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Livelihood-sensitive restoration: overcoming scale challenges in the governance of landscape restoration

The case of the Quito Water Fund in the Ecuadorian highlands

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Acknowledgments

At my first official day of fieldwork in Quito, I was invited to the office of FONAG. I was warmly welcomed by the staff members and shown my desk, that would be my research base for the next five months. A colleague approached me and asked curiously, "what is your name?". I answered, "my name is Nina Flohr". She seemed surprised. "Really? Are you sure?". "Yes", I said. She smiled and responded confidently. "Your name will be *Chuquiragua* from now on". It is Ecuador's most representative flower of the *páramo* and the flourishing orange blossom usually symbolises that the *páramo* ecosystem is in a healthy state. Translated from Quichua to Spanish, *Chuquiragua* means *flor de fuego* – the fire flower. She explains, "just as your name - *Nina* means fire in Quichua and *flor* means flower in Spanish". The *Chuquiragua* flower can be seen on the title page of this thesis.

With this anecdote, I want to start by thanking the incredibly welcoming staff at FONAG's technical secretariat for making this research possible. I am very thankful for your willingness to share your daily work, for your encouragement to be critical and for your relentless effort to integrate me into the team. Your motivation and dedication to make a difference for nature and people alike is truly inspiring. My special thanks go to Bert, Susy, Carla and Fernanda, but also to everyone else who made my time at FONAG an enriching experience and helped me along the way.

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Abstract
Ecosystem degradation and deforestation in the wider Quito region in central Ecuador put pressure on the sensitive *páramo* ecosystem that hosts 97% of Quito's drinking water sources. To answer ongoing degradation while securing the future water supply of the citizens of Quito, the Nature Conservancy (TNC) alongside the Public Metropolitan Drinking Water and Sanitation Company (EPMAPS) and Fundación Antisana created the Quito Water Protection Fund (FONAG) in 2000 – a voluntary mercantile trust fund that finances and implements restoration activities around Quito. The objective of this study is to identify the strategies that FONAG uses to reconcile landscape restoration with rural livelihoods in upstream communities. Applying scaling theory to the empirical case of FONAG in Ecuador, this study contributes to the systematic understanding of scale challenges and scale-sensitive governance occurring in landscape restoration. The study was informed by fieldwork conducted in Ecuador from August until December 2019. Rural livelihoods were studied in two rural communities, namely Oyacachi in the province Napo and San Francisco de Cruz Loma in the province Pichincha. Qualitative data was collected through observation, document analysis and 43 semi-structured interviews with 34 respondents. The results suggest that FONAG uses five restoration strategies: (1) generation of hydrometeorological and socioeconomic data, (2) declaration of conservation areas, (3) passive and active restoration of degraded *páramo*, (4) environmental education as well as (5) hiring of *guardapáramos*. In the process, four scale challenges were found: (1) a temporal mismatch between short-term election cycles and long-term restoration timelines, (2) a temporal blind spot in considering short-term livelihood losses in long-term restoration processes, (3) a spatial mismatch as restoration interventions provoke a displacement of the problem to another area and finally (4) a spatial blind spot in EPMAPS' failure to consider upstream water needs while downstream water needs are targeted. FONAG uses a variety of scale-sensitive governance strategies to address those challenges, which include elements of scale-sensitive observing, acting and enabling. The study concludes that addressing scale challenges remains a complex challenge for restoration practitioners, as there is no such thing as a lasting or fixed solution. Instead, a long-term multilevel and adaptive governance approach is needed, that should be embedded in the local context. To inform future landscape initiatives about the experience of FONAG, the author coins the term livelihood-sensitive restoration (LSR) as a promising approach in restoration governance, whereby the livelihood needs of rural upstream communities are reconciled with ecosystem needs of the watershed.

Key words: landscape restoration governance, water fund, FONAG, rural livelihoods, scale challenges, scale-sensitive governance

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Abbreviations

ACH	Water Conservation Areas
AIH	Areas of Water Interest
COOTAD	Organic Code of Territorial Organisation, Autonomy and Decentralisation
CSR	Corporate Social Responsibility
DMQ	Metropolitan District Quito
EEQ	Quito Electricity Company
EPMAPS	Public Metropolitan Drinking Water and Sanitation Company
FLR	Forest and Landscape Restoration
FONAG	Quito Water Protection Fund
FONAPA	Water Fund for the Conservation of the Paute River Basin
FORAGUA	Regional Water Fund
GAD	Decentralised Autonomous Governments
LSR	Livelihood-sensitive restoration
MAE	Ministry of Environment Ecuador
MASL	Meters Above Sea Level
NGO	Non-Governmental Organisation
PDOT	Development and Territorial Land Use Plans
PES	Payments for Ecosystem Services
ROI	Return on Investment
SENAGUA	National Water Secretariat Ecuador
SNAP	National System of Protected Areas
TNC	The Nature Conservancy
USAID	United States Agency for International Development

1. Introduction

1.1 The context of landscape restoration governance in Latin America

Global ecological challenges, such as ecosystem degradation and deforestation, have drawn the attention of policy-makers to the restoration of ecosystems for natural and human well-being (Goldman-Benner et al., 2012, p. 55; Millennium Ecosystem Assessment, 2005, p. 61). From 2021 to 2030, the global community commits to the United Nations Decade on Ecosystem Restoration, which aims at preventing and reversing ecosystem degradation in every region of the world (United Nations, 2021). Estimations show that about 60% of ecosystem services are currently degraded, as a result of unsustainable land use and deforestation (Millennium Ecosystem Assessment, 2005, p. 6). To counteract this, the last two decades showed increasing efforts by international cooperation, governments and the non-profit sector to invest in the restoration of ecosystems and landscapes (Mansourian, 2016, p. 1; UNCCD, 2019, p. 45). Landscape restoration[1] is defined as "a planned process that aims to regain ecological integrity and enhance human well-being in deforested or degraded landscapes" (Mansourian et al., 2017, p. 2).

As investment and intervention increased all over the world, there has been a rising interest by scholars to understand *what* governance arrangements lead to successful restoration; and *how* restoration processes should take place to create benefits for nature and people (Mansourian, 2016, p. 268; Stanturf et al., 2019, p. 50). In fact, more attention is given to the systematic analysis of the nature of problems in environmental governance (Cash & Moser, 2000, p. 109). As other environmental problems too, restoration governance can be called a complex and changing "wicked problem" (Termeer & Dewulf, 2014, p. 38). It surpasses conventional scopes of analysis, and crosses through various academic disciplines (Termeer et al., 2010, p. 1). Therefore, *scaling theory* is a suitable lens through which restoration governance can be systematically analysed (Gibson et al., 2000, pp. 217–218). The underlying idea is that governance challenges occur in human and natural systems alike, because they interact and are dependent on each other (cf. Cumming et al., 2006; Gibson et al., 2000; Wyborn & Bixler, 2013). For example, healthy ecosystems as a result of restoration may not only lead to ecological benefits, such as biodiversity prosperity or the combat of climate change, but they can also help ending poverty by sustaining ecosystem services upon which urban and rural livelihoods depend (Erbaugh & Oldekop, 2018, p. 76). At the same time, the lack to address the underlying natural and human drivers of degradation, also implying the livelihoods of people living within the landscape, can undermine restoration success in the long run (Mansourian et al., 2017, p. 2). In other words, restoring ecosystems while improving rural livelihoods is a process of constant reconciliation between human and natural systems, and the central topic of this study.

Latin America hosts 23% of the world's forests and is home to 60 to 70% of the world's biodiversity (UNCCD, 2019, p. 8). In addition, almost 30% of global freshwater resources are present in this region (UNCCD, 2019, p. 8). Much of the water is stored in glacial meltwater of the Andes, but large parts are also captured by *páramo*[2] landscapes. *Páramo* are unique high-altitude grasslands that form an important hydrological ecosystem in the Ecuadorian Andes (Harden et al., 2013, p. 376). It is found above the timber line and below the snow line between 3,200 and 4,700 meter

[1] Note that the term landscape restoration originally stems from *Forest and Landscape Restoration (FLR*). This study not only focusses on restoration processes of forests, but whole landscapes including forests, grasslands, arid and semi-arid areas. Moreover, landscape restoration is used as an overarching term for simplicity, but includes both, restoration and conservation activities.

[2] Note that there is no literal translation of the word *páramo*. Thus, the Spanish term will be used in this research.

above sea level (MASL) and characterised by high water availability as well as excellent water quality (Buytaert et al., 2006, p. 54; Harden et al., 2013, p. 376). This is attributed to high levels of humidity, soil with little to no surface run off and water-storing grassland vegetation (Bremer, 2012, p. 6; Buytaert et al., 2006, pp. 57–58). Although *páramo* occupies less than 2% of Ecuador's surface, it is considered "the richest tropical mountain flora in the world" (Bremer, 2012, p. 9) and constitutes one of the global hotspots for biodiversity. The *páramo* hosts roughly 5000 different plant species[3], 60% of which are endemic (Buytaert et al., 2006, p. 55). The *páramo* stores water but is also the main producer of freshwater for Andean highlands. It naturally sustains high river flow rates from the mountains to the valleys, where urban centers are located (Echavarria, 2002, p. 1).

Quito, the capital of Ecuador, receives 97% of its drinking water from the surrounding *páramos* (The Nature Conservancy, 2021). While urban water demand steadily increases as a result of population and economic growth, the *páramo* faces natural and human threats, such as climate change and soil degradation on the one hand, and unsustainable land-use or the expansion of urban centers on the other hand. The largest human threat is ongoing intensive land use, including livestock rearing, fertilised agriculture and the periodical burning of shrub (Bremer, 2012, p. 43; Echavarria, 2002, p. 2). Highland populations that live in the *páramo*[4] depend on such land use activities to sustain their livelihoods. However, degradation of the *páramo* ecosystem may have a devastating impact on the water cycle and jeopardise the quantity (i.e. less water infiltration leads to lower stream flow) and quality (i.e. livestock rearing and cultivation of crops leads to eutrophication, erosion and sedimentation) of water resources for the city of Quito (Buytaert et al., 2006, p. 62).

The Quito Water Protection Fund[5] (FONAG) was created in the year 2000 by the Nature Conservancy (TNC) alongside the Public Metropolitan Drinking Water and Sanitation Company (EPMAPS) and Fundación Antisana to provide a response to ongoing *páramo* degradation in the Metropolitan District of Quito[6] (DMQ). It is a sustainable financing mechanism for water source protection and restoration (Kauffman & Echavarría, 2012, pp. 3-4). FONAG is set up as voluntary trust fund for the accumulation of capital, which is managed for 80 years by an independent financial authority that invests the capital. The returns are then invested in restoration interventions in upstream *páramo* landscapes that supply the city of Quito with water. FONAG can be classified as a Payment for Ecosystem Service (PES) mechanism, in which downstream beneficiaries of freshwater resources compensate upstream land stewards by investing in the restoration of the *páramo* to secure future supply of water (Bremer et al., 2016, p. 218; Kauffman & Echavarría, 2012, p. 4).

FONAG is recognised as innovative institutional arrangement to finance the restoration of *páramo* landscapes (Kauffman, 2014, p. 39). It has served as a model institution for four other water funds in Ecuador, and many more throughout Latin America, with rising trends of water funds in developing phases (Bremer et al., 2016, p. 218). Hence, given an expected increase in water funds as

[3] Endemic species of vegetation differ depending on the hight of the *páramo*. Dominant species include tussock grasses, small and giant ground rosettes and shrub cushion plants (Buytaert et al., 2006, p. 55). In the high *páramo*, grasslands dominate and forests of *Polylepis* and *Gynoxys* occur in the vicinity of water streams.

[4] In 2002, Echavarría (2002) estimated the number of people living in communities in the *páramo* surrounding Quito to be 20.000 (p. 2).

[5] Spanish: *El Fondo para la Protección del Agua* (FONAG)

[6] Spanish: *Distrito Metropolitano de Quito (DMQ)*

restoration institutions under the UN Decade on Ecosystem Restoration, it becomes a relevant field of study. Although a considerable amount of research exists on water funds in Latin America and Ecuador, past studies mainly addressed the financial mechanism and formal structures of water funds (cf. Bremer et al., 2016; Goldman-Benner et al., 2012; Kauffman, 2014; Kauffman & Echavarría, 2012; Meli et al., 2017). Yet, few scholars have focused their research on how water funds translate restoration targets into interventions at the local level of governance. A growing number of voices demand more research to be conducted on social outcomes of water fund interventions, and especially the effects that restoration has on rural communities living in the target areas (cf. Bremer, 2012; Bremer et al., 2014; Farley & Bremer, 2017; Joslin, 2019a, 2019b).

This study will contribute to filling this gap by investigating the reconciliation of landscape restoration efforts with rural livelihoods in the Ecuadorian Andes, specifically by studying the case of FONAG in DMQ. The research is conducted in form of a master's thesis and embedded in a wider research project together with two other master students investigating the Regional Water Fund[7] (FORAGUA) in Loja and the Water Fund for the Conservation of the Paute River Basin[8] (FONAPA) in Cuenca.

To demarcate the conceptual understanding of this study, some definitions will be applied.

- *Landscape restoration* - Policymakers frequently adopt a landscape approach in restoration governance with the aim to reconcile conservation and development agendas (Dudley et al., 2005, p. 4; Reed et al., 2017, p. 482). The landscape approach is the idea that multiple land managers across sectors (ex. agriculture, energy, industry) jointly engage in the management of a landscape to minimise trade-offs and maximise synergies among them. As different actors in a landscape have different interests and agendas, negotiated approaches enhance multifunctionality within a landscape (Reed et al., 2017, p. 481). Landscape restoration is "a planned process that aims to regain ecological integrity and enhance human well-being in deforested or degraded landscapes" (Mansourian et al., 2017, p. 2).
- *Sustainable rural livelihoods* - A livelihood consists of the capabilities, assets and activities of people to sustain their means of living (Chambers & Conway, 1992, p. 6). By extension, tangible (resources) and intangible (claims and access) assets are used to sustain their well-being. A livelihood is sustainable when it can "cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation" (Chambers & Conway, 1992, p. 6). In the context of this research, livelihood will mainly refer to the ways in which rural communities generate income to secure basic needs. A focus is laid on the ability to use and manage their land for productive activities versus alternative livelihoods.
- *Reconciliation* – Reconciliation refers to the bringing together of two or more opposing perspectives in the governance process of landscape restoration. It is linked to the concept of environmental justice, in which justice for the environment and justice for the people presents a potential conflict between the needs of the natural world versus the needs of humans (Schlosberg, 2013, pp. 37–38). To prevent such a conflict, the different needs and priorities of actors involved in and affected by restoration initiatives have to be identified, considered and eventually reconciled in the governance process. In this research, reconciliation is the central concept used to describe the effort of FONAG to restore watersheds for water security in Quito, while at the same time changing livelihoods of rural communities positively.

[7] Spanish: *Fondo Regional del Agua* (FORAGUA)

[8] Spanish: *Fondo del Agua para la Conservación de la Cuenca del Rio Paute* (FONAPA)

1.2 The research problem

As the very first water fund in the world, FONAG already collected more than 20 years of experience in landscape restoration in the Ecuadorian Andes. As opposed to other water funds, FONAG distinguishes itself because it not only *finances* restoration and decides about the allocation of the returns, but it actively *implements* restoration activities at the local level (Bremer et al., 2016, pp. 228–229). This raises the question how the implementation of restoration activities plays out for the people living in the watersheds. Generally, a misbalance between the evaluation of ecological impacts and societal impacts of restoration initiatives can be observed in academia, with the latter receiving considerably less attention (cf. Bremer et al., 2016; Farley et al., 2011; Farley & Bremer, 2017; Goldman-Benner et al., 2012; Meli et al., 2017).

FONAG engages with rural communities with the aim to reconcile restoration targets for watershed restoration with livelihood targets for rural development of communities (FONAG, 2020, p. 3). Although many other restoration initiatives in Ecuador only list livelihood as a co-benefit of restoration, FONAG has committed itself to making livelihood improvements a priority, and a key determinant for long-term restoration success (Bremer et al., 2016, p. 230). The underlying idea behind this is that unsustainable land use practices of rural communities are a driver of *páramo* degradation. Some even go so far to say that although water as an ecosystem service orginiates within natural ecosystems, "it is the land management and land use by the human communities living on private, public and communal lands in the watershed that determine service delivery; these communities are the key service providers" (Goldman-Benner et al., 2012, p. 57). Thus, by changing rural livelihoods to alternative ones, FONAG aims at addressing the human driver of *páramo* degradation by supporting long-term change in the management of land (Mansourian et al., 2017; Mansourian & Parrotta, 2019).

Yet, engaging in livelihood improvements comes with a number of challenges at different levels of governance. First, it is important to consider the governance arrangement that emerged to finance, implement and maintain landscape restoration activities at community level. Restoration governance happens in a socio-ecological landscape, where actors of different levels of governance negotiate and interact. In the process, governance challenges may emerge along and across levels. To anticipate and potentially counteract such challenges, it is important to understand the nature of them, and what strategies FONAG applies to address them. This alludes specifically to what extent reconciliation takes place between upstream and downstream water users. Recognising that only few scholars dedicated themselves to a critical analysis of potential (governance) challenges inherent to FONAG's restoration intervention in communities (cf. Farley & Bremer, 2017; Joslin, 2019b), there is a knowledge gap in understanding FONAG's restoration strategies and in how far they reconcile ecological and human needs.

Second, permanently changing the land-use and livelihood activities of communities has a large impact on the lives of people. It needs to be understood what the on-the-ground impacts of such interventions are. This is especially important as communities, or rural land stewards, are often seen as the key determinants for success in *páramo* restoration (Bremer et al., 2016, p. 230; Farley et al., 2011, p. 394; Stanturf et al., 2019, p. 49). They are the ultimate decision-makers of whether and for how long they adopt FONAG's restoration approaches in their lands. Failing to achieve a situation in which communities can expect positive economic implications for their livelihoods hampers the likelihood for restoration success (Farley & Bremer, 2017, p. 372). Most studies about FONAG analyse its financial mechanism as a trust fund (cf. Bremer et al., 2016; Echavarria, 2002; Kauffman, 2014; Kauffman & Echavarría, 2012), while others concentrate on large-scale

comparative evaluations of water fund schemes as PES approaches (cf. Farley et al., 2011; Goldman-Benner et al., 2012). In contrast, only few on-the-ground case studies have investigated the social and livelihood outcomes of restoration activities by water funds (cf. Bakx, 2020; Bremer et al., 2014; Farley & Bremer, 2017). There has been a call for more empirical evidence to understand how water funds address livelihoods in rural communities and what potential long-term effects for the communities are (Bremer et al., 2014, p. 149; Farley & Bremer, 2017, p. 372).

Third, and closely connected to this, is a lack of understanding of experiences lived by Andean communities who participate in restoration initiatives as well as the associated livelihood changes. To date, only Farley & Bremer (2017) and Joslin (2019b, 2019a) explicitly display rural perceptions as part of empirical case studies in Ecuador to showcase how restoration impacts their lives. They highlight that local perceptions of communities are frequently ignored, which leads to poorly designed restoration strategies (Farley & Bremer, 2017, p. 379). In the case of FONAG, restoration initiatives are planned in the Quito-based headquarters of FONAG. Therefore, gaining and understanding of rural perspectives, needs and priorities is key to design initiatives that are actually supported by those for whom they are intended. This is supported by the observation that "in many landscapes […] ecological restoration, without regard to sustaining livelihoods and addressing needs of local communities, is a prescription for failure" (Mansourian et al., 2017, p. 180).

1.3 Objective and research question

This study addresses the existing research problem through an empirical case study of the Quito Water Fund in Ecuador. The overall objective of this study is to identify the strategies that FONAG uses to reconcile landscape restoration with rural livelihoods in upstream communities. This study therefore aimed to understand (1) what cross-scale or cross-level challenges emerge in the process of restoration, (2) how FONAG attempts to address those challenges and (3) what consequences this has on rural livelihoods by means of capturing the perceptions of communities affected by FONAG's restoration activities.

The research objective will be met by answering the following overall research question:

How does FONAG change rural livelihoods in the process of overcoming scale-challenges in landscape restoration?

The following sub-questions have guided the research:

1. What **landscape restoration strategies** does FONAG use?
2. What **scale challenges** emerge in this process?
3. What **scale-sensitive governance strategies** does FONAG use to overcome these scale challenges?

The answers to these sub-questions are used to answer the main research question from the view of both, the implementer and the receiver of landscape restoration – a holistic perspective that is largely missing in contemporary water fund literature (Joslin, 2019b, p. 618).

The next section introduces scaling theory and scale-sensitive governance as a part of the theoretical framework and how it is applied to the particular case of FONAG (Section 2). This will be followed by a thorough elaboration of the research methods used during the preparation, fieldwork and data analysis phases of the study (Section 3). Subsequently, a comprehensive overview of the results of the study will be given (Section 4), completed by a discussion consisting of the interpretation of the results, implications for future landscape restoration initiatives and scaling theory, as well as research limitations (Section 5). Finally, the study will be concluded with a summary of the main takeaway's and reflect on the objective and research question (Section 6).

2. Theoretical framework

Scholars increasingly develop the idea that environmental governance faces problems, because stakeholders fail to recognise and deal with scale challenges. This section develops the theoretical framework of this study by analysing recent environmental governance literature that deals with scaling theory and specifies the theoretical approach that is used in this study. First, an introduction to scaling theory and definitions of the concepts *scale*, *level* and *dimension* will be provided (Section 2.1). Then, theoretical approaches towards *scale challenges* will be summarised (Section 2.2), followed by a definition and explanation of *scale-sensitive governance* (Section 2.3). Lastly, the theoretical framework will be applied to the case study (Section 2.4).

2.1 Scaling theory: scale, level and dimension

Since the 1990s, governance scholars have progressively developed scaling theory in environmental governance to respond to specific and complex environmental problems (Cash & Moser, 2000, p. 109; Padt & Arts, 2014, p. 1). Today's most pressing issues, such as climate change, threats to biodiversity and landscape degradation surpass conventional scopes of analysis, and cross through various academic disciplines (Termeer et al., 2010, p. 1). Thereby, the importance of scaling is still less considered in the social sciences than it is in the natural sciences (Gibson et al., 2000, pp. 217–218). There is consensus among scholars that human and natural environments interact and that they are dependent on each other (cf. Cumming et al., 2006; Gibson et al., 2000; Wyborn & Bixler, 2013). Scaling is thus a theoretical approach that is applied to systematically analyse problems that occur in human (or social) and natural (or ecological) systems. The underlying idea is that phenomena in socio-ecological systems occur at different levels and can be analysed through the lens of different scales. Likewise, problems occur in and across different levels and scales. Gibson (2000) argues that there is no single correct level or scale at which phenomena can be studied (p. 221). Instead, scaling theory should be individually applied to each complex environmental governance system, thereby recognising the multi-level, multi-scalar as well as interdisciplinary nature of environmental governance. The concepts of *scale*, *level* and *dimension* are at the base of scaling theory and defined subsequently[9].

Gibson et al. (2000) define *scale* as "the spatial, temporal, quantitative, or analytical dimension used to measure and study any phenomenon" (p. 218). In other words, scale is a measuring device that enables researchers to demarcate abstract and complex ecological and social processes (Padt & Arts, 2014, p. 4). This definition has found agreement among a wide range of scholars (cf. Cash et al., 2006; Cash & Moser, 2000; Termeer et al., 2010; Wiegant et al., 2020; Wyborn & Bixler, 2013). The central idea is that scales are relational, meaning that they cannot be analysed is isolation, but that they are always dependent on interactions with other scales (Howitt, 2003, p. 140). Examples of scales could be spatial, temporal, jurisdictional, institutional or management scales (Cash et al., 2006, p. 3; Padt & Arts, 2014, p. 3) in environmental governance.

The *dimension* is the analytical scope that is used within a scale to measure and study any phenomenon. Gibson et al. (2000) name the dimension the "extent of a measurement" (p. 119). Examples are spatial or temporal dimensions.

[9] Note that the concepts of *scale* and *level* have been defined and applied in various ways in the past, depending on the academic discipline in which they are used. In scaling theory literature, the terms are often even used synonymously (Gibson et al., 2000, p. 218).

Levels refer to "the units of analysis that are located at different positions on a scale" (Cash et al., 2006, p. 2). In other words, levels constitute the resolution of the studied scale dimension (Gibson et al., 2000, p. 219). By extension, they are not a traditional quantitative unit, but rather a qualitative order of measurement, which can sometimes, but not always, be hierarchically ordered (Padt & Arts, 2014, p. 2).

