a dialogue with the municipal authorities of Peñamiller, recognized Civil Society Organizations and other relevant institutions could have provided more perspectives to integrate in the analysis. The study contemplates the view of the community members and external stakeholders of the municipal authorities, but not the authorities' own voice. Similarly, other institutions and associations that may have an influence on the GEF project or other parallel projects of alternative livelihoods, could have provided different perspectives than the ones analyzed.

5.3.2 Further research possibilities

With this study, new paths for studying the community and the livelihoods have emerged. The first one would be the road of implementing each of the proposed alternative livelihoods, meaning taking into reality what was written and

discussed. This includes assessing the role of the external stakeholders in the implementation of the alternative livelihoods as well as the means of organization that the community chose to execute, and its social dynamics and power relations.

Part of the road of implementing the alternative livelihoods is the monitoring and evaluation process of all the parts of the project. Applying the Guidance Note of the UNEP but now to actual livelihoods that the members chose to follow could be a future research idea, to analyze their outcomes and determining what worked and what could be improved. This goes hand in hand with the assessing the impact of policy intervention from external stakeholders in either supporting or hindering sustainable development efforts in rural areas,

The characteristics of the natural landscape surrounding Camargo create a field of comparative studies for assessing the livelihoods of populations living in semi-desert ecosystems in an NPA. Indeed, the ejido system is a particularity of Mexico, but communal land management exists in other parts of the world, and it could be interesting to see the strategies other people implement in similar environmental and social contexts. Whether they were miners or farmers, people living in semi-desert areas come up with interesting livelihoods that defy what traditionally is seen as rural development beyond agriculture.

Linked to the economic analysis limitation, this study triggers research on the opportunities and challenges related to economic diversification in rural areas. This could involve studying supply chain development, market linkages, and value addition strategies to explore how economic diversification can be supported through better access to markets, ultimately enhancing the sustainability and profitability of new livelihoods.

Lastly, this research opens the space of discussion for other alternative livelihoods that could be implemented and the road to execute them. All in the spirit of diversification as a mean for increasing the resilience of the community and to withstand future uncertainties, like the climate change scenarios, and economic shocks, such as market fluctuations.

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