2.2 Scale challenges

For successful governing of socio-ecological systems, actors need to pay attention to interactions within and between scales and levels (Cash et al., 2006, pp. 2–4; Termeer & Dewulf, 2014, p. 38). Those dynamics are called cross-scale and cross-level interactions and they can vary in intensity and direction (Cash et al., 2006, p. 4). Both, human-induced social changes as well as unpredictable ecosystem changes may provoke *scale challenges*[10], which emerge when there is a cross-scale mismatch or cross-level misalignment (Cumming et al., 2006, p. 12). Cash et al. (2006) define scale challenges as "a situation in which the current combination of cross-scale and cross-level interactions threatens to undermine the resilience of a human-environment system" (p. 4). The consequences of scale challenges are undesirable situations for ecological or social systems, or both. For example, landscape degradation can lead to a lack of functionality of ecosystem services or compromise biodiversity, whereas degraded social systems can threaten livelihoods and therefore human well-being (Cumming et al., 2006, p. 13).

Cash et al. (2006) identify three common challenges that emerge (p. 4):

a) ***Blind spot***[11]***:*** *the failure to recognise important cross-scale and cross-level interactions.*
   A blind spot can stem from ignorance, inexperience, neglecting of the existence of multiple scales and levels or a simplification of the understanding of the human-environment system. An example from within landscape restoration governance is when ecological restoration targets are only tackled on the ecological scale (ex. active reforestation activities), while disregarding livelihoods on the governance scale (ex. creating a system in which the restored land is sustainably managed). The recognition of interaction between the two scales, and measures to sync ecological and governance activities in the long run, is key to a sustainable and effective restoration (Wiegant et al., 2020, p. 2).

b) ***Mismatch:*** *the persistence of mismatches between scales and levels in human-environment systems.*
   Mismatch problems typically emerge when human activities do not fit the biophysical nature of the problem. That is to say, an activity's or governance arrangement's demand on an ecosystem does not fit with the ecosystem's capability to satisfy the demand (Cash et al., 2006, p. 4; Wiegant et al., 2020, p. 3). Cash et al. (2006) highlight that mismatches may happen on the spatial as well as temporal dimension of a scale (p. 4). As a spatial example, a landscape restoration institution may execute global restoration targets by restoring a large number of hectares. Yet, the global targets have not been sufficiently translated into local policies that generate restoration success within the borders of the restored land (i.e. mismatch between the global targets and the local restoration needs). An example of a mismatch in the temporal dimension would be that the budget of a large-scale restoration policy is only able to cover activities for a short amount of time, whereas restoration success can only be observed after a considerable amount of time (i.e. mismatch between temporal dimensions of the governance and ecological scales).

c) ***Plurality:*** *the failure to recognise heterogeneity in the way that scales are perceived and valued by different actors.*

[10] Note that in this study, the term *scale challenge* implies not only challenges that emerge from cross-scale interactions, but also challenges that emerge from cross-level interactions. For reasons of simplification, they are summarised into one term. It is common in scaling theory literature, that no distinction is made.
[11] Cash et al. (2006) use the term *ignorance*, which will be renamed *blind spot* in this study. This highlights the fact that the lack of recognition of cross-scale and cross-level interactions is not necessarily intentional.

The flawed assumption that a challenge can be analysed through one 'correct' scale or level leads to plurality issues. Neither a whole system, nor all actors within it will perceive and value scales homogenously (Cash et al., 2006, p. 4). Since policies in landscape restoration governance are often designed at a different level than the one for which they are intended, the problem framing of the policy maker sets the basis for the solution. Van Lieshout et al. (2011) introduce *scale framing*, the process of making sense of the world and placing problems at single scales and levels (pp. 2-3). This can result in ineffective decision-making when tackling scale challenges; or unsuitable outcomes for those who have not been considered or less power to make themselves heard (Cash & Moser, 2000, p. 112). If, in turn, plurality is sufficiently considered, the restoration outcome is a rather negotiated one that encompasses the needs of different actors (Cash et al., 2006, p. 6). An example is that the problem of landscape degradation is understood discordantly by different actors. Whereas global institutions frame an issue at the global level, national actors frame an issue at the national scale, and local actors frame an issue at the local scale etc. Yet, the heterogenous scale framing of the problem definition is vital to prevent oversimplification.

2.3 Scale-sensitivity as a governance capability

Some scholars have attempted to find governance solutions to address scale challenges (cf. Cash et al., 2006; Cash & Moser, 2000; Termeer & Dewulf, 2014). To that end, first approaches included the systematisation of institutional responses to scale challenges (cf. Cash et al., 2006; Cash & Moser, 2000). Cash et al. (2006) distinguish (1) institutional interplay, (2) co-management and (3) boundary or bridging organisations as the most effective institutional governance responses to challenges that stem from cross-scale and cross-level interactions (see Table 1).

Response	**Explanation**
Institutional interplay	Institutional interplay refers to the vertical interplay of actors that are part of a governance arrangement. An example is the interplay between restoration actors on the state level and restoration actors at the municipal or parish level. All three have different views and frame the problem differently. Actors in positions of power on higher levels tend to decide on restoration policy, whereas local institutions are left out. Flexible cross-level mechanisms of interplay enable critical actors to shape landscape restoration inclusively and appropriately.
Co-management	Co-management refers to shared responsibility and agency between different levels of governance. An example of landscape restoration is the shared management of restoration areas by a restoration organisation/institution and the local actors whose territory is being restored. The joint management makes local actors owners of the restoration process. It is especially important that co-management develops as a natural, self-emerging process of experience, instead of a planned redistribution of power across levels.
Boundary or bridging organisations[12]	Bridging organisations have a mediating function between different actors across levels. They have a primary function in the production of knowledge as a translator of scientific information across scales, as communicator of research needs on the ground to the scientific community, or as a neutral forum for discussion that promotes long-term trust building (Cash & Moser, 2000, pp. 115–116). Apart from this, they can strengthen accountability for all parties, be a neutral mediator and enhance participation. An example is scientific knowledge versus rural knowledge in restoration ecology.

Table 1: Institutional responses to scale challenges
Source: author; based on Cash et al., 2006, p. 6-9

[12] For reasons of simplicity, from here onwards *bridging organisations*.

Building on this approach, but broadening from institutional to more overarching governance responses to scale challenges, Termeer et al. (2015) develop a framework of governance capabilities. Therein, they define *governance capability* as "the ability of policy-makers to observe wicked problems and to act accordingly, and the ability of the governance system to enable such observing and acting" (p. 683). In the framework, the authors identify four governance capabilities for successful governance of wicked problems, namely reflexivity (dealing with multiple frames), resilience (flexible adaptation to changes), responsiveness (responding wisely) and revitalisation (lifting deadlocks in policy) (Termeer & Dewulf, 2014, p. 39).

Further, the framework sets forth three central dimensions for governance capabilities: (1) scale-sensitive observing – the deliberate effort of actors to design strategies on the basis of alternative observations that are not necessarily an immediate response within the typical action repertoire, (2) scale-sensitive acting – the development of fitting strategies to address complex scale challenges and (3) enabling scale-sensitivity – the critical review or change of conventional governance systems that are unfit to host scale-sensitive observing and action strategies (Termeer et al., 2015, p. 681). The authors argue that in governance literature, little attention is paid to observing and enabling conditions of governance systems in the context of wicked problems, while the main focus are usually action strategies. Yet, all three dimensions are equally important as they mutually reinforce each other (Termeer et al., 2015, p. 682).

Elsewhere, Termeer & Dewulf (2014) introduce scale-sensitivity as a fifth governance capability to respond to scale challenges (see Table 2). They analyse core elements of scale-sensitive observing, acting and enabling and the types of responses that are suitable for each capability.

i.	**Scale-sensitive observing**	ii.	**Scale-sensitive acting**	iii.	**Scale-sensitive enabling**
a)	Identifying cross-level issues during scale framing to guarantee equity among actors.	**a)**	Strategies to decouple levels during scale framing to answer on the corresponding level.	**a)**	Openness for multiple scale logics, and thus leaving behind scale as a dogmatic concept.
b)	Examining interdependencies between the scales and levels.	**b)**	Strategies to remodel the scales that are at the core of the governance system.	**b)**	Flexible institutions to create and recreate fit.
c)	Understanding fits and mismatches between different scales and levels.	**c)**	Strategies to match cross-level interactions of different scales.	**c)**	Tolerance for redundancy and blurred responsibilities.

Table 2: Scale-sensitive governance through observing, acting and enabling elements
Source: author; adapted from Termeer & Dewulf, 2014, p. 51

2.4 Application to the case study

In prevailing academic research, scaling theory has only been applied to short examples of environmental governance, but in-depth applications to case studies are largely missing (Cash et al., 2006; Cumming et al., 2006; Termeer & Dewulf, 2014). Consequently, this study will apply scaling theory to the case of FONAG in an innovative way, by devoting an in-depth qualitative analysis to the understanding of present scale challenges, how FONAG attempts to overcome those challenges through scale-sensitive governance, and what impact this has on rural livelihoods.

To that end, the restoration governance arrangement in DMQ has been carefully analysed, and the following scales, levels and dimensions are deemed critical to detect scale challenges as well as responses thereto (see Figure 1).

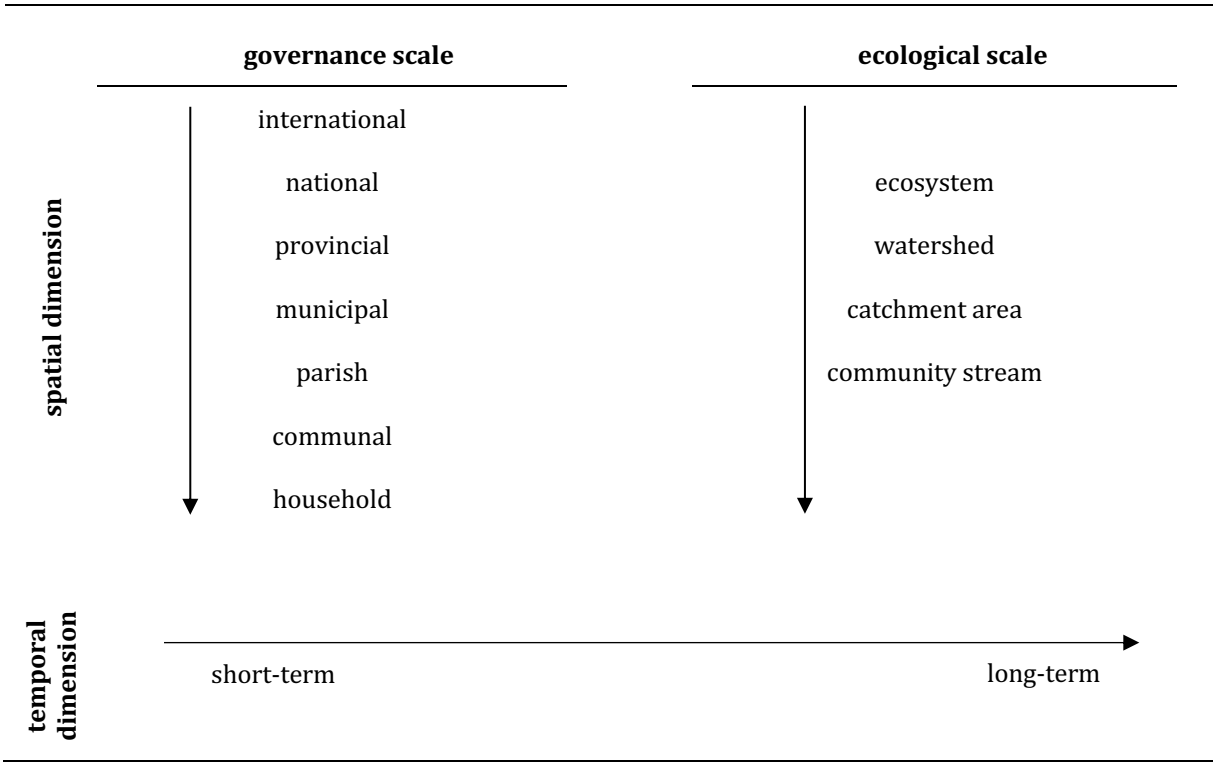


Figure 1: Application of scales, levels and dimensions to the case study

Choice of scale

In the case study, landscape restoration is executed by a variety of actors along the governance scale, while restoration activities happen on the ecological scale. The governance and ecological scales have been deliberately chosen to demarcate the analytical range of restoration processes in the case study. Interactions between governance actors and ecological processes are often not aligned and "can create dynamic feedback loops in which humans both influence and are influenced by ecosystem processes" (Cumming et al., 2006, p. 2). This study therefore analyses landscape restoration efforts by FONAG in the wider Quito region and the corresponding governance arrangement, as well as the ecological results of such efforts. The main focus are interactions between the governance and the ecological scales.

The governance scale encompasses the governance arrangement of landscape restoration in the wider Quito region. As an executer of restoration, FONAG is the central player in the case study. However, they are not a stand-alone stakeholder, and dependent on other institutions and actors

that form a governance arrangement. The choice of the governance scale as the analytical dimension intends to systematise who does what in restoration governance and how power and responsibilities are distributed among actors.

The ecological scale encompasses human restoration activities as well as natural ecological processes and how these interact. Human intervention through restoration activity by FONAG has effects on the state of the *páramo* ecosystem as a whole, as well as water quantity and quality for urban and rural citizens. This, in turn, impacts the landscape in terms biodiversity, streamflow capacity etc., but it also impacts human well-being. Human intervention is complemented by existing ecological processes, such as climate change, weather conditions and the consequences of already existing degradation.

Choice of dimension

On both scales, the spatial and temporal dimensions constitute the analytical scope to measure and study FONAG's restoration efforts as well as ecological and livelihood outcomes. That is to say, space and time are the extent to which interactions on the governance and ecological scales can be studied (Gibson et al., 2000, p. 219). Although a variety of dimensions can be used to measure interactions within and between the governance and ecological scales, this study uses spatial and temporal dimensions because they offer a clear demarcation for the analysis. Furthermore, spatial and temporal dimensions are frequently applied by other scholars in restoration governance literature (cf. Cumming et al., 2006; George & Zack, 2001; Mansourian, 2016; Wiegant et al., 2020)

Choice of level

On the governance scale, the spatial dimension is composed of seven levels that correspond to the respective governance authority. Because of its decentralised character, Ecuador's governance of natural resources is shared by different governing bodies. The chosed levels are

(1) international: landscape restoration governance by multilateral and international non-profit donors
(2) national: landscape restoration efforts by ministries or other national bodies, often aggregated in national programmes
(3) provincial: provincial governments may introduce environmental taxes for environmental management and restoration activities; FONAG executes restoration in three provinces around Quito
(4) municipal: municipalities manage the public drinking water service in the respective territory; together with the regional and provincial GADs they jointly coordinate the maintenance of water basins that provide water for human consumption
(5) parish: parish governments implement policies and programs of landscape restoration that come from any other level above; rural parishes that have decentral access to water, coordinate the infrastructure for service provision with the corresponding parish GAD and the community water board
(6) communal: communities play a central role in the execution and translation of landscape restoration activities that originate at any level above; rural community water boards manage the water that they consume and maintain water extraction and treatment infrastructure
(7) household: rural families implement landscape restoration activities in their daily livelihoods

On the ecological scale, landscape restoration plays out on the (1) ecosystem level, (2) watershed level, (3) catchment area level and the (4) community stream level. Although other levels could

have been chosen, the observations in the field showed that FONAG's landscape restoration activities produce considerable changes on these levels. For example, in the effort to restore parts of the *páramo*, FONAG acts on the level of the ecosystem as a whole (ecosystem level). FONAG's mission, in turn, is intended for particular watersheds in DMQ (watershed level). Moreover, the areas around the catchment in *páramos* are usually the primary target areas for restoration activity due to the strategic importance of water quantity and quality (catchment area level). Lastly, the community stream is the level where restoration activities, and especially the lack thereof, is felt most prominently (community stream level).

To conclude, this study will analyse landscape restoration efforts by FONAG in the wider Quito region by understanding what cross-scale and cross-level interactions on the governance and ecological scale lead to scale challenges. Then, the response to those scale challenges will be examined by understanding FONAG's efforts for scale-sensitive governance. Finally, the reconciliation between landscape restoration and rural livelihoods can be understood (see Figure 2).

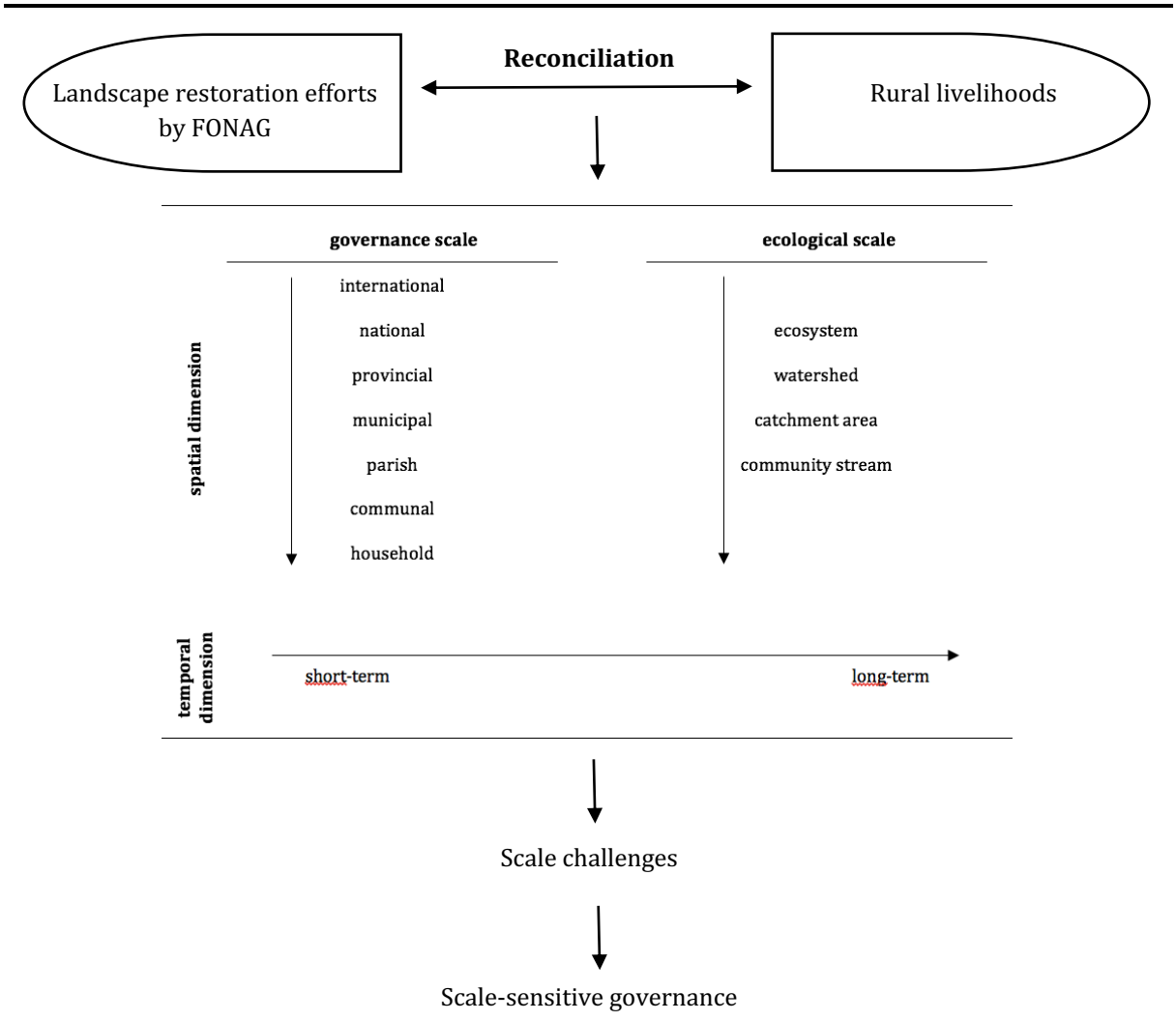


Figure 2: Applied theoretical framework

3. Methods

This section presents the research methods used in this study. First, the general design (Section 3.1) of the research will be explained. Then, the context in which the research was conducted (Section 3.2) is given. Third, the methods of the case selection are elucidated (Section 3.3), followed by a thorough description of the data collection (Section 3.4) and analysis (Section 3.5) methods.

3.1 Research design

The aim of this study is to understand what strategies FONAG uses to overcome scale challenges in restoration governance and how this influences the livelihoods of communities. To study this, a single case study of FONAG in Quito, Ecuador was chosen. As FONAG is involved in landscape restoration since 2000, and works with numerous Andean highland communities, existence of the data needed to fulfill the aim of this study was expected. The case study sheds light on restoration strategies of FONAG on the one hand, and experiences of two rural communities on the other hand. For the latter, two rural communities were chosen: (1) Oyacachi in the province Napo and (2) San Francisco de Cruz Loma in the province Pichincha. Qualitative data was collected during fieldwork from August until December 2019 in Ecuador, of which 10 weeks were spent in the headquarters of FONAG in Quito and four weeks were spent in the two rural communities. Data was collected through observation, document analysis and 43 semi-structured interviews with 34 respondents.

This study was approached in an inductive manner, rather than being confirmatory (Bernard, 2011, p. 9). This means, neither the research methods, nor the application of scaling theory to the case study were defined rigidly prior to the fieldwork. Instead, the researcher chose to discover dynamics and perceptions in landscape restoration freely during the fieldwork. For example, the methods of data collection and sampling of respondents was based on key informants in the field. Yet, the research was demarcated through the application of sensitising concepts. Generally, much space was given to the topics, priorities and perception of the respondents during interviews. The advantage of a less restricted approach was the possibility to shift the focus of the research during the course of the study, depending on the findings (Bernard, 2011, p. 7). Building on values and perceptions of respondents, this study acknowledges that there is no such thing as 'reality'. Rather, perceptions are socially constructed, and subjectivity is an integral part of understanding how FONAG's restoration intervention impacts people at the local level.

The study is divided in four research stages (see Table 3). The first stage was the preparatory phase in which a research proposal was written. It included a thorough literature review and stakeholder analysis, conceptualising the theoretical approach as well as a preparation of the fieldwork (see Appendix C: Interview guide). This stage was jointly accomplished with the other two researchers who focused on FORAGUA and FONAPA, to mainstream the approach for comparability. In the second stage, 10 weeks of fieldwork were conducted in the head office of FONAG in Quito, Ecuador. The main activity was the collection of qualitative data through observation, document analysis and interviews to understand FONAG's strategy of landscape restoration. Especially the beginning phase served as orientation in the field, in which a research network was constructed. Moreover, the rural communities were chosen based on the data collected up to this time. FONAG staff facilitated entry to the field for the third research stage by establishing contact to the rural communities. Accordingly, the third research stage consisted of several field visits to rural communities in Napo and Pichincha provinces for a total amount of 4 weeks. Thereby, observations of and interviews with rural community members were conducted to provide an understanding of rural livelihood realities in FONAG's intervention area. Special attention was paid

to grasp the perception of rural communities as to how their livelihoods change through FONAG's intervention. In this stage, the researcher lived among the community members either in a family-owned hostel or in a host family. This allowed for a close contact with community members.

	Stage one	**Stage two**	**Stage three**	**Stage four**
Subject	Research proposal	Fieldwork FONAG	Fieldwork Rural communities	Data analysis
Time	3 months	10 weeks	4 weeks	6 months
Place	Wageningen, Netherlands	Quito, Ecuador	Oyacachi, Napo, Ecuador San Francisco de Cruz Loma, Pichincha, Ecuador	Wageningen, Netherlands
Activity	Literature review, stakeholder analysis, interview guide	Data collection of FONAG's landscape restoration strategy	Data collection of rural livelihood realities	Transcription of interviews, coding, writing
Goal	Preparation of fieldwork, common approach for comparability	Answer sub-questions on landscape restoration efforts and gain access to field	Answer sub-questions on rural livelihoods	Data analysis and finalisation of MSc thesis

Table 3: Four stages of the research

3.2 Case study context

Quito is located in the northern Andean highlands of central Ecuador in the Guayllabamba river basin (FONAG, 2019, p. 29). The city was built on a long plateau in a valley, surrounded by several volcanos and *páramo*. With a population of more than two million people, Quito is highly dependent on the water supply from the surrounding *páramos*. About 85% of Quito's freshwater is sourced from *páramo* surface waters (Buytaert et al., 2006, p. 60). The water originates from the surrounding peak mountain ranges and is then stored in, and slowly released by, the *páramo*. The *páramo* is seen as a natural regulator of the hydrological cycle, and often referred to as 'Quito's sponge' (Bremer et al., 2019, p. 887).

FONAG' intervention area is located in the provinces Pichincha and Napo and covers the upper Guayllabamba river basin which is sub-divided into several smaller hydrographic units (Kauffman, 2014, p. 48). The intervention area amounts to roughly 6.847 km² or 2,4% of Ecuador's total territory and is divided in nine so-called work axes (see Figure 3) (FONAG, 2019, pp. 28–30).

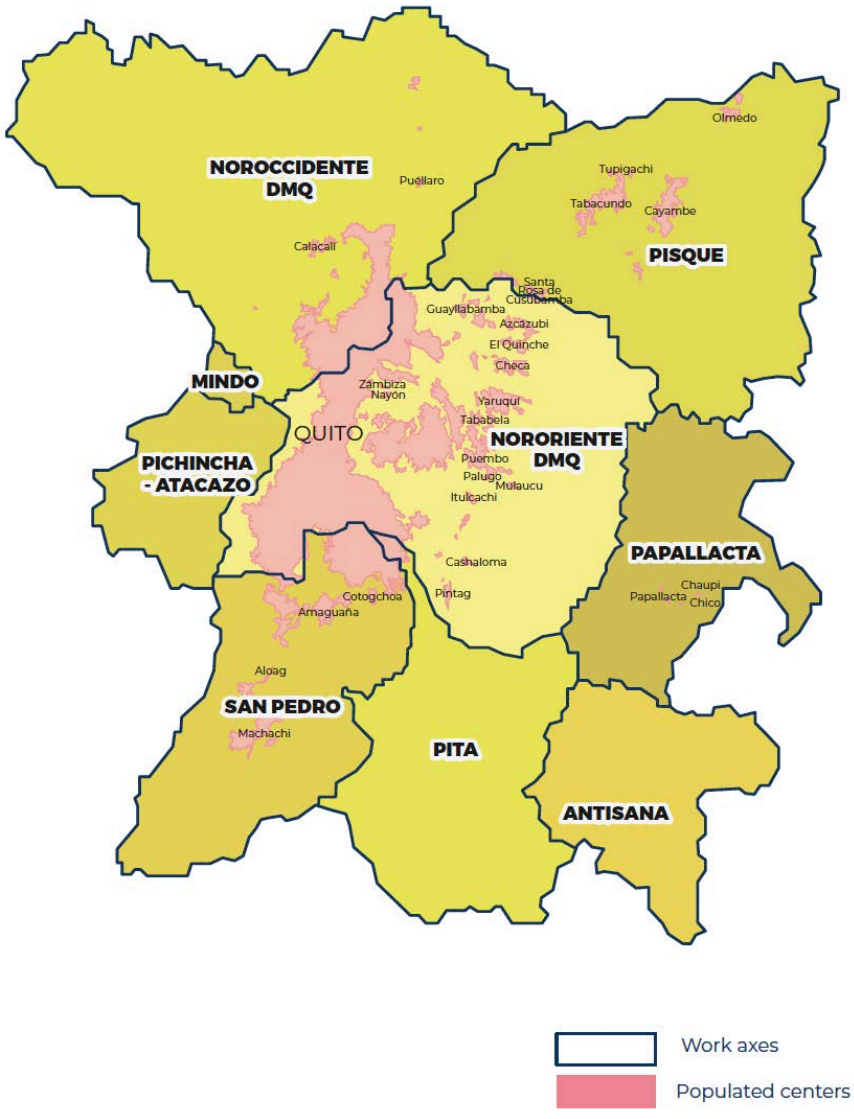


Figure 3: FONAG's intervention area divided in nine work axes
Source: FONAG (2019). *The Path of Water - FONAG: work and lessons.* P. 32.

Within this area, the Public Metropolitan Drinking Water and Sanitation Company of Quito[13] (EPMAPS) extracts large quantities of water from catchments, which are transported to the capital city for human consumption, irrigated agriculture and hydropower production (Bradley et al., 2006, p. 1755; Farley & Bremer, 2017, p. 372). In fact, from the total intervention area of 6.847 km^2, about 2.366 km^2 have been classified as priority areas, because of high interest for water extraction by EPMAPS (FONAG, 2019, p. 30). Studies show that vegetation and land use change can put significant pressure on the ability of the *páramo* to regulate the hydrological cycle (Bremer et al., 2019, p. 887). For example, since the 1970s, livestock grazing of cattle and sheep, periodical burning of shrub for faster growth, and increased agriculture significantly degraded the *páramo* in Pichincha and Napo (Bradley et al., 2006, p. 1756; Goldman-Benner et al., 2012, p. 57). At the same time, EPMAPS extracted water for Quito's population for decades, without consideration for the need of hydrological regeneration and restoration of the water system (Boelens et al., 2012, pp. 6–7). In addition, the importance of the *páramo* for the livelihoods of rural communities has increasingly been edged away, as importance of the *páramo* for the urban population rose.

Most of the water catchments located in FONAG's intervention area are also located within the borders of protected areas, such as the Antisana Ecologic Reserve, the Cayambe Coca National Park and the Cotopaxi National Park. This is no coincidence, as FONAG was originally created with the objective of being a funding mechanism for national parks around Quito (Joslin & Jepson, 2018, pp. 12–13). Between 1980 and 1990, Ecuador followed the global trend of national park creation, as advocated by multilateral donor organisations; and by the year 2000, about one quarter of Ecuador's total territory was already categorised as a protected area (Joslin, 2019b, p. 12). At the time, The Nature Conservancy (TNC) was highly involved in biodiversity conservation efforts in Ecuador, and heavily funded by the United States Agency for International Development (USAID) through the Parks in Peril programme that aimed at strengthening protected areas in Latin America. Yet, protected areas created in this context were often referred to as 'paper parks', lacking state enforcement mechanisms and real conservation outcomes (Joslin & Jepson, 2018, p. 14). Therefore, TNC shifted from advocating state-led protected park systems towards a landscape approach outside of the jurisdiction of inefficient state structures. With USAID funding coming to an end, TNC therefore seeked the creation of a new funding mechanism for biodiversity conservation (Joslin & Jepson, 2018, p. 13).

On January 25 in 2000, TNC joined forces with EPMAPS and Fundación Antisana[14] and created FONAG as a "privately managed mercantile trust"[15] (FONAG, 2019, p. 17) with the idea to accumulate capital and reinvest the generated interest in restoration activities. The estate is managed by a private independent financial institution that governs the trust for a contractual period of 80 years. Apart from the original constituents TNC, EPMAPS and Fundación Antisana, also the Quito Electricity Company[16] (EEQ), the National Brewery[17], the Non-Governmental Organisation (NGO) CAMAREN Consortium and the beverage bottling company The Tesalia Springs Company S.A. ac-

[13] Spanish: *Empresa Pública Metropolitana de Agua Potable y Saneamiento de Quito* (EPMAPS)

[14] According to Joslin & Jepson (2018) an Ecuadorian NGO "created in 1991 for the sole purpose of forming a protected area around the Antisana volcano" (p. 12). During the fieldwork it appeared that the foundation ceased to exist, leaving FONAG with six active constituents.

[15] Legally referenced as "Environmental Trust Fund for the Protection of Catchments and Water FONAG" (FONAG, 2019, p. 17).

[16] Spanish: *Empresa Eléctrica Quito*

[17] Spanish: *Cervecería Nacional CN S.A*

ceded as voluntary constituents. Together, they form the board of directors decide and about investment decisions of future landscape restoration activities (FONAG, 2019, p. 16). Every entity has a separate contract with FONAG, determining the amount and conditions of the financial contributions to the trust. The most important legal prerequisite for FONAG is a municipal ordinance from 2007[18], which requires that EPMAPS needs to contribute a minimum of 2% of the collected water fees to FONAG, without increasing the costs for the end users (FONAG, 2019, p. 17). This is critical for FONAG, because with 87% EPMAPS is by far the biggest contributors to FONAG, followed by EEQ with 9% (FONAG, 2019, p. 19). Consequently, FONAG enjoys relative financial stability because of the secure long-term contributions of the water and electricity utilities. The estate has been continuously increasing since FONAG's existence and amounted to 18.7 million dollars in December 2018 (see Figure 4).

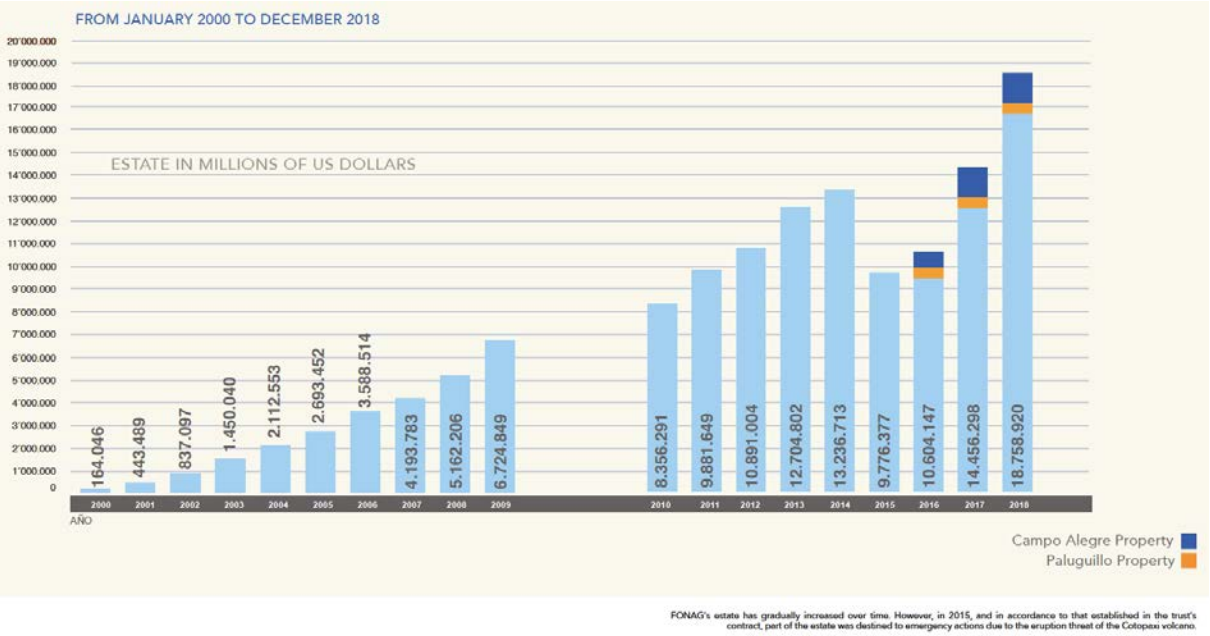


Figure 4: Accumulated contributions to the FONAG trust 2000 - 2018
Source: FONAG (2019). *The Path of Water - FONAG: work and lessons.* Pp. 20-21.

The first four years of FONAG's existence served only for the accumulation of capital (FONAG, 2019, p. 32). Since 2004, the interests were invested in the implementation of restoration activities in a priority area decided upon by FONAG's board of directors. According to the increase in the estate (see Figure 4), also investment and implementation of restoration activities on the ground increased with time. The implementation of landscape restoration activities is done by the technical secretariat, which is a team of about 50 professionals based in Quito. They have developed four complementary programmes to protect the watersheds around Quito (1) The Water Management Programme, (2) The Plant Cover Recovery Programme, (3) The Environmental Education Programme and lastly, (4) the Sustainable Water Conservation Areas Programme (FONAG, 2021c).

FONAG manages purchased property on the one hand and engages with private landowners and rural communities on the other hand. This study focuses on FONAG's interaction with the latter.

[18] Metropolitan Ordinance No.199 and No. 213 from 2007 (FONAG, 2019, p. 17).

Restoration interventions in areas inhabited by rural communities are subject to the Sustainable Water Conservation Areas Programme, in which FONAG negotiates conservation agreements. Hereby, the consideration of livelihoods is a rather recent phenomenon. Since about 2016, FONAG increasingly developed strategies that aim at the strengthening of alternative livelihoods in exchange of efforts from the community to apply sustainable land use activities in their territory.

FONAG's work is subject to the decentralised organisation of Ecuador's political and administrative system as defined by the Organic Code of Territorial Organisation, Autonomy, and Decentralisation[19] (COOTAD). It defines the legal obligations and responsibilities of governing bodies at different levels of governance (see Table 4). According to the governance scale as applied in this research, the international and household levels have no designated legal roles.

Governance level	Water Management Task	Implication for FONAG
National	• Creation of national laws and regulations for water management • Autonomy of declaration of National System of Protected Areas[20] (SNAP) by the Ministry of Environment Ecuador[21] (MAE) • Decentralised management of all water resources by National Water Secretariat[22] (SENAGUA)	• The Integral Amazon Programme for Forest Conservation and Sustainable Production[23] (PROAmazonía) of MAE channels some of its funds to FONAG for restoration activities in the Amazon region • FONAG supports MAE in the management and monitoring of some protected areas around Quito • FONAG bridges negotiations between SENAGUA and communities over water authorisations; FONAG supports the legalisation of rural water boards with SENAGUA
provincial	• Creation of river basin councils • Regional and Provincial Decentralised Autonomous Governments (GAD) in coordination with river basin councils may establish fees designated for watershed conservation and environmental management	• No direct implication

[19] Spanish: *Código Orgánico de Organización Territorial Autonomía y Descentralización* (COOTAD); watershed management specifically under Art. 32, 132, 136 and 137 (Villacís et al., 2011).
[20] Spanish: *Sistema Nacional de Áreas Protegidas* (SNAP)
[21] Spanish: *Ministerio del Ambiente Ecuador* (MAE)
[22] Spanish: *Secretaría Nacional del Agua* (SENAGUA)
[23] Spanish: *Programa Integral Amazónico de Conservación de Bosques y Producción Sostenible* (PROAmazonía)

	• Definition of Development and Territorial Land Use Plans[24] (PDOT) in province's cantons.	
municipal	• Municipal GAD provides potable water services to populations living up until 2800 MASL • Coordination and management of water resources in the territory, including restoration of watersheds • Planning of land use through PDOT	• The mayor of Quito also heads EPMAPS' governing board. It is the largest contributor to FONAG's trust fund. • FONAG works with many communities living above 2800 MASL who are not supplied with potable water. FONAG bridges the negotiation between communities and EPMAPS about rural water infrastructure as compensation.
parish	• Activities for the preservation of soils, natural resources, biodiversity and the environment • Coordination of environmental policies, programmes, and projects of all other levels of government • Rural parishes coordinate water supply of rural areas where no community water board exists	• No direct implication
communal	• Organisation through rural water boards with individual water authorisation from SENAGUA • Rural water boards responsible for the supply and treatment of water for the community; the maintenance of infrastructure is to be carried by the board itself	• FONAG supports in the legalisation of rural water boards in areas where they do not yet exist • FONAG supports the training of personnel responsible for water treatment and donates chlorination equipment/other materials

Table 4: Decentralised water governance in Ecuador and the implication for FONAG
Source: author; adapted from Bakx, 2020, pp. 24-25; based on Villacís et al., 2011

[24] Spanish: *Plan de Desarrollo y Ordenamiento Territorial* (PDOT)

3.3 Selection of rural communities

For the selection of representative rural communities within the case study, internal knowledge of FONAG staff was of critical importance. Because of the large intervention area and in-part poorly documented history of restoration activities, verbal recommendations of three FONAG key informants were critical. Intervention activities are well documented since 2015, however little information on community work can be found before that time.

The aim was to select two cases that represent typical cases of interaction between communities and FONAG (Lichtman, 2014, p. 123). The first choice that has been made was to focus the research on intervention activities from the Sustainable Water Conservation Areas Programme. The goal of the programme is to establish conservation areas by means of conservation agreements, in which sustainable land-use with limited negative influence on the water resources is ensured. Since this programme is most focused on work with rural communities, it was decided that only communities with an already signed conservation agreement will be taken into account. To date, 10 communities have signed a conservation agreement with FONAG and were thus considered as possible case studies (FONAG, 2020, p. 3). Seven minimum criteria for the selection of rural communities were chosen, to guarantee the feasibility for this study (see Table 5).

#	Criterion	Explanation
1	A conservation agreement between FONAG and the community was signed	Guarantees measurable and comparable intervention in the community.
2	The conservation agreement was signed at least one year ago	Guarantees that landscape restoration activities have already started and consequences for community members are observable.
3	The community is accessible for field visits	Secures that the community can be reached within realistic travel distance, offers accommodation, and is safe.
4	The community members are willing to participate in the research	Ensures that the community is comfortable with the research and participates voluntarily.
5	The community members have a good command of Spanish, either as first or second language	Guarantees the possibility to communicate freely to be able to enter the field without a translator or field assistant.
6	The community is considerably large	Ensures flexibility in the selection of interview participants.
7	Livelihood changes are observable	In some communities, FONAG does not necessarily advocate livelihood changes, but rather focuses on ecological restoration measures. This criterion steers the focus to those communities, that show a clear pattern of shift of livelihoods, to generate suitable data to answer the research question.

Table 5: Criteria for selection of rural communities

After careful evaluation of the ten considered communities, only three matched with all minimum criteria established. Of those three, the (1) ancestral community Oyacachi and (2) peri-urban community San Francisco de Cruz Loma were chosen (see red and yellow areas in Figure 5), as they

were more accessible and limited time for the fieldwork did not allow for three communities to be studied.

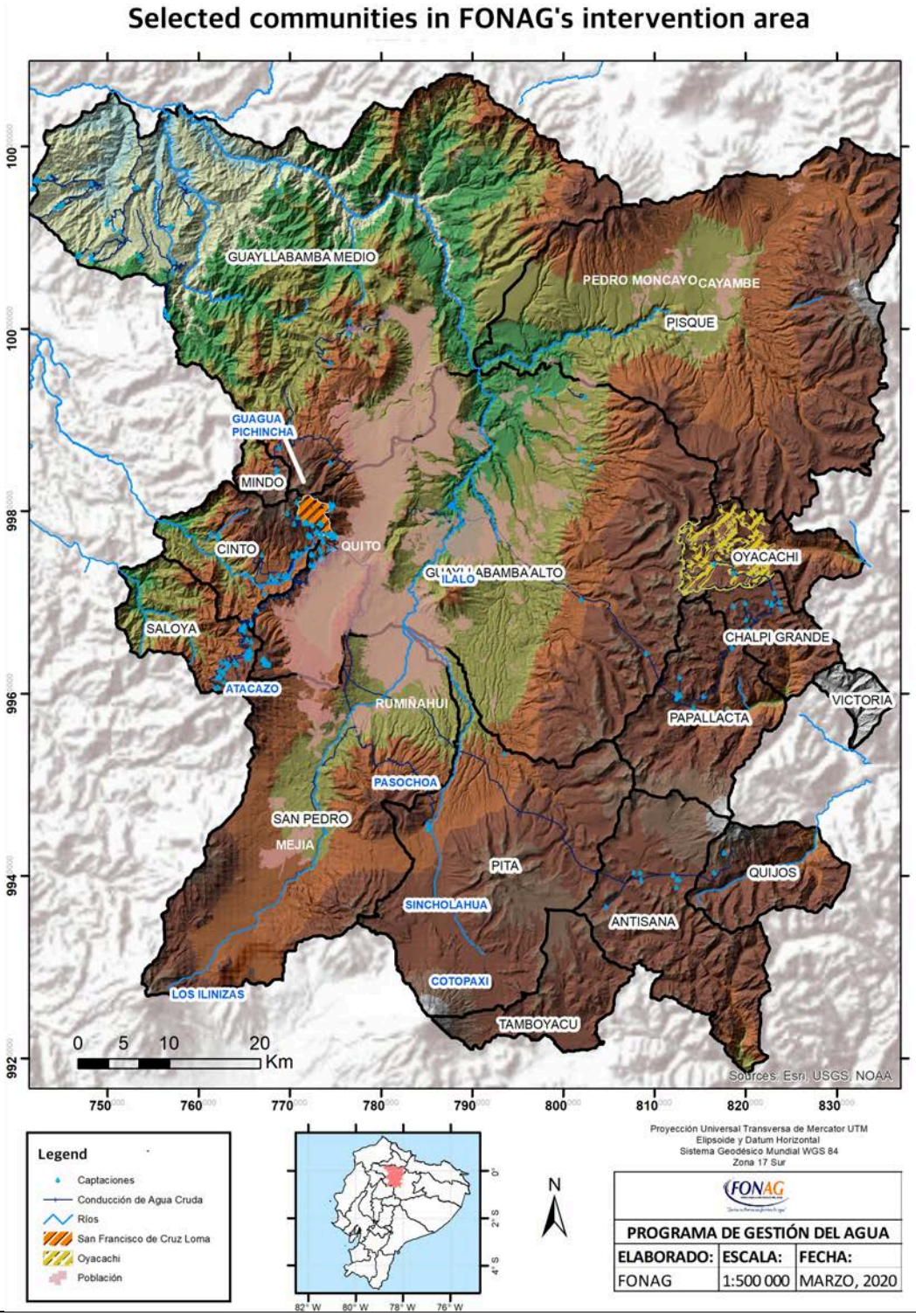


Figure 5: Selected communities in FONAG's intervention area
Source: elaborated by author with geographical data from FONAG

(1) Oyacachi: this community lays in the province of Napo and is a crucial watershed for the extraction of freshwater for Quito. Several water wells lay within the Oyacachi territory supply 30% of Quito's drinking water [SI_SENAGUA__a_1]. Due to their indigenous status, the community enjoys nationally protected territorial rights, although their territory is located inside what is today the Cayambe-Coca national park. FONAG is involved in the community since 2004 and has continuously supported the reduction of livestock farming in the upper parts of the *páramo*, in exchange for alternative livelihood activities. Apart from this, three local *guardapáramos*[25] have been hired by FONAG to monitor the *páramo*, making the conservation of the territory a local matter.
(2) San Francisco de Cruz Loma: this community is located in the outskirts of Quito and is of less strategic importance to EPMAPS than Oyacachi. Yet, water wells of EPMAPS capture small amounts of water on the community territory. The land-use practices of most families led to contaminated water resources in the past. To prevent water contamination, FONAG supports the community in the improvement of soil quality and water availability in the area, while at the same time strengthening alternative livelihoods through community tourism.

The two cases show one distinctive similarity: the shift of livelihood activities away from agriculture and livestock rearing towards community tourism. FONAG has supported the communities in both cases in the establishment of community tourism activities. Even though the cases are subject to completely different contexts and locations, the livelihood changes can be compared and traced back to the strategies that FONAG employs in their work with communities. Moreover, both cases belong to the intervention sites in which FONAG shows longest involvement: Oyacachi was the first community that FONAG entered. Although the conservation agreement is relatively new, the relationship between FONAG and Oyacachi dates back to 2004, when FONAG first started the execution of landscape restoration activities. With the community San Francisco de Cruz Loma, in contrast, FONAG signed its very first conservation agreement in 2017, whereas they have already been in contact with the community since 2015. At least five years of experiences between FONAG and the communities creates a good research basis in both communities.

[25] A *guardapáramo* is a hired local community member who works as *páramo* ranger, monitoring the state of the ecosystem by walking daily control routes, taking samples and reporting back to FONAG.

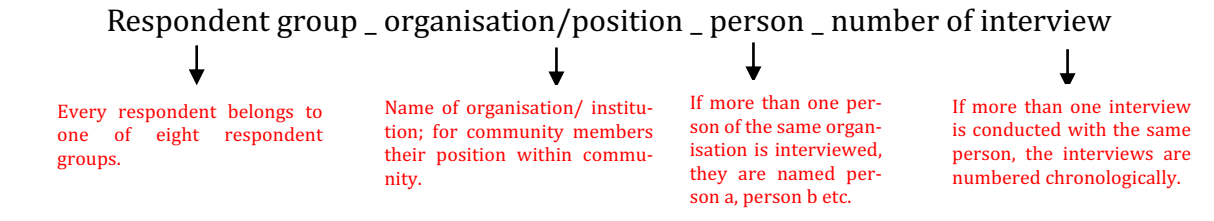
3.4 Data collection

During the fieldwork (see Table 3), data was collected in the form of observations, documents and semi-structured interviews, which will be elaborated one by one.

First, field observations were made at both stages, at the FONAG head office and in the communities (Bernard, 2011, pp. 156–157). The interactions between individuals, the general atmosphere and particular details, that could not be captured through documents or interviews, were recorded in form of field notes (Kumar, 2011, p. 43). Moreover, impressions, feelings and experiences of the researcher during the fieldwork were documented to understand the emotional context at the time of data collection for possible influence at later stages. Observation had a predominant role during the stay in the communities, as accommodation was facilitated through either a family-owned community hostel (Oyacachi) or a host family (San Francisco de Cruz Loma). The constant interaction with the families, shared meals, as well as the possibility to follow their daily livelihood activities made it possible to gain valuable insights. Moreover, the families facilitated the participation in community activities, such as sports events or community *mingas*[26]. Living with a family also created a relative level of trust that permitted approaching more sensitive topics, unsuitable for formal interview settings(Bernard, 2011, p. 156).

Second, in research stage two, access to relevant public and non-public documents was granted by FONAG (i.e. publications, strategic plans, action plans, conservation agreements as well as data sheets and maps). The non-public documents only serve as background data.

Third, a total number of 43 semi-structured interviews have been conducted with individuals who were grouped into eight respondent groups (see Figure 7). Of those, 25 interviews were conducted with FONAG staff, while 18 interviews were conducted with rural community members. Each interview received a unique code, which guarantees anonymity of respondents but reveals the respondent group and organisation/ position of the respondent (see Figure 6).



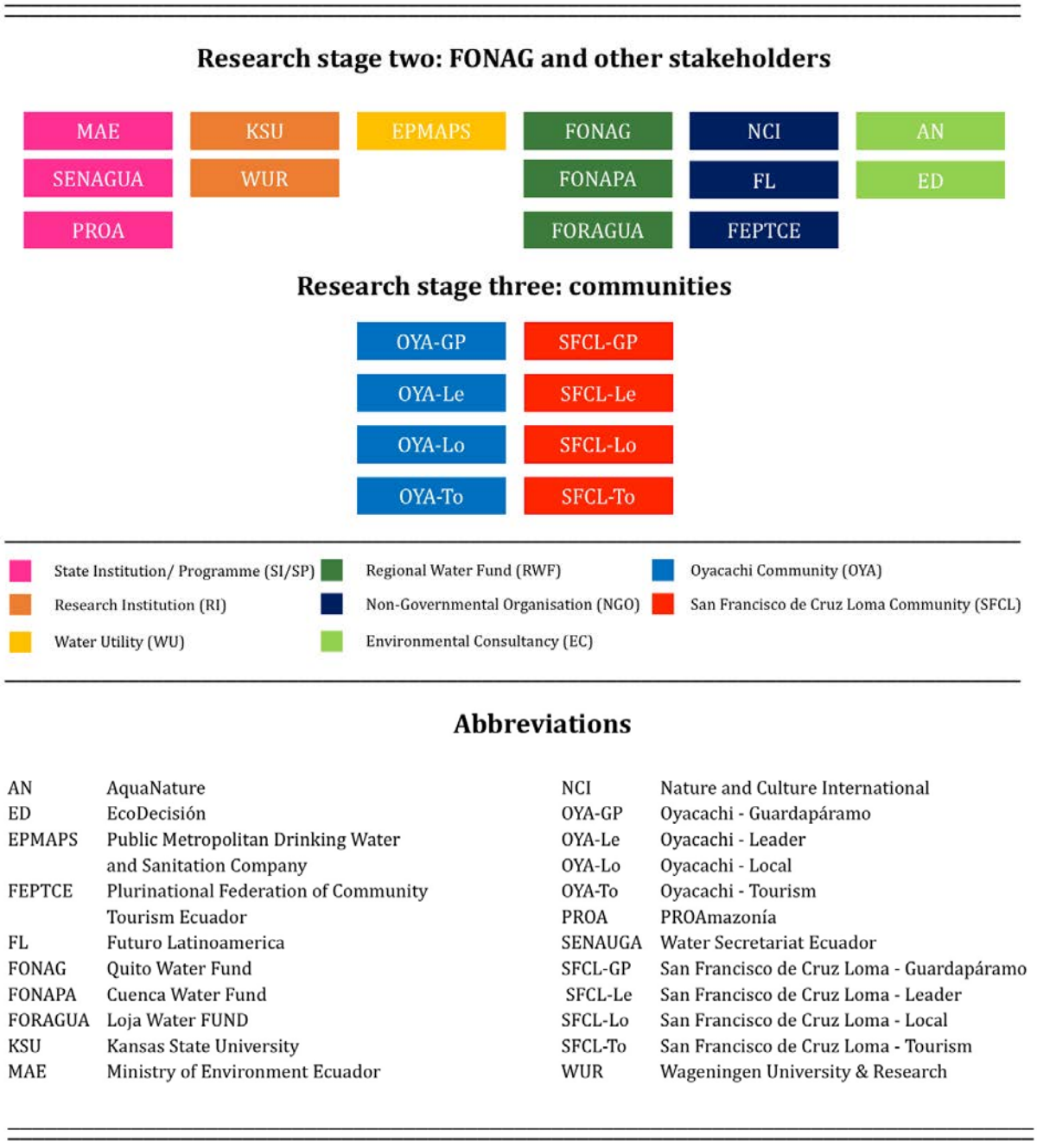
Example: SI_MAE_b
Interview with respondent of the Ministry of Environment Ecuador, who belongs to the respondent group 'State Institution' (SI). The 'b' shows that at least two people were interviewed at MAE. Person b, has only been interviewed once, as the number of interviews is not shown.

Example: RWF_FONAG_d_2
Interview with respondent of FONAG, who belongs to the respondent group 'Regional Water Fund' (RWF). The 'd' shows that the respondent was the fourth person to be interviewed at FONAG. This interview was the second interview of person d, as shown by the number 2.

Figure 6: Composition of interview code

[26] Quichua word for joint community work for the common good.

The rural community members were grouped according to their position within the community: (1) *Guardapáramo*, (2) leader (ex. community president or comparable role), (3) local (i.e. member of community without specific role) and (4) tourism (i.e. individual working in tourism sector).



Abbreviations

AN	AquaNature	NCI	Nature and Culture International
ED	EcoDecisión	OYA-GP	Oyacachi - Guardapáramo
EPMAPS	Public Metropolitan Drinking Water and Sanitation Company	OYA-Le	Oyacachi - Leader
		OYA-Lo	Oyacachi - Local
FEPTCE	Plurinational Federation of Community Tourism Ecuador	OYA-To	Oyacachi - Tourism
		PROA	PROAmazonía
FL	Futuro Latinoamerica	SENAUGA	Water Secretariat Ecuador
FONAG	Quito Water Fund	SFCL-GP	San Francisco de Cruz Loma - Guardapáramo
FONAPA	Cuenca Water Fund	SFCL-Le	San Francisco de Cruz Loma - Leader
FORAGUA	Loja Water FUND	SFCL-Lo	San Francisco de Cruz Loma - Local
KSU	Kansas State University	SFCL-To	San Francisco de Cruz Loma - Tourism
MAE	Ministry of Environment Ecuador	WUR	Wageningen University & Research

Figure 7: Interviewed respondents divided in respondent groups and abbreviations
Source: author; adapted from Wiegant et al., 2020, p. 4

Apart from three exceptions, all interviews were performed in Spanish. The interviews were held in different settings, ranging from formal to informal, depending on the respondent and context. Moreover, the interviews were deliberately semi-structured (Berg, 2001, p. 70; Bernard, 2011, pp. 157–158). Using an interview guide (see Appendix C: Interview guide), topics and questions wished to be covered by the researcher, have been chosen prior to the interview (Bernard, 2011, p. 158).

This broad selection of topics and sensitizing concepts as well as corresponding interview questions steers the interview to an extent but leaves room for a natural development of the conversation, so that priorities of respondents crystallise. In the second research stage, the interview guide was slightly adjusted before every interview, because different information was seeked from every respondent. In the third research phase, in turn, only one interview guide per community was prepared to guarantee comparability of responses. The interviews were audio recorded with informed consent and later transcribed into written format by an Ecuadorian transcriptionist (Bernard, 2011, p. 168; Kumar, 2011, p. 220). The interviews in English language were transcribed by the researcher. As respondents frequently used Spanish sayings and symbolic language, transcription from a native-speaker familiar with the cultural context increased accuracy of the data (Maclean et al., 2004, pp. 114–115).

All interviews were transcribed manually by intelligent verbatim, in which wording may be edited while transcribing (Maclean et al., 2004, pp. 113–114). The aim is to correct grammar or delete conversation fillers and repetitions. In this study, the contextual meaning of the interviews is more important than the exact wording. The readability and understanding of sentences was improved by correcting sentences (Berg, 2001, p. 34).

Moreover, non-probability sampling was applied, which is the deliberate choice of respondents to meet a specific end. Non-probability sampling is a common method to analyse in-depth case studies (Kumar, 2011, p. 187). Thereby, the number of respondents is not defined prior to the fieldwork, rather the research ends when the point of data saturation is reached (Kumar, 2011, p. 188). Within non-probability sampling, different strategies were applied: purposive sampling, snowball sampling and at times even convenience sampling (Berg, 2001, pp. 32–33; Bernard, 2011, p. 144).

First, purposive sampling is applied based on the judgement of the researcher as to who may best provide data for the purpose of the study (Bernard, 2011, p. 145; Kumar, 2011, p. 189). In research stage 2, for example, factual information about the different communities was needed to select a case study. Therefore, respondents involved in community interaction (i.e. FONAG or external experts) were actively looked for. Further, as the first indigenous community was a rather male-dominated society, female voices and perceptions were actively looked for. Essentially, with purposive sampling, respondents are found who contribute important knowledge, critical opinions, and personal perceptions for a specific purpose at different stages of the research.

Second, snowball sampling was applied during fieldwork (Berg, 2001, p. 33; Kumar, 2011, p. 190). It is the idea that one respondent acts as key-informant, who then directs the researcher to other individuals that can provide a valuable perspective about the topic. In the second research stage, an ex-FONAG staff member functioned as a key-informant. This person had been involved in FONAG for years, understood the internal dynamics and history, and still possessed a professional network in Quito. Through this person, contact with many other experts was established, which gradually resulted in a research network. Moreover, in both communities, the host families served as key informants as they referred the researcher to other community members.

Third, convenience sampling was used at times, but not predominantly (Bernard, 2011, p. 147; Kumar, 2011, pp. 189–190). Convenience sampling is used when an individual, who might offer an interesting story, just happens to be in the vicinity and ends up being interviewed, without

having planned it before. Whether such data is useful for the research is difficult to estimate beforehand. Yet, field research in communities is not a rigid collection of data, but the interaction and connection with other human beings, who share their story.

3.5 Data analysis

The collected data was made sense of through content analysis, a method that is frequently used to analyse text-based qualitative data (Kumar, 2011, p. 229). The transcribed raw data was systematically reviewed to find patterns in the answers of respondents. Content analysis is a useful method for the purpose of this study, because it gives the data room to tell a story, rather than using fixed themes through which the data is viewed (Bernard, 2011, p. 429). This corresponds to the inductive nature of this study.

The content analysis was performed through inductive or open coding using ATLAS.ti (version 8.4.5). In a first round, all 43 interviews were read by order of respondent groups, and interesting codes were highlighted while themes of responses were identified. Those themes were selected based on the research (sub-)question(s) and served as basis for the code book, which is the documentation of codes identified (Kumar, 2011, p. 230). In the second round, the interviews were neatly coded using the open coding method (Bernard, 2011, p. 430). Here, the codes are developed based on reoccurring statements and experiences mentioned by the respondents. To add more depth to the analysis, the codes were given a maximum of four dimensions, going from broad to specific (ex. perception – livelihood change – positive – more income). A total number of 266 units of codes were identified in the second round of coding. Because this number is overwhelming, and not all information was relevant to answer the research question, a simplified code tree was developed in retrospective (see Appendix B: Code tree – simplified). Simultaneously, a short interview memo was written for each respondent group in order to understand patterns found among different respondents of the same group (Bernard, 2011, pp. 435–436). The memo included outstanding quotes as well as a summary of the main takeaways from the coding and was frequently used during the writing phase to keep a red line of argumentation.

The data found in the interviews was not always coherent, especially when respondents refer to numbers and hard facts. Therefore, triangulation has been used as a method to cross-check such data (Carter et al., 2014, p. 545). Statements were generally weighted against what other people said, but also compared to the same information found in public and non-public documents.

4. Results

This section portrays the results of this study along the order of the three research sub-questions. First, FONAG's landscape restoration strategies are described (Section 4.1). Then, the scale challenges that emerge in the process of landscape restoration as well as the scale-sensitive governance responses by FONAG to overcome those scale challenges are presented (Section 4.2). Both sections are informed by the perception of the rural communities with regards to their livelihood changes.

4.1 Landscape restoration strategies

FONAG applies a number of strategies to restore and conserve the Andean *páramo* landscape[27], with the aim to improve water availability and quality. FONAG is a unique actor in *páramo* restoration among the Ecuadorian water funds, because its strategy is not only to finance restoration activities, but also to implement them [EC_AN_a_1]. An environmental consultant who has analysed the different types of water funds that exist in Ecuador made the distinction between (1) the financing water fund like FORAGUA in the South of Ecuador, (2) the hybrid water fund like FONAPA in the Paute watershed and finally (3) the implementing water fund like FONAG. Whereas the first only finances restoration activities and leaves the implementation to the municipality, the second actively outsources and monitors restoration activities [EC_AN_a_1]. Yet, both types of water funds are not active implementors of restoration activities. FONAG, in turn, has implemented *páramo* restoration since the consolidation of its technical secretary in 2004 (FONAG, 2019, p. 33). Respondents reported that one of the biggest advantages of being an implementer is that throughout its twenty years of existence, FONAG has profited from its learning experiences in restoration [EC_AN_a_2; RWF_FONAG_a_2]. Through trial and error in the field, FONAG has developed and used a set of five strategies for *páramo* restoration that are applied individually on a case-to-case basis (see Table 6).

i. Generation of hydrometeorological and socioeconomic data

One of FONAG's key strategies is the collection and analysis of hydrometeorological as well as socioeconomic data in the area of interest. Such data serves as the basis for decision making as to what extent and how an area will be restored (FONAG, 2015, p. 14). Hydrometeorological data is generated through (1) ecological flow analysis, (2) climate monitoring and (3) hydrological monitoring. The analysis of ecological flows is the study of the quantity, quality and flow of water necessary to maintain a freshwater ecosystem at a level at which it can function fluently. As almost all intervention areas of FONAG are also catchment areas covered by EPMAPS, this data is used by both institutions as a basis for decision making in watershed management as well as water catchment infrastructure planning (FONAG, 2015, p. 14). Second, FONAG currently manages 19 climate monitoring stations in its areas of intervention which continuously provide information on climate conditions. Third, FONAG monitors the hydrological flows at five measurement stations to determine water availability for impact evaluations of restoration activities (FONAG, 2021b). The data that FONAG collects sets the basis for ecological restoration activities such as determining priority protection zones, fencing off degraded areas or planting native species.

[27] Hereafter named *páramo restoration*.

No.	Strategy	Description	Achievements
i	Generation of hydrometeorological and socioeconomic data	FONAG collects hydrometeorological data through ecological flow analysis, climate monitoring and hydrological monitoring. The data is collected via 19 climate monitoring and five hydrological monitoring stations in its area of intervention. To understand the local reality before entering the field, FONAG conducts hydrosocial diagnostics on watershed level since 2016.	The watershed Cinto was the first area where FONAG conducted a hydrosocial diagnostic in 2016. The study analysed the geographic territory, the plant cover in the *páramo*, the productive activities and opportunities to change rural livelihoods, and a stakeholder analysis (FONAG, 2016).
ii	Declaration of conservation areas	Water Conservation Areas (ACH) are purely designated towards restoration activity and research in territory that either FONAG or its constituents own. In the remaining Areas of Water Interest (AIH), FONAG forms voluntary conservation agreements with rural communities. They include mutually agreed conservation and sustainable land use zones and determine how the community reduces pressures on the *páramo* in exchange for support in alternative livelihoods.	In 2017, FONAG signed its first conservation agreement with the San Francisco de Cruz Loma community. To date, 10 conservation agreements with rural and indigenous communities were signed (FONAG, 2020, p. 3).
iii	Passive and active restoration of degraded *páramo*	In degraded intervention areas of FONAG, the restoration of vegetation cover and soil functions is a key strategy. This can be achieved by active restoration (i.e. planting of native species) or passive restoration (i.e. fencing of areas under stress).	More than 15.000 ha have already been actively or passively restored by FONAG (FONAG, 2021a).
iv	Environmental education	Since 2005, FONAG focuses on environmental education of children in intervention areas, their teachers as well as community members about the importance of the *páramo* ecosystem for water.	Currently, 22 schools take part in environmental education by FONAG. Common methods are experience walks and community workshops [RWF_FONAG_c_1].
v	Hire *guardapáramo*	FONAG hires *guardapáramos* – local páramo rangers – in the communities in which they work. As representatives of the community and employee of FONAG, they not only monitor the restoration activities in the water protection zones but mediate the needs and priorities of both.	FONAG employs 21 *guardapáramos* in their intervention area who participate in regular workshops to be equipped against fires, monitor the state of the *páramo* and mediate in situations of conflict. They enjoy a high level of trust by both, FONAG and the communities [RWF_FONAG_b_2].

Table 6: Landscape restoration strategies of FONAG

The collection of socioeconomic data is rather recent in FONAG. Its staff expresses that after 10 years of work with rural communities, they have learned that each place is unique and therefore needs a unique *páramo* restoration strategy [RWF_FONAG_d]. In order to develop a customised strategy for each case, the ecological and hydrological conditions of the area are just as important as the socioeconomic situation of the communities who live in the area. Therefore, FONAG conducted its first hydrosocial diagnostic in the Cinto watershed in 2016. The hydrosocial diagnostic is a comprehensive baseline study in which ecological and social pressures, potential conflicts, existing livelihoods and rural realities are identified [RWF_FONAG_d]. The data is collected by FONAG staff and/or external consultants in agreement with the rural community in question. Ideally, it sets the basis for a conservation agreement at a later stage-

"There are areas of water importance with people, communities, conflicts, power relations, interests; the work in those areas is much more complex. We first try to understand the hydrosocial reality, and only then propose concrete actions. Those often materialise in a conservation agreement with the community." [RWF_FONAG_d]

ii. Declaration of conservation areas

FONAG identified about 236.000 ha of its intervention area[28] as priority water sources that supply DMQ with drinking water. Of those, only 81.000 ha are protected by SNAP, whereas the remaining 155.100 ha are in the need for protection to continue supplying DMQ with water (FONAG, 2020, p. 2). FONAG's strategy to conserve the *páramo* in its intervention area is twofold: for one, they establish Water Conservation Areas[29] (ACH) in property that they own[30] and for another, they establish Areas of Water Interest[31] (AIH) in territory where the land tenure system is characterised by rural or indigenous communities [RWF_FONAG_d]. FONAG's property areas amount to about 20.000 ha without inhabitants, resulting in ACHs that are purely destined at restoration of degraded *páramo* with maximum control (see scale challenge iii). This also makes their property an ideal research site to better understand the functions and behaviour of the understudied *páramo* ecosystem [RWF_FONAG_d]. Important thereby is the fact that land adquisition is not a priority strategy of FONAG, but rather a complementary element:

"It depends on the socio-economic and land tenure system in the territories. We do have a particular niche of land tenure regime [large landowners] where purchasing is an option. That is absolutely not the case for the whole of our territory, no way! [...] We have not done any active campaigning of calling out and saying we want to buy. Everything that we have done have been sellers who have come here to offer." [RWF_FONAG_a_2]

The remaining 135.000 ha of land, which have a more complex land tenure system, are AIHs for FONAG. FONAG staff indicated that the restoration activities in AIHs should be just as diverse as the context of each place is [RWF_FONAG_d]. The answer to the question what restoration strategy is most effective in AIHs was:

"None of them. Every particular situation has its best solution. The diversity of solutions is the strength." [RWF_FONAG_a_2]

The AIHs are inhabited by communities or private property owners. To protect the water sources

[28] FONAG's total intervention area covers about 684.700 ha (FONAG, 2019, p. 28).
[29] Spanish: *Áreas de Conservación Hídrica* (ACH)
[30] Note that FONAG only owns two out of five properties, the other three are owned by EPMAPS and TNC, but restoration activities are managed by FONAG [RWF_FONAG_a_2].
[31] Spanish: *Áreas de Interés Hídrica* (AIH)

in those areas, FONAG initiates the joint management of *páramo* ecosystems through voluntary conservation agreements. The first conservation agreement has been signed in 2017 and to date, FONAG achieved the signing of 10 agreements with rural and indigenous communities (FONAG, 2020, p. 3). A conservation agreement typically includes a jointly agreed area of hydrological importance, upon which a participatory zonification of sustainable use of the territory follows. In other words, FONAG and the community agree on the water sources that need protection, define the areas around the water bodies that are dedicated to conservation activities and with that also define the areas destined for sustainable land use for the community [RWF_FONAG_d]. Sustainable land use includes the determination and strengthening of alternative livelihoods that reduce pressures on the *páramo* ecosystem while at the same time improving the livelihoods of rural families (ex. community tourism or agroecology). Conservation agreements are long-term voluntary collaborative arrangements between FONAG and the communities that aim at generating a common vision about alternatives and actions to reduce pressures that affect availability and access of water (FONAG, 2020, p. 3). They usually consist of three years of investments based on a jointly agreed action plan, followed by 10 years of monitoring and evaluation of the conserved *páramo* area. Restoration activities, such as fencing areas, planting native species, but also the building of infrastructure for tourism are usually carried out in a community effort by *mingas*. Similarly as the amount of money that FONAG agrees to invest in the conservation agreement, the community agrees to implement restoration activity counted in labouring hours through *mingas*, thereby counting an average hourly wage in Ecuador. Livelihoods are continuously strengthened with the support of FONAG throughout the time[32]. A particularly important part of this strategy is the strong commitment of FONAG to contribute to improved rural water management in communities, where the water service provision by EPMAPS is insufficient.

"The first principle is that none of the communities from which the water for Quito comes should lack water, neither in quality nor in quantity. That is to say, these communities should not have less water quality than the people in Quito. If the community […] does not have water, our first action is to have 'good' water: chlorination systems, disinfection systems, and the legalisation of rural water boards systems, which many communities do not have." [RWF_FONAG_d]

FONAG names three basic principles whenever engaging with communities (FONAG, 2020, p. 5):

(1) Water rights: every community that shares its territory with catchments where water is retrieved for Quito should enjoy safe access to and quality of water.
(2) Alternative livelihoods: every community should have alternatives to maintain their income with activities that do not generate any pressures on the ecosystems that are of FONAG's interest while increasing the community's resilience to external pressures.
(3) Water justice: no community should perceive inequality in water access.

Further, FONAG has been involved in the effort to establish country-wide hydrological protection areas. To that end, FONAG worked intensively with SENAGUA to advocate a tenth category in the currently nine national protection categories[33] under SNAP: the hydrological protection area

[32] Technically, investments are limited to three years. However, FONAG staff indicated that next to the ecological monitoring, also donations of material as well as capacity building may informally continue upon demand for the 10 years.

[33] Currently, there are nine categories under SNAP: (1) national parks, (2) ecological reserves, (3) biological reserves, (4) wild life refuges, (5) national recreation areas, (6) reserves for the production of fauna, (7) marine reserves, (8) coastal marine reserve and (9) conservation areas (Aguirre Mendoza, 2014, pp. 6–7).

[RWF_FONAG_a_2]. The idea is a new national category aimed at watershed protection that are of critical importance to increase water quantity and quality for Ecuador. Together with FONAG, SENAGUA declared three hydrological protection areas to date [SI_SENAGUA_a_2]. However, the areas never entered the SNAP system and are therefore not under legal protection of the Ecuadorian constitution. The reason for this is continuous discrepancies between MAE and SENAGUA, or more specifically, a lack of political will by MAE to create a tenth category.

"There are many problems. First, it is an issue that the MAE does not want to lose its ability to declare Protected Areas and perhaps, they are a little threatened by this. It has been almost two years since we want to enter them [hydrological protection areas] here and there have been no efforts [by MAE]." [SI_SENAGUA_a_2]

At the same time, MAE stresses that they generally support the creation of hydrological protection areas, but that the establishment of a new category under SNAP is neither efficient, nor is it an easy bureaucratic process [SI_MAE]. The process of hydrological protection areas is arguably politically deadlocked, despite FONAG's efforts to support SENAGUA with their expertise in the declaration.

iii. Passive and active restoration of degraded *páramo*

This strategy includes the restoration of vegetation cover and soil function in degraded intervention areas of FONAG. The central aim is to generate continuous vegetation growth which enables the *páramo* to function as a natural water regulator (FONAG, 2015, p. 16). Depending on the state of degradation, either active or passive restoration activities are applied. Active restoration is the re-introduction of native shrub and herbaceous species, seed spreading and restoration of wetlands, to only name a few. The communities are involved in these activities through *mingas*, which are traditional communal works in which one representative of each family joins the joint work force [SFCL-Le_b]. The planting of native species, for example, is often stemmed through mingas. In San Francisco de Cruz Loma, there is a plan to implement a plant nursery for native species and crops in the future. They are to be produced by the community itself and serve for restoration and alimentation purposes [SFCL-Le_a]. The restoration strategy has not always been what it is today. Instead, FONAG staff learned over time how *páramo* reaches a healthy state, namely not by simply planting any species, but through the re-integration of native species. Valuable best practices have developed, for example, that the species found in one valley should not be introduced in another one, even if they are similar [EC_AN_a_1; RWF_FONAG_a_2]. Passive restoration, in turn, is the idea to reduce stress factors of human intervention in *páramo*, such as livestock grazing or fires, by fencing off areas (FONAG, 2015, p. 16).

"[…] the focus was much more on planting, as most other institutions did at that time. Planting, planting, planting. In 30 years, we have learned that that is not the most efficient way. […] The simple logic of: take care of the water by planting a tree, that is too simple. We moved into a much broader portfolio of things we can do. Different areas need different things. Active restoration through planting is only one possible intervention in our intervention portfolio." [RWF_FONAG_a_2]

iv. Environmental education

Environmental education has been a central strategy in FONAG's portfolio since 2005 (FONAG, 2019, p. 81). Currently, five staff members are in charge of creating awareness for the importance of the *páramo* ecosystem for Quito's water. They do this mainly through workshops at 22 schools in their intervention area, but also by educating teachers to include environmental awareness into

their lessons [RWF_FONAG_c_1]. FONAG's methods are experience walks in the Paluguillo Interpretation and Environmental Research Center[34], community workshops as well as projects that combine environmental education and art [RWF_FONAG_c_1]. The central idea is sensitising children for environmental issues and creating awareness of the importance of the *páramo* for water sources among them. As children are the future generation of environmental managers, FONAG invests in them as a long-term strategy.

v. Hire *guardapáramo*

To facilitate the translation of restoration policies from urban-based FONAG staff into rural land and livelihood practices, FONAG hires *guardapáramos* - or *páramo* rangers. Particularly interesting is that those *guardapáramos* are members of the communities themselves. They assume a role as bridge builders between FONAG and the community, as they understand both perspectives. To date, FONAG employs 21 *guardapáramos*, of which two are female, who live in their respective community and work in the conservation of the zones of hydrological importance [RWF_FONAG_b_2]. They receive regular practice-oriented workshops about ecology, hydrology and zoology by FONAG. A local *guardapáramo* explains his work in the following:

"My job for FONAG is to protect the water resources for EPMAPS and likewise to take care of the flora and fauna, monitor that there are no fires, river poisonings or clandestine fishermen, and make sure that nobody extract plants." [OYA_GP].

In other words, *guardapáramos* are the representatives of FONAG working closest with the communities in the community territory. They are equipped by FONAG with material such as a motorcycle, a horse or other adequate modes of transportation and follow a daily monitoring route in the *páramo* conservation zone to detect potential threats: cattle, dogs, fires or productive activity (OYA-Lo_b). They also continuously monitor the state of the *páramo* through samples and photo reporting [OYA_GP]. That way, they report back to FONAG, which in turn supports in case of severe problems, such as fires. Interestingly, the *guardapáramos* not only translate restoration policy from FONAG to the community, but also communicate the needs and priorities of the community members to FONAG, making them intrinsic mediators in the *páramo* restoration process [SFCL-To_d]. The *guardapáramos* are elected in the local assembly[35] by fellow community members and therefore enjoy trust within their communities. Not least, because they are seen as highly educated in páramo restoration processes:

"FONAG has trained us [guardapáramos] a lot, for example, in the conservation of water resources, vegetation cover, on fires, first aid. These trainings have served us a lot to have knowledge and to develop further in our work." [OYA_GP]

Guardapáramos are the intermediaries that allow FONAG to influence the community's livelihoods through restoration activity, while at the same time securing trust and exchange between the communities and FONAG.

"We [guadapáramos] have always been involved in the decisions of the community and FONAG. And we have always been informing both, […] the community about projects that are planned and likewise FONAG about the decisions of the community. Thus, we are mediators." [OYA_GP]

[34] One of FONAG's conservation properties that is used as a research site and for environmental education.
[35] Rural Andean communities are typically governed by a local assembly with elected representatives who decide upon changes, including restoration activities and collaboration with organisaions such as FONAG.

4.2 Scale challenges and scale-sensitive governance response

The case study revealed four scale challenges in FONAG's efforts of reconciling landscape restoration with rural livelihoods. This section presents the four scale challenges and gives an example of each community to illustrate them. Further, the scale-sensitive governance responses by FONAG to overcome each challenge are presented, which ensures a coherent understanding of how FONAG adjusted its activities and strategies over time (see Table 7).

i. Election cycles mismatch with restoration timelines

Landscape restoration only starts showing ecological effects after at least 10 years of intervention [RWF_FONAG_a_2] and therefore needs to be backed by continuous long-term restoration policy. The election cycle of the municipal government of Quito, which staffs the public water utility EPMAPS, only amounts to four years. EPMAPS, in turn, is the most dominant member of FONAG's trust board that holds most decision power. Frequently changing leadership within EPMAPS was problematic in the past, because it caused instability and discontinuity within FONAG. This endangered FONAG's restoration activities in Andean communities and thereby the sustainability of *páramo* restoration in DMQ as a whole.

Example from municipal elections in 2009

An internal crisis in FONAG as aftermath of the 2009 municipal elections in Quito demonstrated that restoration activities needed to be resilient towards political change [NGO_FL_a_1]. Although FONAG's trust fund was legally established for 80 years, which safeguarded financial contributions to the fund by the constituents in the long run, restoration activities within this time were not automatically continued and expedient [RWF_FONAG_b_2]. That is, because restoration policy was mainly decided by EPMAPS and drastically changed over time.

Before 2009, one of FONAG's main foci in restoration was biodiversity conservation [RWF_FONAG_a_2]. The biodiversity focus was introduced by TNC, which was involved in the creation of FONAG right from the start [RI_KSU]. One of the largest initial projects was financed by USAID and targeted biodiversity conservation of the protected areas surrounding DMQ. FONAG's rural interventions did target communities with *páramo* territory adjacent to protected areas, but EPMAPS was not necessarily drawing water from those areas (Joslin & Jepson, 2018, p. 17). With time, however, the influence of TNC became weaker because it focused more on the creation of new water funds across Ecuador and Latin America. Instead, EPMAPS' shares in the trust and the corresponding influence became larger.

"During the history, the share of the water utility in the funding has always been increasing. At the beginning, the position of the water utility was not that dominating as it is today." [RWF_FONAG_b_2]

As a public municipal company, the election of a new municipal government usually also meant that management positions in EPMAPS were replaced [RWF_FONAG_b_2]. On top of that, the mayor of Quito even personally heads EPMAPS' governing board (Joslin & Jepson, 2018, p. 14). As a result, the 2009 municipal elections led to new leadership positions within EPMAPS, which drastically impaired the relationship between EPMAPS and FONAG [RWF_FONAG_a_2].

"When you have a good mayor [of the municipality of Quito], you have a good manager [at EPMAPS]. The mayor decides about the water company. And when you have a good manager [at EPMAPS], you have a very good relationship with FONAG. When you have a bad mayor, you have a bad manager [at EPMAPS], and you have a bad relationship [with FONAG]." [NGO_FL_a_2]

No.	Scale challenge	Description	Challenge type	Scale-sensitive governance response	Response type
i	Election cycles mismatch with restoration timelines	The short-term election cycles on municipal level on the governance scale mismatched with the inherently long-term restoration timelines on the ecological scale. The election of a new municipal government in Quito in 2009 caused instability between EPMAPS and FONAG; and ultimately endangered FONAG's restoration activities in Andean communities.	b) Temporal mismatch between the governance and ecological scale	Recognition within EPMAPS; ROI study	Institutional interplay
				Formalising agreements	iii. Scale-sensitive enabling/ co-management
				Local restoration agents	iii. Scale-sensitive enabling/ bridging organisation
				Advocating national water fund	iii. Scale-sensitive enabling
ii	Lack of consideration of short-term livelihood losses when starting long-term restoration processes	While FONAG recognised ecological restoration processes as long termed, it partly underestimated the long transition time from traditional Andean livelihood activities to alternative ones. This resulted in short-term livelihood losses for the communities, in particular for vulnerable groups. Lack of infrastructure investments as well as knowledge and capacity building further hampered livelihood changes.	a) Blind spot on the temporal dimension of the governance and ecological scale	Adaptation to local context	i. Scale-sensitive observing
				Focusing on vulnerable groups	i. / ii. Scale-sensitive observing and acting
				Diversify livelihood activities as resilience strategy	ii. Scale-sensitive acting
iii	Restoration intervention in the catchment displaces the ecological problem to another area	FONAG's restoration intervention displaced the ecological problem from the catchment to other areas, partly within the same and partly to other watersheds. Mitigating this was problematic, because FONAG's intervention areas were limited to priority catchments as defined by EPMAPS. With this limitation, negative impacts on other levels on the ecological scale could not be counteracted.	b) Spatial mismatch between the catchment level and other levels (watershed, ecosystem) on the ecological scale	External funding	iii. Scale-sensitive enabling
				Increase in constituents	iii. Scale-sensitive enabling

iv	Lack of consideration of upstream water needs while downstream water needs are targeted	While EPMAPS perceived urban water security as the most pressing issue, its actions lacked consideration for the water needs of rural communities. Extensive water extraction at watershed level threatened water availability and water-dependent rural livelihoods. Part of FONAG's restoration activities was an attempt to compensate this blind spot.	a) Blind spot of upstream water needs, while attempting to meet downstream water needs on the ecological scale	Hydrosocial diagnostic	i. Scale-sensitive observing/ brigding organisation
				Support rural water services	ii. Scale-sensitive acting/ brigding organisation

Table 7: Scale challenges and scale-sensitive governance responses identified in case study

The new staff of EPMAPS had serious doubts about FONAG's focus on biodiversity conservation as restoration strategy and questioned its usefulness for Quito's water resources [WU_EPMAPS]. As EPMAPS increased its contributions to the trust fund to 2% of its yearly profits, it demanded this money to be strictly invested in water resource protection. The CEO and environmental manager of EPMAPS did also not approve of FONAG as it was organised at the time and prompted a change of the technical secretary, which resulted in drastic personnel and programme changes within FONAG [NGO_FL_a_1; EC_AN_a_2]. FONAG reported that it needed to approach the environmental department of EPMAPS to justify not only the ecological value of its restoration activities for freshwater, but even its existence as a whole [RWF_FONAG_a_1; NGO_FL_a_1].

The following years between 2011 and 2014 were described as a time of political survival for FONAG, in which a time and resource consuming trust building process with EPMAPS was initiated. During that time, almost all community work was momentarily paused [EC_AN_a_2]. As EPMAPS demanded the strict re-organisation of FONAG's restoration activities in DMQ, they remembered this as a period of aligning interests and streamlining efforts for the protection of Quito's water sources [WU_EPMAPS]. For FONAG, however, the internal crisis and change of focus meant inability to continue with community interventions for at least some years. In some places, FONAG never continued its work afterwards [EC_AN_a_2].

"*Our community work was paused during those years, which means we were not present [in the field]. At that time the administration [of EPMAPS] was changing. There was a lot of instability and it was very complicated. […]."* [RWF_FONAG_b_2]

Upon re-structuring and aligning their missions, FONAG eventually stabilised itself in terms of EPMAPS' political support in 2016 [RWF_FONAG_b_2]. Since then, restoration interventions with communities resumed. However, it alarmingly portrayed that municipal elections and the associated change in EPMAPS' leadership can have far-reaching consequences for FONAG's ability to continue its work with communities.

Example from Community Oyacachi
FONAG's instability had a negative impact at community level. In Oyacachi, the internal restructuring of FONAG created discontinuity in restoration activities [OYA-Lo_c; RWF_FONAG_b_2]. The missing presence of FONAG, and the fact that no formal conservation agreement had existed at the time, unsettled the trust relationship with FONAG.

"[…] of course, some of them [FONAG] are interested [in restoration], but then they stopped. They were very sporadic, they only wanted to be present, but they did not want to leave anything behind." [OYA-Lo_c]

In the following years from 2011 to 2014, Oyacachi received little support in practical restoration activities in the field [EC_AN_a_1]. Although monitoring through *guardapáramos* and environmental education continued, activities with regards to alternative livelihoods were not further developed [RWF_FONAG_b_2]. This means, passive restoration in the *páramo* still continued, because *guardapáramos* continued their vigilance routes and relocated cattle that grazed close to the Salve Faccha dam. At the same time, the community was left alone during that time to develop tourism as an alternative.

To conclude, the example of 2009 shows that election cycles at municipal level mismatch with long-term restoration timelines. For FONAG, this meant political dependency on leadership

changes within EPMAPS every four years. In the past, EPMAPS prompted a shift from biodiversity targets to strict source water protection targets. For the communities, the restructuring of FONAG as a result of the municipal elections created instability in restoration activities for some years. This jeopardised the sustainability of landscape restoration efforts on the ground.

Scale-sensitive governance response

Since FONAG enjoyed more political stability from 2016 onwards, it noticeably concentrated on developing strategies to deal with the uncertainty associated with the municipal election cycles. Scale-sensitive action and enabling strategies include (1) strengthening FONAG's reputation within EPMAPS through a Return on Investment (ROI) study, (2) formalising conservation agreements with rural communities, (3) building local environmental awareness and (4) advocating a national water fund together with SENAGUA to safeguard water fund's *raison d'être* in Ecuador.

First, with regards to the four-year election cycle, and the associated consequences that this may imply for the management of EPMAPS, FONAG's strategy is the creation of good working relationships not only with EPMAPS' CEO and environmental manager, but also with technical staff in different departments.

"Now that the whole administration in EPMAPS has changed a few months ago, it causes [does not find words]. What we [FONAG] have done to mitigate that risk is to have a good cooperation with the water utility. To have a broader basis within the technical departments of EPMAPS." [RWF_FONAG_a_2]

To inform EPMAPS on the economic benefits of restoration and conservation, FONAG conducted the ROI study in 2018 [NGO_FL_a_1]. The objective of the study was to value the financial and economic benefits resulting from the restoration and conservation efforts of FONAG in one of its intervention basins, the El Cinto river basin (Lascano, 2018, p. 2). The results indicate that for every dollar that is invested in actions for the sustainable management and protection of El Cinto, about USD 2.15 are generated (Lascano, 2018, p. 79). The ROI study therefore serves as *raison d'être* for FONAG [NGO_FL_a_1]. The financial viability of restoration was meant to convince future management staff at EPMAPS in a new election cycle. For them, water extraction and treatment are more costly in the long run, if *páramo* is degraded. This is a strategy of institutional interplay in which FONAG safeguards a continuous cooperation between EPMAPS and FONAG in the future by showing that the benefits of restoration exceed the costs.

"I think the way to mitigate that is to make a strong relationship. Today, we are lucky to have this strength. That makes it difficult for a new manager to come into EPMAPS and say 'FONAG is rubbish'. Our basis is sufficiently wide for someone to say 'FONAG is a recognised institution'. That is […] our most important capital." [RWF_FONAG_a_2]

Second, when the internal crisis after the 2009 election forced FONAG to pause much of its community work, it was recognised that the formalisation of agreements with community members is an important strategy. Not only do formal agreements safeguard long-term intervention of at least 10 years, but they also give security to the communities that investment will not simply stop from one day to another. Instead, they go beyond short-term local election cycles. By formalising agreements, FONAG uses a scale-sensitive enabling strategy (type c) in which responsibilities between restoration actors and the community are blurred. At the same time, this can be classified

as co-management. Ultimately, FONAG promotes a governance approach in which co-management of the landscape means that the community and restoration practitioners assume ownership.

"[…] the projects with FONAG before were more informal. In [a community] where FONAG carried out activities of […] restoration, the transition of authorities of FONAG led to an end of intervention. […] FONAG did not come back. This taught FONAG to formalise. […] They [FONAG] learned that an agreement must be a binding part signed between the two parties, because the people [community] should not be affected by [political] changes. [EC_AN_a_2]

Third, FONAG strongly emphasises a slow negotiation process with the community, to establish trust and an informed basis for intervention [RWF_FONAG_b_2]. Thereby, the locally contracted *guardapáramo* plays an important part in the negotiation process. In San Francisco de Cruz Loma, FONAG focused on the collaboration with all community members who developed a strong affinity with restoring their environment. This led to a situation where not only the contracted *guardapáramo* felt responsible for the protection of the *páramo*, but the whole community did [SFCL-To_c]. The high level of environmental awareness among the community made them feel like guardians of the *páramo* themselves [SFCL-To_c]. This can be classified as a scale-sensitive enabling strategy (type c) where blurred responsibilities are at the heart of restoration. Moreover, FONAG acts as a bridging organisation since it is the connecting point between the g*uardapáramo,* EPMAPS and the rest of the community members. FONAG facilitates exchange between the different actors, most prominently through the *guardapáramos*. Creating agency among the community bridges the mismatch between short-term election cycles, because an environmentally conscious mentality which is reflected in the livelihood activities of the community members secures sustainability bottom-up.

"We feel not just proud, but happy to see the people [in Quito] have their water, […] a vital resource. We are happy that our children have good water to drink. […] The change is happening, we are removing the animals; we are banning them from water sources; EPMAPS will not have to spend a lot of money on making it drinkable. […] we [the community] feel happy to say 'we have produced more water'. [SFCL-GP]

Lastly, FONAG supports SENAGUA in the development and conceptualisation of a nation-wide water fund [SI_SENAGUA]. The idea is that water for human consumption remains free of charge, as water is considered a state resource, however when water is used for irrigation or extensive industrial use, a fee to SENAGUA becomes payable, which contributes to a national water fund [SI_SENAGUA]. This fund would ideally distribute the return of the trust towards the regional water funds. Although the idea is still in the early stages of development, FONAG promotes this approach. Funding provided by a national water fund would be resistant towards electoral cycles on the municipal level and pave the way for continuous execution of long-term (national) restoration policy. Promoting a national water fund is a scale-sensitive enabling strategy (type b), because FONAG advocates water funds to be flexible institutions that are set up on the level where they can best create fit between different levels of governance while being resistant to political change. The idea emerged after years of observing that many water funds face similar challenges of instability connected to electoral cycles. A national water fund thus is an enabling strategy to overcome this reoccurring challenge.

ii. Lack of consideration of short-term livelihood losses when starting long-term restoration processes

In Andean communities, FONAG's main strategy was to strengthen *páramo*-friendly alternative livelihoods through community tourism[36], improved dairy farming[37], household subsistence farming[38] or small animal breeding[39] in exchange for strict restoration activities in mutually agreed areas. While FONAG recognised that the ecological recovery of degraded *páramo* takes at least 10 years of restoration intervention, it partly underestimated the long transition time to go from traditional Andean livelihood activities[40] to alternative ones. In both cases, the communities had to deal with short-term livelihood losses, until the benefits of alternative livelihoods could be felt. Apart from the fact that customs and traditions were one reason that hampered the transition process, especially infrastructure investments as well as knowledge and capacity building were lacking in the communities to guarantee a quick change to alternative livelihoods. The result were situations in which families were dependent on, and had to search for, multiple alternative livelihoods to bridge the transition phase and maintain family income. Moreover, vulnerable groups of the communities, such as elderly or people without a university degree felt less prepared for the livelihood changes and were therefore disadvantaged.

Example from Community Oyacachi

In the Oyacachi community, the investments in tourism were insufficient in the first three years after the conservation agreement was signed, which exerted pressure on the rural livelihoods. In the past, the community's main traditional livelihood used to be pastoral agriculture in the high parts of the *páramo*, but also timber logging of the nearby cloud forest for the construction of wooden houses and handicrafts. Dairy farming used to be a minor subsistence livelihood activity. FONAG entered the community in 2006 and identified an already existing transition trend towards community tourism. This was a result of the construction of natural thermal pools by the community with the help of other NGOs [OYA-Lo_c]. With the signing of the conservation agreement, FONAG committed to strengthening community tourism with the aim of increasing the income generated by the community and reduce livelihood-related pressure from the *páramo*.

To that end, FONAG invested USD 70.000 per year from 2018-2020 in community tourism by supporting family-owned restaurants in the drafting of a more tourist-friendly menu, held workshops about attending clients in gastronomy, constructed a hiking path to a waterfall, installed signposts for tourist orientation, and hired a consultant specialised in community tourism [RWF_FONAG_b_2]. Although many community members mentioned that those activities strengthened community tourism as an alternative livelihood, others argued that the investments were insufficient [OYA-Lo_c].

[36] Community tourism includes livelihood activities such as gastronomy, guided hikes or horse rides through the community territory, producing and selling of handicrafts as well as farming of small animals for consumption by tourists.

[37] Dairy production already existed before in both communities, but it was executed in an inefficient way. Dairy production improved because of (1) more suitable cattle breeds that give a higher number of litres of milk per day, (2) the cultivation of more nourishing pasture and (3) the relocation of the cows from the *páramo* to lower laying areas.

[38] Subsistence farming refers to ecological vegetable gardens that sustain each family with food for daily use. Only excess products are sold to other families or local markets. In the past, the large-scale cultivation of crops was often associated with the use of agro-chemicals [SFCL-To_c].

[39] Examples are guinea pigs and chicken; more rarely pigs or llamas.

[40] Traditional Andean livelihood activities include cattle farming as well as agriculture in the *páramo*, often accompanied by harming land use practices such as burning of shrub.

After three years of concrete investments in 2018, 2019 and 2020, income from tourism was not guaranteed for all families. This is problematic, as almost all families significantly reduced the amount of cattle held in the *páramo*, and therefore needed an alternative. Some families revealed that the change felt like an economic and cultural sacrifice for them.

"Because of Salve Faccha they have always told us to remove the cattle; now it is not so much of a problem anymore, but before it was a big problem. But for them [FONAG] to tell us to remove the cattle [from the páramo], knowing very well what the cattle is worth […] it is for food, for education. It [prohibiting] is like taking money out of our pocket, taking away our work, tying our hands […]." [OYA-Lo_c]

The community members specifically disclosed five challenges related to (1) infrastructure, (2) income, (3) capacity building (4) customs and traditions and (5) differing starting conditions. First, adequate infrastructure for community tourism was largely missing. For example, some families wanted to construct family hostels to move away from day-trip tourism. However, the houses in Oyacachi were not equipped with warm water facilities which would guarantee a level of comfort needed for tourists to stay overnight [OYA-To_a]. Creating and maintaining such infrastructure is a long-term process, and the number of tourists interested in visiting Oyacachi depend on them.

Second, the respondents in Oyacachi highlighted that at the time of the research, only about 30% of the community directly benefit from tourism as reflected in their income [OYA-To_a; NGO_FEPTCE_a_1]. This means, 30% of the community can live from tourism as their main livelihood, because they are directly paid as tourist guides, ticket sellers or maintenance workers. In retrospective, this also means that about 70% of the community are dependent on multiple alternative livelihoods, such as dairy farming, handicrafts, trout farming or other businesses to sustain themselves. Despite the dependence on different alternatives, FONAG mainly focused its support on tourism.

"In my family we are working in four sources of economic income: I work in tourism and my sister works in a restaurant; other family members work in trout farming, livestock and handicrafts." [OYA-To_b].

Additionally, many community members developed a strong feeling of water injustice. They recognised that they protected the *páramo* which delivered ecosystem services to downstream populations. In return, they asked for more compensation by FONAG, financially as well as in-kind, that would generate more visitors and increase tourism to bridge the transition phase.

"[…] all the help of FONAG has not been enough […] if they really want to remove all the cattle, they should think about making an investment of USD 1.000.000 or USD 2.000.000 […] that would provide work for 100 to 150 people." [OYA-Le_a]

Third, community members were in need for more capacity building. Although one of FONAG's main strategies was the transfer of knowledge through workshops[41], many capacities were still lacking. For example, almost no community member working in tourism spoke English, although many saw it as a central skill and wished to learn it. Moreover, the community criticised that a large part of the budget that FONAG invested in 2019 was spent on technicians from Quito who

[41] Community members mentioned that FONAG held workshops for attending tourists, changing to tourist-friendly menus and guiding tourists.

came to Oyacachi temporarily to work on the safety provisions of hanging bridges and hiking paths around a waterfall [OYA-To_a]. Almost all interviewed community members expressed that too much money was spent on technicians who were unaware of the local reality, and that they would prefer FONAG to contract locals [OYA-To_c]. In fact, community members were unhappy with the result of the safety provisions and convinced that they would have gotten the job done better [OYA-To_a]. Contracting local community members was a decisive trust factor for the community.

"[…] we live here, and we know much better; some technicians are from elsewhere and do not know the reality. For us it is necessary […] more than anything […] that they hire people from here. We have professionals in the community itself." [OYA-Le_a]

Fourth, customs and traditions, which are inherently dominant in indigenous communities, may hamper the transition process between livelihoods. An example is the attempt by FONAG to reform the responsibilities in the tourist office in Oyacachi. FONAG aimed at establishing working groups with according group leaders [OYA-To_c; NGO_FEPTCE_a_1]. The coordinator of all group leaders was chosen by FONAG to be a local woman [OYA-To_c]. Unfortunately, the other male applicants did not accept the selection and exerted pressure to disown the coordinator from her position [OYA-Lo_b]. Although FONAG stressed the importance of women's participation as also agreed in the conservation agreement, it underestimated the rigidity of change under the customs and traditions of a male dominated indigenous community [RWF_FONAG_b_2; FONAG, 2018].

Fifth, difficulties in the transition phase included that different members of the community started off under different conditions. That is to say, elderly felt less prepared for the changes that FONAG 's intervention entailed than younger people [OYA-To_a]. Moreover, community members who did not enjoy university education felt disadvantaged in their starting condition and wished for more support in the transitioning of their livelihood [OYA-Lo_a]. This accounted for tourism just as much as it did for dairy farming, trout farming or other activities.

"Some people are more prepared, they say 'we must have cattle that gives up to 10 litres', but some of us have small cattle that give 4, 5, 6 or 3 litres. You have to sell those [cattle], then change the grass they eat […]. They are people who are already prepared, who are tourist guides and who trained at universities […]." [OYA-Lo_a]

Example from Community San Francisco de Cruz Loma

The community San Francisco de Cruz Loma is located outside of Quito, on top of the valley. With the land reform starting in 1948, the San Francisco neighbourhood was formally established as a *hacienda* with initially 32 parceled landowners. From the city up to the Pichincha volcano, each landowner received an urban zone, an agricultural zone as well as a large part of the *páramo* [SFCL-Le_b]. Their traditional livelihoods aligned with the tripartite division of the territory. Accordingly, the landowners lived in the urban zone closer to the city, cultivated traditional crops[42] and produced dairy in the agricultural zone, and held cattle in the *páramo* as a family insurance. The products were directly sold at local markets in Quito [SFCL-Le_a]. Community members mentioned that economically speaking, pastoral agriculture and large-scale agriculture used to be the predominant livelihoods. Because of market pressures and insect plagues, however, profits sank about 20 years ago and the community lost large parts of their agricultural livelihood [SFCL-To_b]. Only cattle held in the upper part of the territory was left. However, a municipal ordenance in

[42] Examples are potato, onion, carrot, maize, and many other crops.

2012 established that all territory above 3.800 MASL, to which the majority of the *páramo* belonged, was henceforth recognised as natural patrimony [SFCL-Le_b]. This entailed the strict prohibition of use for productive activities, including pastoral agriculture. As a consequence, the community members sold their livestock and lost large parts of their second livelihood, for which they have not been compensated by DMQ [SFCL-To_d].

Even before FONAG entered the community, the families created ASOCRUZLOMA, an association that focused on establishing community tourism. The construction of the *Teleférico de Quito* in 2005, a cable car transporting tourists from the Quito city center to the *páramo* and volcano Pichincha, was the turning point for new livelihood opportunities. Community members used this opportunity and offered guided horse riding for tourists. They also prepared lunch in a community restaurant next to the cable car on weekends.

Yet, income levels from horse tours and selling lunch were not sufficient in order to account as the main source of income for everyone. FONAG entered the community in 2015 and signed a conservation agreement with them in 2017. Therein, FONAG committed to invest USD 5.000 for a duration of 3 years to support activities that enhance and improve tourism with the aim of securing a livelihood for future generations and avert migration to Quito.

The respondents revealed that about 70% of the community directly benefitted from tourism, either through gastronomy or through horse riding [SFCL-Le_a]. Many argued that although there was still room for improvement, their economic situation has improved by a lot ever since they changed to tourism [SFCL-Le_b]. The majority of the community members therefore saw their future livelihoods in community tourism.

"We have to be realistic; tourism is what really supports us. We do have our vegetable gardens for the family's expenses, but it is not much money. A lettuce sells for 50 cents if it is big, if it is small 25 cents, a broccoli 50 cents, so it is not much. Our alternative is tourism." [SFCL-To_c]

As almost no family was able to sustain themselves from community tourism alone, they saw the necessity to diversify income sources in the transition phase from traditional to alternative livelihoods [SFCL-Lo_b]. Generally, these alternatives did not push families to fall back into harming land-use practices because livestock rearing was forbidden in the biggest part of their territory and agriculture was not profitable. Most families found themselves in a situation where the family father started working in waste collection for the Quito municipality. The rest of the family dedicated itself to horse guiding throughout the whole week, gastronomy in the weekends, as well as their vegetable gardens for family subsistence on the side.

"My husband works in waste collection [in Quito]. There is a saying that goes 'in life you have to wash your face with both hands to be clean'. With my husband's works alone, we do not have enough money. I support him with the work here in the [tourism] association […]. It is not the world, but it is a great support because I provide the food for the household. With what my husband earns, we pay for [our children's] studies. [SFCL-To_c].

The most important infrastructure for tourism in San Francisco de Cruz Loma was the Teleférico de Quito. Although the community members were worried about the risks associated with a private company owning and operating the cable car [SFCL-GP], infrastructure turned out to be a decisive success factor to enable tourism, similarly to Oyacachi. Community members also acknowledged that smaller infrastructure contributions by FONAG, such as the construction of a

communal kitchen, a roofed restaurant hut or the putting up of signposts fundamentally increased the professional appearance in the eyes of tourists [SFCL-GP; SFCL-Lo_b]. In addition, community members benefitted from capacity building through workshops, which was one of FONAG's main activities. For example, FONAG provided the community with workshops about hospitality, about the *páramo* as an ecosystem, but also about how the landscape can be used in favour for tourism [SFCL-To_a]. This manifested in the setting up of different hiking routes around the Pichincha volcano for tourists after the workshop.

In general, San Francisco de Cruz Loma had favourable starting conditions in changing their livelihood towards tourism. That is, the access infrastructure for tourists, namely the cable car, already existed when they started the change. Not to forget, the geographic location in proximity to the city of Quito enabled many visitors right from the start. Finally, as a mestizo community, San Francisco de Cruz Loma showed much interest and flexibility with regards to changes in general. Their customs and traditions did not appear to hamper or contradict FONAG's livelihood interventions connected to restoration. Quite the opposite, they welcomed new opportunities, and showed high levels of trust towards FONAG.

"We know that we will do well [in the future] because today, we trust FONAG with our eyes closed." [SFCL-GP]

To conclude, both cases demonstrated that FONAG underestimated the short-term livelihood losses that communities encountered when changing to sustainable livelihood activities. The communities highlighted the importance of both, infrastructure as well as capacity building, to develop tourism into the main livelihood activity for all. The financial investment that FONAG could stem at the time was partly insufficient to cater for those needs. Moreover, the community's customs and traditions may hamper success just as much as different levels of individual's readiness for livelihood change. However, the two cases also showed that the conditions under which communities start the change significantly impact the livelihood and restoration success. While for community members in Oyacachi limited alternatives favoured the danger to fall back into harmful land use practices, this could not be observed for the community San Francisco de Cruz Loma.

Scale-sensitive governance response

In both case studies, the transition from traditional pastoral agriculture to more ecosystem-friendly livelihoods was supported by FONAG under the framework of a conservation agreement. After years of experience with communities, FONAG understood that the transition from one livelihood to another may create short-term economic losses, especially for those who are less prepared or more vulnerable. To mitigate this, FONAG responded by (1) adapting its intervention activities to the local context and needs, (2) focusing particularly on the inclusion of vulnerable groups and (3) enabling resilience to income fluctuations by promoting multiple livelihood activities.

FONAG highlighted that they had learned over time that the context in each community is so different, that intervention activities need to be adapted to each individual case [RWF_FONAG_a_2]. At the bottom of this is active listening to the problems, needs and conflicts of the community, in order to observe what livelihood alternatives can be strengthened and have future perspective. This can be classified as a scale-sensitive observing strategy (type b and c), in which FONAG identified cross-level issues during scale framing (i.e. usually at the start of an intervention when problems are defined and analysed) to guarantee that the activities actually benefit local actors and

generate a positive impact for the community. For example, in San Francisco de Cruz Loma, the community was exposed to a malfunctioning rural water supply system, which enormously burdened the community. The community members faced difficulties investing in tourism, if the water they sourced for gastronomy and sanitation was not guaranteed at all times. FONAG observed this and thereupon prioritised the rural water supply system in its intervention, before focusing on the support of community tourism.

"It is true that they [FONAG] came first with the intention to support the tourism sector. But we [the community] explained the needs of the sector and they decided to support us with basic services first, because a sector without basic services is practically useless. Imagine what good it is if we want to undertake tourism without access to water, or gastronomy, without quality of water. That is why we first prioritised what the neighbourhood needed." [SFCL-Le_a]

In Oyacachi, FONAG observed the need for more organisation in the tourism sector and therefore promoted the official establishment of a tourism office led my community members, which was to be registered with the Ministry of Tourism in Ecuador. Having an officially registered office gave the community members the chance to appear in official promotional material by the government and moreover enabled self-organised ownership of touristic activity by the community. FONAG is well aware that scale-sensitive observing and consequently adapting its activities may secure basic needs of the communities, which is the foundation for thriving livelihoods. Especially, because changing from traditional livelihoods to alternative ones sometimes requires more water use, such as washing of plates and preparing of dishes in tourist restaurants.

"Our [FONAG] focus […] has been to listen well to the community. They need to win, and we have to listen carefully to be sure that it [cooperation with FONAG] is really a win for them. […] That is also why we have a diversified portfolio. It was not our idea, which is a shame I think, to work on the rural water supply system, but it happened through listening." [RWF_FONAG_a_2]

Second, in both communities, FONAG particularly focused on the inclusion of vulnerable groups within the community to leave no one behind. This is a scale-sensitive action strategy (type a) answering to inequity in the starting condition of community members based on scale-sensitive observing (type a). FONAG identified disadvantages for vulnerable groups within the communities and attempted to decouple the target levels within the community to strengthen those community members, who were disadvantaged when changing livelihoods. In the rather traditional Oyacachi community, this unfolded through the promotion of women in leadership positions in community tourism [RWF_FONAG_b_2]. Although the division of traditional gender-based roles continues to be a problem, FONAG insisted to incorporate a clause in the conservation agreement which secures the participation of women in decision processes and livelihood activities. Although with regards to leadership roles, progress appears rather moderate, the restaurants in Oyacachi are almost solely led by women. In San Francisco de Cruz Loma, the tourism association enables participation of elderly and people with disabilities [SFCL-GP].

"They are elderly people, they are not going to get a job in the city, not even as dishwashers. Here, they work side by side with everybody else [in tourism]. We mixed groups of young, elderly and disabled people to work together, to balance their abilities." [SFCL-GP]

The association defines three working groups that work in turns on weekends in food preparation for tourists. Those with less physical strength are given the freedom for replacement, in case they feel unable to attend for their shift.

"The physical capacity they [vulnerable people] have for the activity, is taken into account a lot. For example, if it is my mum's turn to sell on Saturdays, she might be okay, but on Sunday she usually cannot proceed anymore. […] *the elderly have the right to have a person, be it their daughters or granddaughters, to help them, as long as someone takes the shift."* [SFCL-Le_b].

Third, to mitigate short-term livelihood losses provoked by income fluctuations in the transition phase from one livelihood to another, FONAG expressed that focusing on multiple alternative livelihoods can be beneficial [RWF_FONAG_a_2]. That is to say, if one livelihood is either not developed enough to generate much income, or threatened by external influences, the community members will still be able to sustain themselves with other activities. This can be classified as a scale-sensitive action strategy (type c), in which FONAG addresses bridging the long transition phase between livelihoods. Although FONAG expressed this idea repeatedly, investments in other activities are still marginal and the main focus remains to be tourism.

iii. Restoration intervention in the catchment displaces the ecological problem to other areas

FONAG's restoration mandate was tightly coupled to its mission: to protect the water basins that supply water to the Metropolitan District of Quito [RWF_FONAG_a_2]. More specifically, FONAG focused its activities on the *páramo* surrounding catchments that EPMAPS sourced water from. Thereby, a lack of landscape thinking led to situations where restoration activity in the catchment displaced the ecological problem to other areas; partly to areas within the same watershed (see example Oyacachi) and partly to areas laying outside of EPMAPS' working watersheds (see example San Francisco de Cruz Loma). Because of FONAG's lacking mandate to operate outside of *páramo* areas within EPMAPS' priority watersheds, dealing with this displacement effect was problematic. The reason for this inflexibility was EPMAPS' dominant share of 87% in the fiduciary trust and the associated decision power related to intervention locations and restoration strategies.

Example from Community Oyacachi

In the case of Oyacachi, the community's territory included large parts of *páramo* around EPMAPS' catchments, the populated valley, as well as a large cloud forest part in lower laying areas. FONAG only intervened in the high part of the *páramo* at about 3500 MASL. The reason for this was that only the *páramo* of the Oyacachi community was considered priority intervention area by FONAG's six constituents, of whom EPMAPS had the dominant decision-making power.

The majority of community members stated that apart from livelihood activities in the populated area, they also sourced wood from the lower-lying cloud forest to build wooden houses, tourist attractions such as hanging bridges, and handicrafts [OYA-To_a]. Almost all families owned a workshop behind their houses, where they processed the logged wood. The conservation agreement that FONAG signed with Oyacachi encompassed an area of *páramo* around EPMAPS' catchments, which was dedicated to strict conservation. The lower residential part of the area was designated for sustainable land use. This was where community members farmed trout and produced dairy, but also where they offered activities for tourists, such as bathing in hot spring thermal pools and hikes [RWF_FONAG_b_1; OYA-Lo_c]. The cloud forest area of the community (see green forest areas next to location of community on the right in Figure 8), in turn, was not included in the conservation agreement (see light green conservation area in Figure 9). Although it was located inside the same working watershed, it was too far from EPMAPS' catchments. Therefore, FONAG had no mandate for restoration activities in the cloud forest.

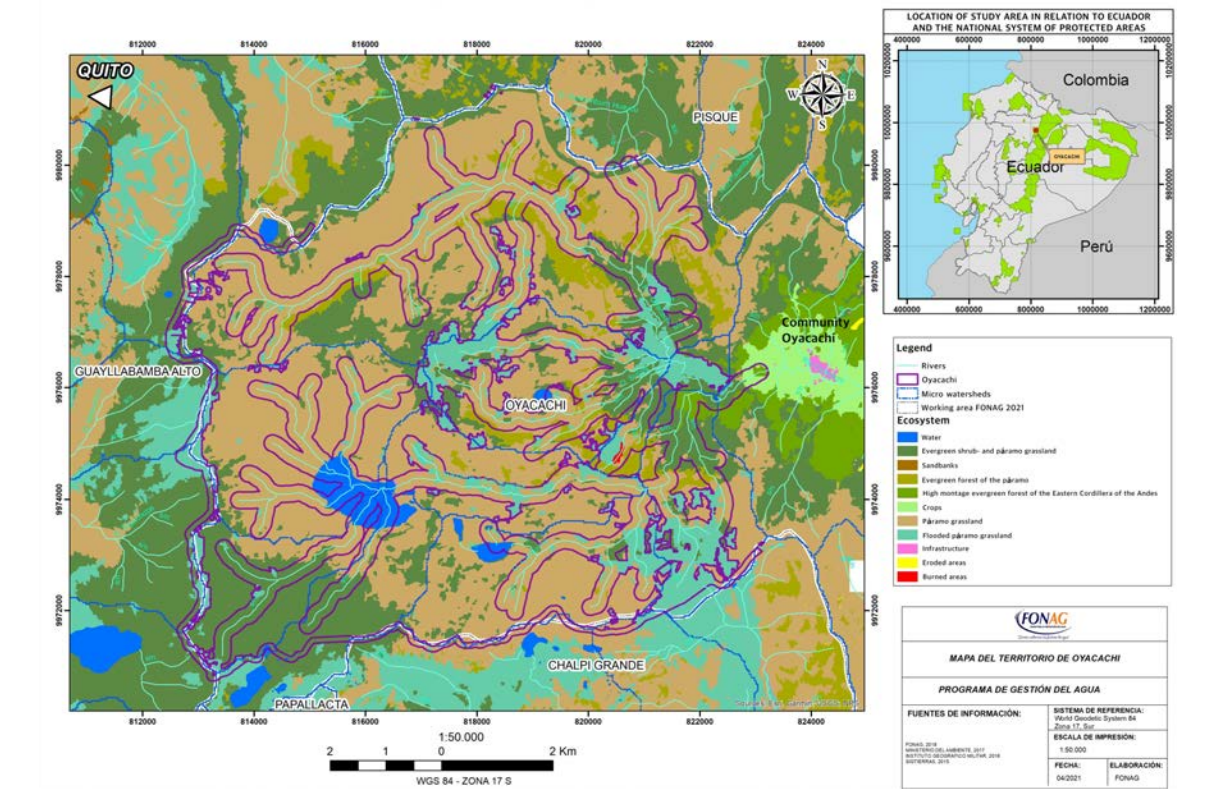


Figure 8: Oyacachi territory, populated area and vegetation cover
Source: elaborated by author with geographical data from FONAG

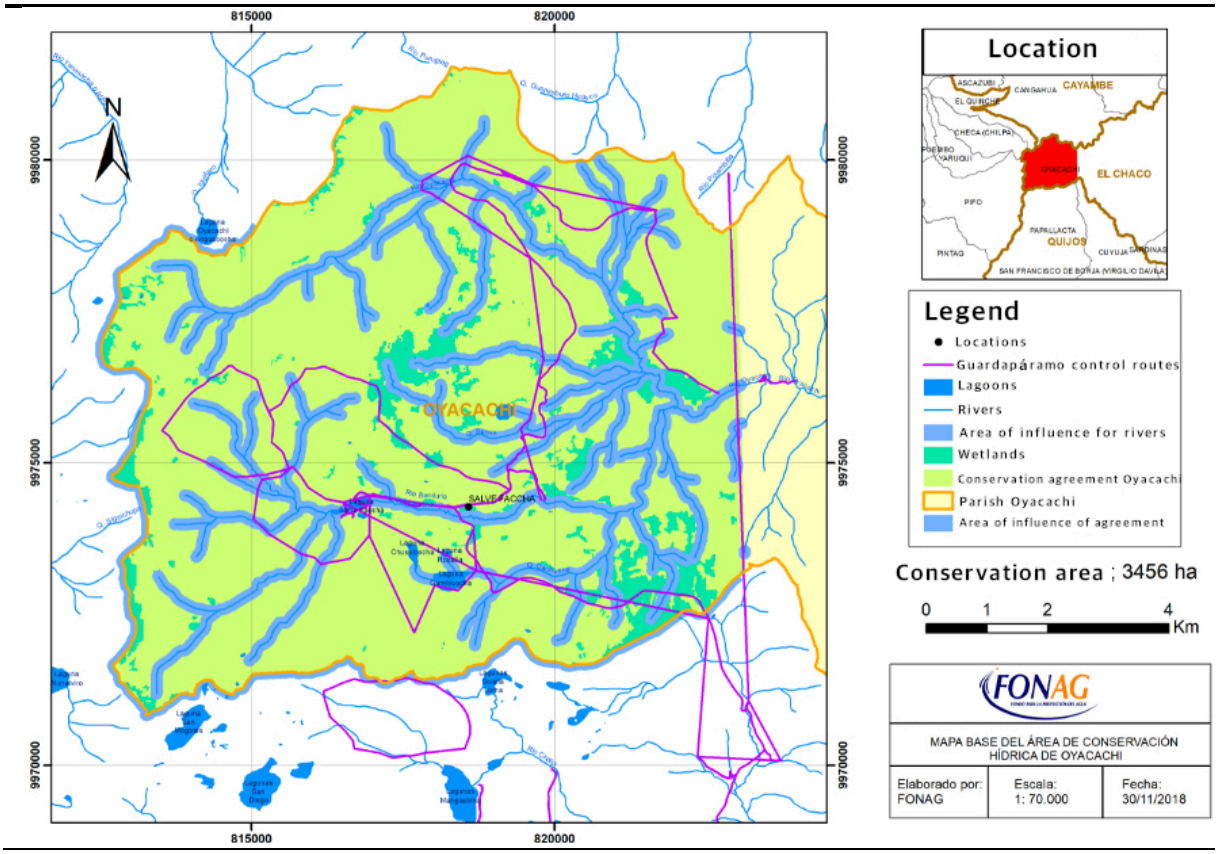


Figure 9: Oyacachi area of conservation agreement does not incorporate most of cloud forest area
Source: FONAG, 2018, p. 7

[…] we are completely focused on the páramo part of Oyacachi, although they have a big cloud-forest part […]. They have some serious deforestation issues there. Right now, we are thinking about what to do there. […] We cannot go too far from our mission. […] The mission is conservation of the water sources for Quito. That completely justifies that we work in the páramos of Oyacachi and with the community of Oyacachi. […] in the lower part of Oyacachi it becomes tricky. If it would be only with own funding, we would not be able to do anything probably." [RWF_FONAG_a_2]

Logging was already a problem before, because community members used wood to build their houses and heat. However, since handcrafting was recognised as a livelihood to bridge the transition phase from traditional to alternative livelihoods, even more logging could be expected. A communal handcraft shop built by FONAG encouraged the families to produce more wooden products and sell them jointly to tourists.

Also other tourist attractions, such as hanging bridges, were built with local wood by the community themselves. That is to say, even if the elimination of pastoral agriculture in the high *páramo* led to healthier water sources at catchment level, the human pressures of livelihood activities were displaced to the cloud forest. The lack of mandate for FONAG to work in the cloud forest of Oyacachi hampered FONAG's ability to mitigate this.

At the heart of the problem lays the fact that EPMAPS holds a share of 87% of the fiduciary trust [NGO_FL_a_1; RWF_FONAG_a_2]. Defining intervention areas, as all other important decisions, were taken by the trust board. The weight of the decision power in the trust board was determined by the shares in the trust. Henceforth, EPMAPS had the biggest power in decision-making:

"[…] if it really comes down to critical decisions, then the weight is all the way in the hands of the drinking water company." [RWF_FONAG_a_1]

As a result, although EPMAPS defined entire priority watersheds, and one would expect restoration to be executed at watershed level, in reality it turned out that FONAG only acted in high laying *páramo* catchments that were critical for water extraction and that hence entailed a financial benefit[43] for EPMAPS [RWF_FONAG_d] (see Figure 10). Restoration in the lower laying cloud forest part, although part of the same catchment, was ignored.

Example from Community San Francisco de Cruz Loma

In the case of San Francisco de Cruz Loma, efforts of FONAG to reduce motocross sports in the *páramo* of the community displaced the problem of associated degradation to Cayambe, and potentially also other areas. The conflict between the community and motocross drivers became apparent during the hydrosocial diagnostic [SFCL-Lo_b]. The disgnostic is a scale-sensitive observing tool. Reportedly, motocross drivers frequently came to the territory of San Francisco de Cruz Loma to use the open territory for adventure sports. In the process, they often destroyed fences and the motocross wheels highly damaged *páramo* vegetation and soil. What is more, they were disrespectful towards the community members and scared the community's animals with the motor noise [SFCL-Le_b].

[43] Financial benefit for EPMAPS occurs if the restoration activity increases water quantity, because more water can be extracted from one catchment which avoids costly expansion. Likewise, financial benefit occurs with increased water quality, because EPMAPS averts costly water treatment procedures downstream.

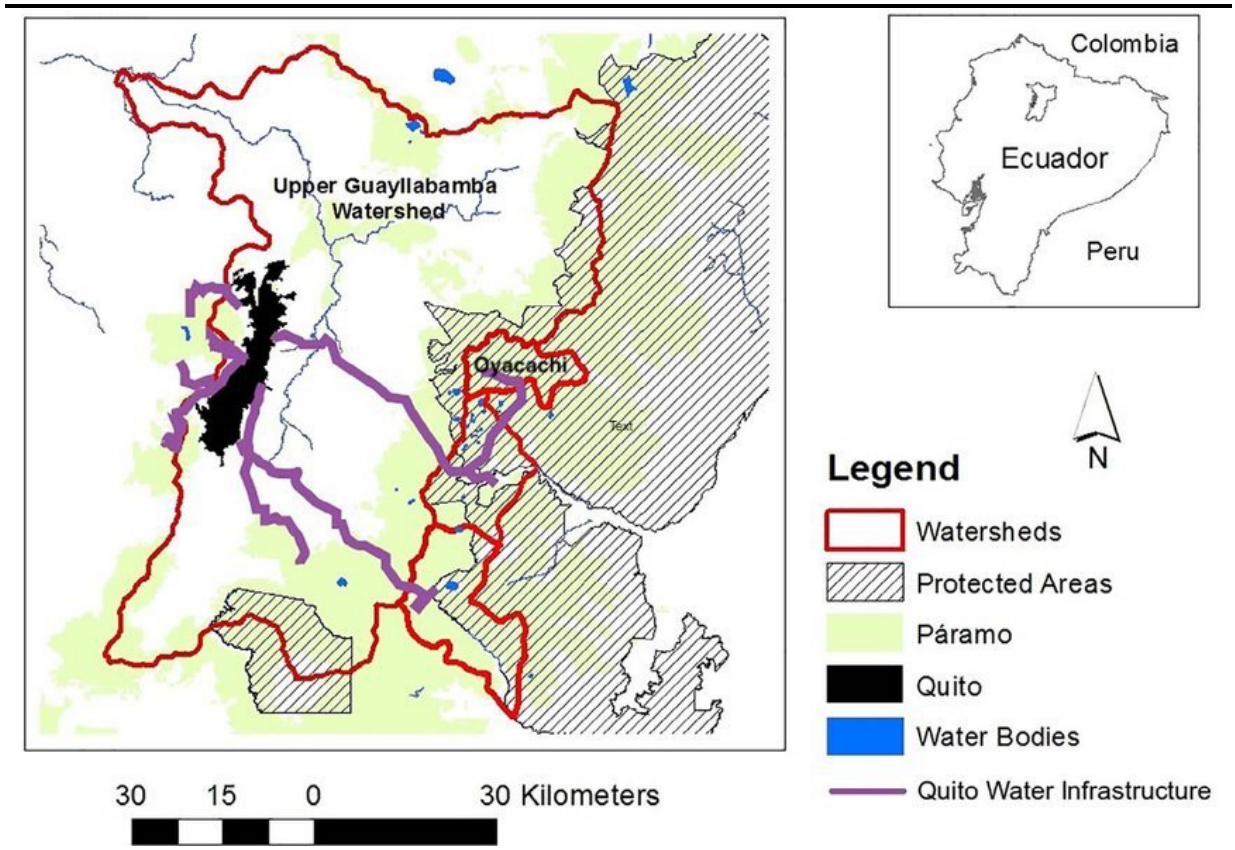


Figure 10: EPMAPS' water infrastructure, FONAG's intervention boundaries and protected areas in 2012
Source: Adapted from Joslin & Jepson, 2018, p. 15

To help the community solve the issue, FONAG intervened in various ways. First, they hired a local community member as *guardapáramo* who monitored the territory daily following different routes. When encountering motocross drivers, the *guardapáramo* confronted and expelled them [SFCL-GP]. Second, FONAG donated a gate to shield the *páramo* area of the community from motocross drivers. That way, the domestic animals were protected and one road from the Quito city center to the *páramo* was blocked [SFCL-Lo_a]. The measures were seen as successful for San Francisco de Cruz Loma, as nowadays, the motocross problem has almost entirely vanished.

"A lot of work has been done regarding this issue, and thanks to God, […] we managed to reduce the number of motocross drastically to almost zero." [SFCL-GP]

Although the motocross pressure has been reduced in the territory of San Francisco de Cruz Loma, it is unlikely that the drivers refrain from exercising the sport completely. As a result, the *páramo* might be destroyed somewhere else, and if the area happens to be outside of EPMAPS' priority watersheds, the ecological damage will most likely be the same. FONAG reflected on this and is aware of the risk of simply displacing the spatial issue to another watershed or ecosystem.

"I feel that we have shifted motocross to other areas. Surely the drivers do not stop doing it just because they cannot do it here anymore. We have already felt that for example in the Cayambe area, there is much more motocross than there was. […] this is a pressure that we shifted [spatially] and we are aware that this is happening." [RWF_FONAG_b_3]

To conclude, both cases showed that restoration intervention bears the risk of displacing an ecological problem from one place to another. It became apparent that in both examples, a landscape

approach, as opposed to a catchment or watershed approach, could have positively affected the situation. However, the cases would have required a landscape approach of different order: while in Oyacachi, the problem was displaced within the same watershed from high to low-lying areas, the motocross was displaced from San Francisco de Cruz Loma (canton Lloa) to the area of the canton Cayambe. The reason why FONAG was unable to counteract the displacement of the ecological problem was that its restoration mandate was strictly coupled to the geographical catchments that EPMAPS extracted water from. As long as restoration actors neglect possible negative effects on other levels on the ecological scale, restoration intervention continues to bear the risk of transferring the problem to somewhere else.

Scale-sensitive governance response

Although FONAG is aware of the limitations and challenges that its strict mandate entails, is has developed strategies of scale-sensitive enabling which allow for a broadening of the mandate by addressing different levels on the ecological scale. They do this by (1) attracting external funding, and (2) recruiting new constituents. While the first enabling strategy could partly be observed in Oyacachi, apart from this both enabling strategies were rather general observations.

To also work outside of places where FONAG is mandated to do so by EPMAPS, FONAG attracts external funding, which may be used independently from the trust board's conditions. This enables FONAG to become a flexible institution which can create and recreate fit in situations where the current government arrangement finds its limits. Attracting external funding is a scale-sensitive enabling strategy (type b), because it creates future possibilities to tackle issues on the ecological scale from multiple governance levels. In 2019, external funding accounted for about 22% to 23% of FONAG's yearly budget, which amounted to USD 560.000 of a total budget of USD 1.700.000 [RWF_FONAG_a_2]. The external donors were PROAmazonía, General Motors, TNC and Tesalia, whereby PROAmazonía provided the highest contributions [RWF_FONAG_a_2]. This money may be spent according to the conditions agreed with the external donors, but regardless of EPMAPS' priority intervention areas. FONAG disclosed that they aim to increase external funding in order to act more independently from its mandate in degraded areas that are currently not within their intervention area.

"[…] with PROAmazonía funding, we will move a little bit more down [to the cloud forest] in Oyacachi than we did before. We can always do more if it is with external funding. And if it becomes stronger, at some point, it might be possible to change things in the [constituent] contract [between FONAG and EPMAPS]." [RWF_FONAG_a_2]

Another example of FONAG's efforts to increase external funding is the corporate water footprint. It is a completely new activity in FONAG's portfolio with the aim to compensate water footprints of private companies in DMQ with restoration activities in the *páramo*. In September 2019, FONAG signed the first agreement with General Motors [RWF_FONAG_a_1]. The aim was to raise awareness that extensive water users were not only the public water and energy companies, but also private companies. With rising recognition of Corporate Social Responsibility (CSR), also private entities need to be involved in compensation mechanisms of their water use. For FONAG this means, the more private companies they sign and external investment they have, the more they can invest in projects that lay outside the intervention area or mission defined by EPMAPS. That is, because 'external money' can be spent without EPMAPS' conditionality [RWF_FONAG_a_1].

Second, in order to mitigate the dominance of EPMAPS in decision-making, FONAG expressed its effort to increase the number and types of constituents. The idea was to reduce the share of the trust currently held by EPMAPS and thereby enable the choice of intervention areas that correspond to the ecological needs of the *páramo*. Also this response is a scale-sensitive enabling strategy (type b), in which FONAG attempts to broaden FONAG's mandate based on involving stakeholders on different levels to decentralise power.

"We would prefer a more equilibrated system. We are also constantly looking for new constituents, even though we have not been successful yet. If we can take another private stakeholder on board or also the smaller municipalities of the catchment [...] that would be good, because it [the current situation] does create a certain vulnerability." [RWF_FONAG_a_2]

iv. Lack of consideration of upstream water needs while downstream water needs are targeted

Water needs of upstream rural communities differ greatly from water needs of downstream actors. The reason for this is that upstream and downstream actors live different realities: what is perceived as a main problem for one group may not be perceived as one by another group. While EPMAPS aimed at addressing the problem of downstream population growth and climate change to threaten urban water security, it ignored the water needs of rural communities who dealt with water shortages as a result of EPMAPS' water intake. This threatened the community's water-dependent rural livelihoods, like trout farming. This scale challenge is connected to the influence of scale frames and the resulting water injustice, rather than directly impacting the restoration activities. FONAG acted as a bridging organisation as it balanced the opposing needs in its restoration intervention. FONAG's efforts to strengthen alternative livelihoods were an attempt to compensate the communities for EPMAPS' failure to consider upstream water needs.

Example from Community Oyacachi

In Oyacachi, EPMAPS failed to consider upstream water needs, while its water intake was aimed at securing downstream water needs. In order to face problems such as population growth and rising water demand in Quito, EPMAPS aimed at capturing more high-quality water from the *páramo* to counteract urban water shortages. The Oyacachi community, in turn, needed less water to be extracted to secure its water-dependent livelihood, like trout farming. The blind spot manifested on two levels of the ecological scale, namely the catchment area level and the community water stream level. On the catchment level, EPMAPS extracted water from constructed reservoirs and pumped it from there directly to Quito, mainly serving urban water security. In contrast, the Oyacachi community was not supplied with the water of the same catchment. It sourced its water for consumption and trout farming from the community water stream a few kilometers downstream of EPMAPS' intake.

In 2002, EPMAPS concluded the construction of the Salve Faccha dam, which was located in the territory of the Oyacachi community in the Cayambe-Coca national park [OYA-GP] (see Figure 11). The building of the dam and the deriving reservoir were a crucial step for the urban water security of Quito, as it supplied the city with about 30% of its drinking water [SI_SENAGUA_a_1]. EPMAPS defined the area around the dam as priority area for restoration, to protect it from human threats [WU_EPMAPS]. Because of the community's proximity to the Salve Faccha dam, the families' animals used to graze freely in the *páramo* next to the reservoir. This resulted in contamination of the reservoir water and reduced water infiltration capacity of the soil. Further, *páramo* vegetation

carried low nutritious value for livestock, which is why constant expansion of pasture was inherent. Consequently, FONAG has been commissioned by EPMAPS to intervene in the area. The conservation agreement with the Oyacachi community included a protection zone of 100 m around all open water bodies, meaning that no animals were allowed in the area around the dam (FONAG, 2018). Livestock rearing was discouraged by FONAG in general, because of its harmful and polluting consequences for the *páramo*. As a result, the community reduced the number of cattle dramatically and relocated the remaining animals to lower laying areas [OYA-GP]. On the one hand, because the animals could no longer drink from open water bodies, and on the other hand, because the expansion of pasture was discouraged.

"We understand the situation [presence of Salve Faccha dam] and want to set an example for the rest. We have neither used the páramo with the cows, nor the forest. We have not expanded our pasture areas for the cows." [OYA-Le_b]

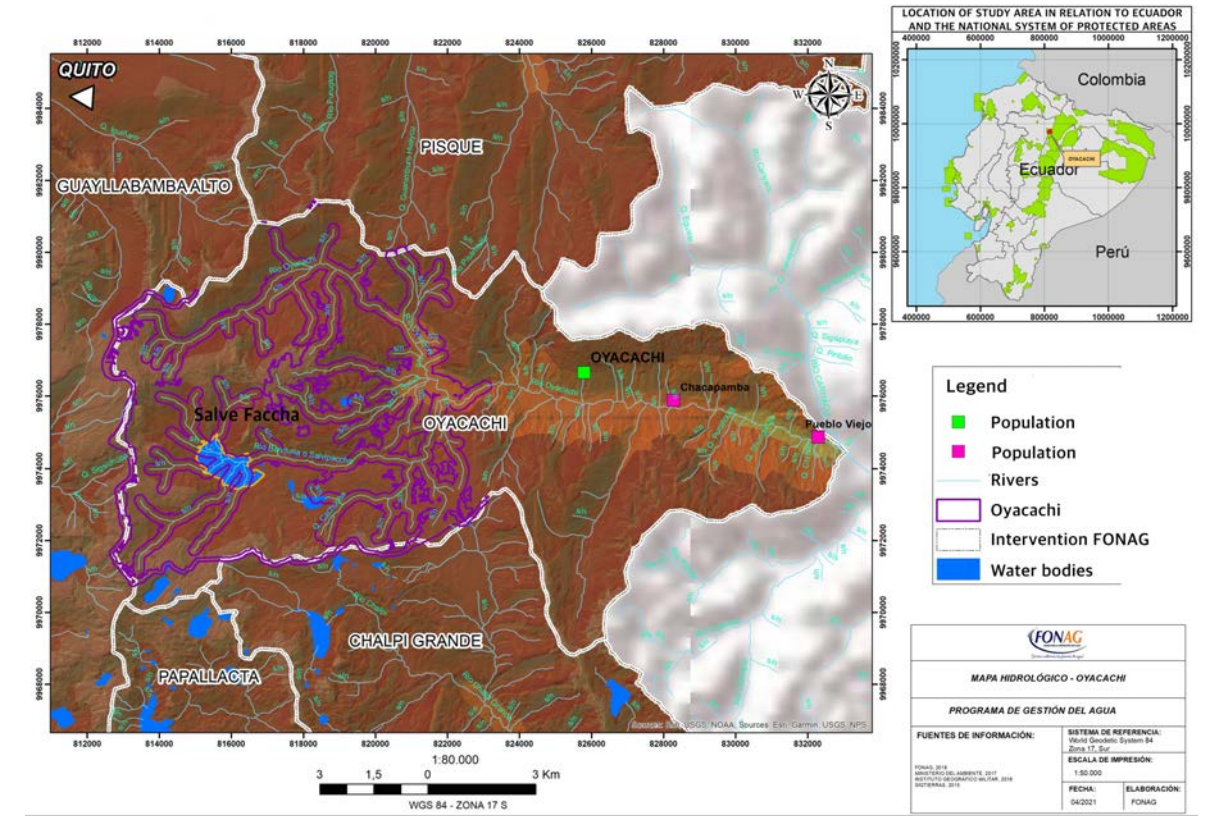


Figure 11: Oyacachi territory, water bodies and the Salve Faccha dam
Source: elaborated by author with geographical data from FONAG

EPMAPS' stance of the situation was that the Salve Faccha dam was urgently needed for the urban water security of Quito [RWF_FONAG_b_2]. In order to meet the water demand of the growing population in Quito, EPMAPS wanted to capture big amounts of high-quality water from the catchment area, that needed as little treatment as possible to make it potable drinking water. Also, in light of future pressures on water resources due to climate change, EPMAPS was increasingly concerned with measures that safeguard continuous extraction from the catchments that derive water from Salve Faccha [WU_EPMAPS].

The Oyacachi community perceived EPMAPS' actions as a threat to rural water security and livelihoods. Because of EPMAPS' call to reduce pastoral agriculture to protect the dam, a large part of the community turned towards trout farming as an alternative livelihood [RWF_FONAG_b_2; OYA-Lo_b]. The Oyacachi river flows from the *páramo* downwards through the territory of the community, where the residential area is located (see Figure 11). Next to their houses, community members created pools for trout farming directly in the river. They introduced this livelihood out of their own initiative. Although the amount of production varied per family and depended on the water level of the river, the community members named trout farming as one of their main alternative livelihoods.

"[…] there are many people who dedicated themselves to trout farming, because they see in trout farming a little more profit than in cattle grazing in the páramo" [OYA-Le_a]

Trout farming was closely linked to other alternative livelihoods, such as community tourism as promoted by FONAG. The idea was that the trout produced by the Oyacachi community was prepared for and sold to tourists directly [OYA-Le_a]. However, community members increasingly feared their livelihood threatened because of the large water intake by EPMAPS despite alarming weather conditions.

"They [trout farmers] worry a lot because the water flow drops strongly in summer. It is very sunny and the water springs dry up. It [water level] is so low that it is barely enough for trout farming. It is very concerning." [OYA-Lo_b].

The community agreed with water extraction throughout the winter months, when the water flow is sufficient for them to breed trout in the Oyacachi river. However, they demanded less extraction in summer, as they feared for the loss of their livelihood [OYA-Le_a]. The authorisation as to how much water may be extracted from any catchment was given by SENAGUA on behalf of MAE. Current Ecuadorian regulation states that the ecological flow requirement, meaning the minimum stream flow that guarantees the continuous ecological function of the aquatic ecosystem, is 10% of a given surface water [OYA-Lo_b]. Yet, this does not account for the amount of water needed to sustain trout farming. The community members therefore called for reduced water extraction by EPMAPS and cuts in the authorisations by SENAGUA.

"I am concerned that a large part of the community is dedicated to trout farming. […] Although in theory there is enough water for trout production, we also need water for the fauna. I do not mean little, but a lot of water. If water levels for trout farming are not met, we will have no choice but to return to cattle grazing in the páramo. […] Authorities such as the Ministry of the Environment and SENAGUA should think about extracting reasonable quantities of water, 10% of ecological flow is very little." [OYA-Le_a].

As restoration actor in the area, FONAG attempted to reconcile the opposing water needs of EPMAPS at catchment level and the Oyacachi community at community stream level. The threat of water scarcity for the community resulted because of EPMAPS' blind spot to adequately consider community livelihood losses as a consequence of water intake. Although FONAG aimed at compensating the community for this blind spot through the development of community tourism as an alternative, it could be seen that the issue of water scarcity for trout farming has not been addressed to date.

Example from Community San Francisco de Cruz Loma

In San Francisco de Cruz Loma, EPMAPS insufficiently considered rural upstream water needs while constructing water infrastructure that secured continuous water intake for downstream populations. Similarly as in the first case, EPMAPS represented urban water needs, as it extracted water from intakes in the San Francisco de Cruz Loma territory and pumped it from there directly to the northern districts of Quito. The community, in turn, was not provided with potable water services by EPMAPS, because it was located above 2800 MASL. At this height, the municipality, which usually holds the competence and responsibility of water service provision, is legally not obliged to provide water services to the communities, even if water for Quito is extracted from their territory [RWF_FONAG_b_3]. The reason for this is the lack of infrastructure to enable pumping potable water to high-laying areas above 2800 MASL [RWF_FONAG_b_2; WU_EPMAPS]. Transportation of this kind would require much investment that is currently missing [RWF_FONAG_b_2]. The community was organised through a rural water board, which held its own water concession with SENAGUA. This was a way to autonomously manage water resources at community level to compensate for the lack of water service provision by EPMAPS.

Community members reported that earlier, EPMAPS extracted water from open channels flowing through the community territory for downstream consumption [SFCL-Lo_b]. The level of contamination of the water was rather high, since the community's animals drank from the channels and defecated them. Therefore, EPMAPS decided to close the water channels in 2010 to replace them with pipes that transport the water directly to Quito without contact to livestock threats [SFCL-To_d]. From EPMAPS' perspective, this averted costly water treatment downstream. However, from the perspective of the community, closing the water channels threatened rural water supply for the community itself.

"Before, we had the open channel. Then, the drinking water people [EPMAPS] said: 'no, this is bad, the water is contaminated, we are going to pipe it'. They brought it through a pipe and we said: 'we are also inhabitants, we are going to run out of water'. [SFCL-To_d]

Earlier, every family was responsible for the purchase of an individual water hose to transport water from the channels to their houses. With the closed water pipes and sheer impossibility to extract water, the rural water board negotiated a small water concession with EPMAPS [SFCL-To_d]. As a result, EPMAPS constructed a small water tank for the community to compensate for the closing of the water channels [SFCL-Le_b]. Yet, the water tank included neither water treatment facilities, nor did it include safe tubes to transport water to each house. Community members also claimed that the construction was of poor quality. Hence, the community members were forced to improvise with inappropriate rubber hoses that provoked leakings and bursts, because of high water pressure. The community experienced about five to six years of unreliable and untreated water provision from EPMAPS' tank.

"EPMAPS left us the tank with errors. […] The they simply left us the pipes up to a certain part [about 10 minutes away from the first houses], from there we had to invest in the hoses ourselves. […] We did not have any experience […] and bought hoses that were wrong."

To conclude, both cases show that EPMAPS failed to consider upstream water needs of communities while catering for the urban downstream needs with the extraction of large quantities of non-

contaminated water. While EPMAPS extracted water on the catchment level for Quito, the communities had to deal with water shortages on the community stream level. The result was that communities had to live with partly too little and partly contaminated water.

Scale-sensitive governance response

FONAG recognised EPMAPS' failure to consider the communities' water needs. As a response, FONAG acted as a bridging organisation in negotiating interventions that compensate the failure to satisfy upstream rural water needs. FONAG used the (1) hydrosocial diagnostic and other studies and (2) support in rural water services as scale-sensitive acting strategies.

First, FONAG conducted a hydrosocial diagnostic in both cases, after observing that rural water needs were insufficiently considered. In both communities, upstream and downstream needs as well as potential conflicts have been analysed through the diagnostic before the restoration and livelihood activities were defined [RWF_FONAG_b_1]. The hydrosocial diagnostic is by all means a scale-sensitive observing strategy (type a) since it aims at identifying possible cross-level issues during scale framing. FONAG staff dedicates months of careful observation and approaching with the community to understand existing conflicts, needs and priorities for action. In Oyacachi, FONAG also commissioned a consulting study in cooperation with SENAGUA about conflict management and mediation potentials, which set the basis for restoration intervention [SI_SENAGUA_a_1]. FONAG thereby initiated a process of decoupling different levels during scale framing, to then rematch interactions between the actors.

"The hydrosocial diagnosis includes a map of Oyacachi with the location of the community, the water resources and the Salve Faccha dam, the catchments of EPMAPS as well as rivers, lakes and lagoons. Around that, we assemble what is important. For example, water is vital for the populated center for the production of trout, thermal pools etc. Then we locate pressures, identify both public and private [...] actors and understand the relationships with them." [RWF_FONAG_b_2]

Second, as a result of EPMAPS' priority in both cases to secure water for the city of Quito, FONAG aimed at compensating the blind spot by acting as a bridging organisation. It negotiated individual solutions with EPMAPS and SENAGUA in each case that safeguarded upstream water interests. Since both communities are located above 2800 MASL, the corresponding municipalities are not legally obliged to provide water service to them [RWF_FONAG_b_3]. In other words, even if both areas were extensively used for water extraction, both communities had to rely on untreated and unreliable rural water infrastructure that EPMAPS provided them with.

In Oyacachi, FONAG's support materialised in the legalisation of a rural water board in 2017 [OYA-GP]. A rural water board, when legalised with SENAGUA, can acquire the competence to extract and treat water for community use. The water board was constituted by community members and henceforth managed the rural water system. FONAG supported not only in the legalisation, but also provided trainings about water treatment methods [RWF_FONAG_b_1]. This is a scale-sensitive action strategy (type a) as FONAG promoted the downscaling of the responsibility for rural water systems to the community level and thereby decoupled the governance levels responsible to for management to answer to existing challenges on a more adequate level. In San Francisco de Cruz Loma, FONAG supported the rural water services with the donation of chlorination equipment, adequate hoses to transport the water to each house as well as water management training of community members [SFCL-Lo_b]. FONAG also negotiated regular water quality monitoring tests through EPMAPS in San Francisco de Cruz Loma [RWF_FONAG_b_3].

FONAG acted as a bridging organisation in both cases, because it highlighted the existence of water injustice for rural communities and undertook concrete actions to counteract the water problems at the local level. In the process, FONAG managed to negotiate infrastructure works and regular water quality tests with EPMAPS. Where the rural needs of safe water had been far behind, such as in the case of San Francisco de Cruz Loma, FONAG acted with the donation of rural chlorination treatment sets.

5. Discussion

This section discusses the presented results of this study. To do so, the results have been briefly summarised and compared with other landscape restoration cases in Ecuador (Section 5.1). Subsequently, the implications for future landscape restoration initiatives (Section 5.2) and scaling theory (Section 5.3) have been depicted. This is followed by a detailed illustration of the research limitations in this study (Section 5.4).

5.1 Interpretation of results

The central question of this study is how FONAG changes rural livelihoods in the process of overcoming scale-challenges in landscape restoration. In order to answer this question, this study examined FONAG's restoration strategies, the scale challenges that emerged in process of restoring landscapes, and FONAG's scale-sensitive governance responses thereto. Special consideration was given to the understudied rural perception of communities with regards to livelihood changes. The results suggest that FONAG's approach to restoration is innovative and in large parts scale-sensitive, which is why FONAG manages to address typical FLR governance criticism. Yet, national restoration efforts are needed to upscale *páramo* restoration and the consideration of livelihoods should be at the heart of it. The following four statements capture the main takeaways of the results (see Table 8) and will be elaborated one by one. While doing so, they will be brought into larger context with FLR governance literature (cf. Erbaugh & Oldekop, 2018; Mansourian, 2016; Mansourian et al., 2017; Mansourian & Parrotta, 2019), studies of water funds and other PES mechanisms in Ecuador (Bremer et al., 2014; Farley & Bremer, 2017; Joslin, 2019a, 2019b; Joslin & Jepson, 2018) and studies of scale challenges in Ecuadorian restoration governance (Bakx, 2020; Wiegant et al., 2020).

No.	Statement
1	FONAG manages to address typical challenges in FLR governance, because it employs innovative and flexible restoration strategies stemming from scale-sensitive governance.
2	FONAG attempts to downscale the execution of restoration activity to the lowest level, while acting as a bridging organisation between different levels of governance.
3	Livelihood-sensitive restoration (LSR) creates a win-win situation for upstream and downstream water users since it safeguards the community's long-term willingness to participate in restoration.
4	Political and financial dependency still limit FONAG's ability to follow a landscape-approach in the restoration of watersheds and call for national mainstreaming.

Table 8: Main takeaways of results

Statement 1: *FONAG manages to address typical challenges in FLR governance, because it employs innovative and flexible restoration strategies stemming from scale-sensitive governance.*

FLR literature displays reoccurring challenges in the governance of restoration processes. Typical challenges include the lack of a guiding framework in restoration governance where ad hoc approaches dominate (Mansourian, 2016, p. 271). This is problematic, because restoration interventions need consistent implementation to show clear results. Closely linked to this is that planning

horizons of projects are often too short to create positive effects at the ecosystem level, while scholars and practitioners agree that ecosystems take at least 10 to 15 years to show restoration results (Mansourian & Parrotta, 2019, p. 263; Stanturf et al., 2019, p. 50). This generally has to do with the fact that politicians only commit to restoration targets in the short-term when politically viable to secure votes. Further, Mansourian (2017) criticises that restoration efforts often include hectare-based targets (p. 2). This makes it is easy for policy makers to measure success and declare an area as 'restored'. However, it says little about the actual state of regained ecosystem integrity and runs the risk of merely counting "the area covered in trees" (Mansourian et al., 2017, p. 3) or other oversimplified criteria. Moreover, scholars disclose that another typical challenge in restoration governance is the failure to address the actual drivers of ecosystem degradation (Mansourian & Parrotta, 2019, p. 262) which "implies improving the livelihoods of people within the landscape as well as the underlying governance" (Mansourian et al., 2017, p. 2). All too often, strict restoration targets leave little space for negotiated strategies between multi-level actors while local realities are ignored (Wiegant et al., 2020, p. 10). Meanwhile, restoration success can be clearly linked to the extent to which local needs and priorities coincide with restoration goals, as the measures are usually implemented at the lowest level of governance (Stanturf et al., 2019, p. 50).

Studies of other landscape restoration initiatives in Ecuador, such as the National Forest Restoration Plan (cf. Wiegant et al., 2020) or the regional water fund FORAGUA (cf. Bakx, 2020) show similar problems. For example, short-term planning horizons and predetermined, non-flexible restoration activities were observed in both cases. They ultimately targeted increasing the number of hectares of the restoration area while ignoring local contexts in the implementation. This not only hampered addressing the underlying drivers of degradation, but casts doubt on whether the areas have been restored at all.

FONAG manages to address typical challenges in restoration governance, because it employs innovative and flexible restoration strategies as a result of applying scale-sensitive governance. First, FONAG applies a long-term restoration strategy. Apart from the fact that financial contributions to the fund are contractually secured for at least 80 years, FONAG plans its interventions in communities for at least 10 years (i.e. duration of conservation agreement). However, even if improvements of the *páramo* ecosystems can surely be felt after 10 years when the agreement comes to an end, it remains unknown how FONAG will proceed with community interventions afterwards. As the first conservation agreement was only signed in 2017, it is too early to measure actual ecological and social long-term effects.

Second, FONAG's ultimate aim was not increasing the amounts of hectares included in its intervention area, but rather improving ecosystem functions such as water regulation and habitat protection within a relatively fixed area of intervention (i.e. EPMAPS' priority watersheds). This was different in the cases of FORAGUA and the National Forest Restoration Plan, where the main goals were expansion of the intervention territory through an increase of member municipalities (Bakx, 2020, p. 67) and increase of participants in land use plans applying for funding under the National Forest Restoration Plan (Wiegant et al., 2020, p. 7). In the case of Oyacachi, for example, the cloud forest was originally not targeted by FONAG's intervention, but overserved deforestation problems in the lower part of the territory were a reason for FONAG to express its wish to intervene there. Not for hectare-sake, but to tackle a specific local degradation problem.

Restoration strategies that have been criticised in other cases as predetermined and non-flexible could not be found in the case of FONAG (Bakx, 2020, pp. 43–44; Wiegant et al., 2020, p. 10). Quite the opposite, interviews revealed that the activities aimed at restoring *páramo* while strengthening alternative livelihoods were highly diverse (see Section 4.1 and 4.2). While in San Francisco de Cruz Loma, FONAG donated materials, supported local structures for rural water supply and strengthed community tourism, the activities in Oyacachi included capacity building through workshops and the construction of infrastructure for tourism and selling. In the past, FONAG appeared to be subject to rigid predetermined activities (i.e. planting trees) which is a typical challenge in restoration governance. However, FONAG changed its approach and increasingly employs adaptable strategies that are based on scale-sensitive observing and developed through trial and error over time. Farley & Bremer (2017) call this adaptive management in restoration governance (p. 378). The starting point for FONAG is to actively listen to the needs and priorities of the community and involve members in decision making. Those needs are captured in the hydrosocial diagnostic as a baseline study and, where urgent, are addressed even before active and passive restoration activities are started. At the heart of this lays scale-sensitive observing from FONAG, which could be observed extensively in both case study communities. FONAG's observation capacity enabled it to identify interactions between actors and resulting cross-scale and level issues. FONAG's restoration activities are adaptated accordingly. It was often emphasised that FONAG only managed to find fitting and adapted solutions to existing problems because it listened to locals and observed challenges between and across levels. For example, in San Francisco de Cruz Loma the call for an improved rural water supply system by locals was prioritised in FONAG's intervention. This shows that in contrast to other landscape restoration initiatives in Ecuador, FONAG's activities may vary strongly on a case-to-case basis. As a result of adaptive management based on local perceptions, FONAG increasingly focuses on the strengthening of alternative livelihoods since 2016, a trend that was largely missing in other restoration initiatives in Ecuador (Bakx, 2020, p. 66; Wiegant et al., 2020, p. 10).

The results show that FONAG integrated aspects of scale-sensitive observing, acting and enabling in its restoration efforts (Termeer & Dewulf, 2014, pp. 45–46). According to Termeer et al. (2015) studies often focus on action strategies, while too little attention is paid to observing and enabling conditions of governance arrangements (p. 682). Existing studies of scale challenges in Ecuadorian restoration governance also display a focus on action strategies (cf. Bakx, 2020) with some notions of scale-sensitive observing (cf. Wiegant et al., 2020). The case of FONAG, in fact, accentuates that observing strategies (i.e. adaptation to local context, focusing on vulnerable groups, hydrosocial diagnostic) were fundamental to adapt sustainable restoration strategies that tackle existing scale challenges. Scale-sensitive observing was found specifically at the start of interventions, which underlines the fact that it constitutes the base for acting and even enabling strategies. Scale-sensitive observing in the case study manifested itself in the deliberate effort of FONAG to design strategies on the basis of observations that were not necessarily responses within the typical action repertoire (ex. active and passive restoration). An example is the hiring of *guardapáramos*, which could not be observed in any other water fund. FONAG also showed efforts of scale-sensitive enabling that aimed at changing the governance system in which restoration in DMQ takes place. On the one hand, there were strategies aimed at distributing responsibilities across scales, thereby creating ownership of restoration processes (i.e. formalising agreements, creating local restoration agents) and on the other hand, there were strategies aimed at remodeling the governance scale addressing existing scale challenges (i.e. advocating national water fund, exter-

nal funding, increase in constituents). Consequently, scale-sensitive observing and enabling conditions can be decisive to address typical FLR governance challenges, as they set the basis for innovative action strategies in restoration.

Statement 2: *FONAG attempts to downscale the execution of restoration activity to the lowest level, while acting as a bridging organisation between different levels of governance.*

The call for high-level government commitments (i.e. Bonn Challenge) to expand restoration to whole landscapes implies the interaction of many actors, sectors and levels, which adds complexity to the governance of restoration (Mansourian, 2016, p. 268). Wiegant et al. (2020, p. 2) and Stanturf et al. (2019, p. 1) argue that such commitments are problematic because little is known about what strategies are used to actually implement restoration on the local level. Closely linked to this is that measurements for success are often either non-existent or highly diverse.

The results of this study, and the study of FORAGUA, suggest that Ecuadorian water funds generally tend to downscale restoration activity and responsibilities to lower levels of governance (Bakx, 2020, p. 61). The difference between the regional water fund FORAGUA and FONAG is that the former transfers the responsibility of executing restoration activities towards member municipalities, while FONAG bypasses the municipal level and implements activities itself through the technical secretary. This decision may come with advantages and disadvantages. However, it seems that political resistance on municipal level with regards to implementation is a frequent problem, as municipalities think and plan in the short term (Bakx, 2020, p. 41). Also national government planning displayed short-term planning constraints and the dependence on support of politicians (Wiegant et al., 2020, p. 7). Bypassing the national and municipal levels in implementation is an effective strategy of FONAG to prevent being blocked by short-term political thinking and opposing approaches by different mayors.

Examples of FONAG's strategy to scale down decision-making to the lowest level of governance while strengthening agency and local autonomy at the community level were the creation and/or strengthening of rural water boards as well as the creation of local tourism offices. In the former, FONAG encouraged communities to manage their own water systems, and in the latter, FONAG pushed for the organisation of tourism activities among the community members while being less vulnerable to changes on higher levels. With regards to restoration activities, both communities showed that implementation was mainly done by community *mingas* and *guardapáramos*. In fact, *guardapáramos* were pivotal in the translation of restoration policy towards local action (Joslin, 2019a, p. 13). They are representatives of the FONAG before the community and vice versa and serve as the most proximate link to connect FONAG with rural land managers (Joslin, 2019a, p. 13). Creating a vertical translator of restoration in the communities was a strategy that could not be seen anywhere else but in the case of FONAG.

In addition, FONAG and FORAGUA show a similar trend of strengthening their positions as bridging organisations. In this study, this manifested in the role that FONAG assumes in the process of scaling down restoration implementation. With the creation of legal tourism offices in communities, FONAG connects the local and national levels (i.e. Ministry of Tourism) and by creating rural water boards, it connects the local and municipal/national levels (i.e. municipality responsible for water service; SENAGUA gives concessions). FONAG represents the interests of the communities before higher levels of governance and facilitates negotiation between them. The same trend

could be seen at FORAGUA, where recent efforts to include rural water boards in restoration activities could be observed (Bakx, 2020, p. 61). Mansourian & Parrotta argue that conversion or legalisation of institutions that represent rural communities is "paramount to any successful land-based intervention such as FLR" (2019, p. 264).

Statement 3: *Livelihood-sensitive restoration (LSR) creates a win-win situation for upstream and downstream water users since it safeguards the community's long-term willingness to participate in restoration.*

The key to building the sustainable governance of landscapes where the needs of nature and people are reconciled is the consideration of rural livelihoods in ecological restoration processes and vice versa. In fact, some scholars go as far as claiming that "ecological restoration, without regard to sustaining livelihoods and addressing needs of local communities, is a prescription for failure" (Mansourian et al., 2017, p. 3). In the past, many ecological restoration initiatives in Ecuador have been criticised for exactly this, the lack of consideration of rural livelihood realities during the implementation of the initiative (Bakx, 2020; Bremer et al., 2014; Joslin, 2019b; Wiegant et al., 2020). For example, Bakx (2020) identified a blind spot scale challenge of FORAGUA and its constituents towards livelihood realities on the household level (p. 49). This crystalised mainly through the discontent of rural landowners with regards to their livelihood opportunities after refraining from harmful land use practices or the selling of their land.

This study showed that FONAG is a special case among Ecuadorian restoration initiatives, because its restoration strategies do, to a large extent, take livelihoods into account. Referring to this phenomenon observed in the case of FONAG, this thesis coins the term livelihood-sensitive restoration (LSR). It is defined as the *conscious reconciliation between local needs to secure livelihoods and restoration activities at different scales and levels in the governance of landscape restoration*. Although it seems that this approach is largely successful in the application to rural contexts, it has to be considered that FONAG has not always worked with LSR. Until about 2016, FONAG's main strategy was the rehabilitation of ecological functions of ecosystems through active and passive restoration of soil and vegetation cover. In such 'traditional' approaches, rural livelihoods are merely seen as a positive side benefit (Bremer et al., 2014, p. 148; Erbaugh & Oldekop, 2018, pp. 76–77; Farley & Bremer, 2017, p. 373). However, over time FONAG changed to a livelihood-sensitive approach[44], meaning that restoration always starts off with rural needs for livelihood alternatives, before ecological restoration processes and change away from traditional livelihoods are initiated. In San Francisco de Cruz Loma, for example, part of the rural population toned the need for pipelines and material for a functioning rural water supply and treatment system. This became FONAG's priority activity, before passive and active restoration started.

The case studies also show that in both communities, changing to community tourism as an alternative livelihood reduced harmful land use practices. This impacts watershed restoration in two ways. For one, the elimination of traditional livelihood activities, such as livestock breeding or cultivation of food crops in the *páramo*, decelerated *páramo* degradation at least with regards to human and livestock pressures. Second, in both case studies, LSR also fostered restoration processes because community tourism increased the awareness about the ecological and economic

[44] This argument accounts only for those territories that are part of community territories. On private property or large landowner properties, FONAG negotiates individual agreements.

value of the *páramo* landscape among community members. As the *páramo* became the community's main asset through tourism, they were more willing to dedicate themselves to environmental protection. This is critical, as research suggests that in restoration interventions, the extent to which human well-being is increased largely depends on the amount of enhanced financial capital that they gain (Bremer et al., 2014, pp. 149–150; Farley et al., 2011, p. 393). The results of the study suggest overall moderate, but positive effects on the economic situation of both case study communities. It could be seen that in Oyacachi, where 30% of population benefit directly from alternative livelihoods, the satisfaction with FONAG's restoration intervention was much lower than in San Francisco de Cruz Loma, where 70% of population benefit directly. This suggests that the immediate net economic benefit has a large impact on the community's willingness to corporate with the water fund in the associated restoration process (Farley et al., 2011, p. 393). Bakx (2020) found something similar, the perception of unbalanced cost-benefit contribution is what demotivated rural landowners to see the benefits of restoration.

Thus, a feedback loop between livelihoods and restoration can be observed: if community tourism generates enough income for the community to feel a substantial improvement of their livelihoods and well-being, they are more likely to continue the *páramo*-friendly activities in place of falling back into harmful activities. Concentrating on tourism as their main livelihood activity, in turn, generates a personal interest for communities in restoring and conserving the *páramo*, because tourists are attracted by thriving landscapes rather than degraded ones. To really make an impact in restoration *and* rural livelihoods, community tourism therefore needs to "compensate landowners substantially more than they could have earned without participation" (Bremer et al., 2014, p. 149).

This study also showed that especially the benefit for future generations through the tourism infrastructure was what motivated communities to work with FONAG. Although future employment opportunities count as an intangible benefit now, they are likely to turn into financial capital in the future (Bremer et al., 2014, p. 149). LSR appears to be a promising approach in landscape restoration that needs to be further developed by FONAG and potentially other water funds or restoration initiatives in Ecuador.

Statement 4: *Political and financial dependency still limit FONAG's ability to follow a landscape-approach in the restoration of watersheds and call for national mainstreaming.*

The results show that albeit measures to diversify the source of funds and to deconcentrate power in decision-making, FONAG remains to be politically and financially dependent on EPMAPS. Joslin & Jepson (2018) studied how EPMAPS uses PES as a platform to exert power within its territory. Therein, they confirm that under EPMAPS' dominant influence, FONAG's initial priority of biodiversity conservation in protected areas shifted towards the protection of water resources consumed by the city of Quito (p. 18). This study reveals that such dependency has led to an internal crisis within FONAG and a temporary halt of all community work in the past, which harmed the trust relationship between FONAG and the target communities (Joslin & Jepson, 2018, pp. 17–18). This example is similar to a situation in the South of Ecuador, where a new elected major in office has the power to terminate the cooperation with the water fund (Bakx, 2020, p. 41).

Political dependency on the electoral cycle is a reoccurring problem. Wiegant (2020) and Bakx (2020) identify similar scale challenges in their studies, in which election cycles cause politicians to favour highly visible, active restoration efforts over passive restoration efforts. In the case of

FORAGUA, this even manifested in the political unwillingness of a newly elected mayor to invest in restoration activity or continue existing efforts. For FONAG, the governance arrangement is somewhat more stable, as a municipal ordinance obliges EPMAPS to contribute 2% of its profit to be reinvested into restoration activities through FONAG [SI_SENAGUA_a_2]. Therefore, at least financial contribution is safeguarded. Still, the instability after the elections in 2009 show that political willingness is pivotal to guarantee continuation of restoration intervention in the long run. It can be seen that in the cases of both, FONAG and FORAGUA, "the water fund needs to prove itself to convince the mayor of its value and necessity" (Bakx, 2020, p. 41). FONAG attempted to overcome this with the ROI study, that was to prove the value of restoration to EPMAPS in the long run. Generally, it becomes apparent that in both water fund cases, the fund itself needs to act politically, create strategic alliances and spend time and resources again and again to prove viability of restoration to decision-makers.

This political dependency is often accompanied by a challenge of enforcement. In a study of the National Forest Restoration Plan, Wiegant et al. (2020) found that although restoration was approached through national targets and implemented at parish level, the concrete implementation was to a large extent unknown and if present, compromised by short-term political interests (Wiegant et al., 2020, p. 10). Similarly, in the study of FORAGUA, restoration was approached regionally and supposedly implemented at the municipal level. However, municipalities lacked political willingness and enforcement mechanisms to actually create meaningful local action (Bakx, 2020, p. 44). What essentially differentiates those two cases from FONAG is that the Quito water fund is an implementing fund with technical capacity. This means, while the National Forest Restoration Plan and FORAGUA so far mainly attract and direct money for restoration that is directed to lower governance levels for implementation, FONAG executes restoration itself and thereby circumvents political hurdles. Respondents frequently mentioned this as the ultimate reason for FONAG's success [EC_AN_a_1; RWF_FONAG_a_2]. With implementation also comes the possibility of setting context-specific indicators and monitoring impacts, which is currently harder for other water funds or national policy makers in other restoration cases by being further away from implementation realities (Bakx, 2020; Wiegant et al., 2020).

Yet, it also becomes apparent that in the case of FONAG, restoration intervention currently only happens within the limits of where those activities benefit DMQ's water service provision (Joslin, 2019b, p. 626), undermining a full landscape approach. Interestingly, both communities of Oyacachi and San Francisco de Cruz Loma would have benefitted from a landscape approach to prevent the problem of displacing an ecological problem to another area through restoration intervention (see scale challenge ii in Section 4.2). Recent trends within FORAGUA, but also FONAG, show that the water funds attempt to push for a mechanism to safeguard the sustainability of restoration efforts in the long-term. For one through a potential national water fund, and for another through the recognition of areas of hydrological importance in MEA's SNAP (Bakx, 2020, p. 60).

5.2 Implications for future landscape restoration initiatives

The case study showed that a large extent of FONAG's success can be attributed to the fact that it is a true learning organisation – based on strategies of scale-sensitive observing, acting and enabling. Future landscape restoration initiatives can learn from the experiences of FONAG and other water funds, and possibly counteract already identified scale challenges. Although scale challenges vary across Ecuador, reoccurring issues are worth considering for planning of future initiatives. It can be highlighted that studying perception of target communities can be especially beneficial to inform science and policy and that initiatives should be based on adaptive management to be able to refit challenges occurring in and between scales and levels.

For future landscape restoration initiatives, be it water funds or other governance arrangements, restoration practitioners should first clearly decide what the concrete aim of the initiative is. Being a mere *financer* (i.e. FORAGUA or National Forest Restoration Plan) comes with different challenges than being an *implementer* (i.e. FONAG). For example, financing initiatives faced challenges of (1) not knowing how restoration funds were actually translated into local action due to lacking monitoring capacity and (2) the levels of government responsible for implementation were largely unfit at spatial and temporal dimensions to execute restoration activities in a way that they restored ecosystem integrity sustainably – both ecologically and socially – while they largely ignored local realities on the ground. As an implementing initiative, FONAG faced different challenges. For example, in Oyacachi sustainably changing livelihoods for the whole community required financial resources that were beyond what FONAG could offer and rural landowners therefore felt that they have not been compensated enough for not using the *páramo* for agriculture and livestock rearing anymore. Moreover, the failure to consider short-term livelihood losses while engaging in a long-term restoration process is a scale challenge inherent to implementing initiatives. Enabling factors such as infrastructure, capacity building and the individual starting conditions of community members need to be carefully considered, when livelihoods are changed. Yet, it needs to be recognised that in the case of FONAG, implementation of restoration activities in rural communities and the gained knowledge from trial and error, generated organisational adaptation capacity. In other words, learning from implementation is what shaped FONAG's restoration strategies over time. FONAG is recognised on national level for this.

In general, scale challenges vary vastly between cases and regions, even in Ecuador itself. The reason for this is that depending on the region, different land tenure systems require different environmental management that also impacts the available options at which landscape restoration can be approached. For example, in the South of Ecuador, many critical landscapes for watershed protection are owned by private landowners (Bakx, 2020, p. 46). This permits strategies associated with buying of land, which would be unthinkable in the case of indigenous communities inhabiting land in a national park, as is the case for the Oyacachi community. Moreover, scale challenges vary based on the geographical location of the targeted restoration area and the related local realities. The restoration interventions of FONAG that aim at changing livelihoods, for example, benefit from the geographical proximity of Quito. In San Francisco de Cruz Loma, the Quito cable car was built right next to their *páramo* territory, which facilitated the change to tourism. Tourists that reside in Quito can be easily incentivised to visit the community for a day trip. In rural and isolated places in the South of Ecuador, tourism is less likely to be as profitable, because of the sheer lack of visitors. Yet, the proximity to Quito also brought about challenges that more rural places do not face. In San Francisco de Cruz Loma, pollution from the large amounts of tourists at the Quito cable car and motocross sports were present issues.

Although scale challenges vary across Ecuador, there are some reoccurring issues that are worth considering for future landscape restoration initiatives. First, political dependency manifests through instability caused by changes in government in election cycles, which temporally mismatch with restoration timelines. In both, financing and implementing initiatives, this could be observed. Hence, restoration practitioners should attempt some sort of mainstreaming on the national level, at least to the extent that the ecological and social benefit of the restoration initiative itself is sufficiently recognised among politicians to safeguard future support. Moreover, pushing the transfer of responsibility of restoration activity to autonomous rural institutions safeguards self-determination. Second, even if to a different extent, a reoccurring issue is the failure to consider rural livelihood realities while initiatives target the needs of the downstream population. Yet, research in Ecuador confirms that the consideration of rural livelihoods lays at the heart of restoration success. With more research being done on social outcomes of restoration, there is also an increasing call for livelihood-sensitive restoration in the implementation of initiatives. Conversely, more LSR creates the need for efficient monitoring of livelihood changes in the implementation of restoration initiatives (Farley & Bremer, 2017, p. 372; Joslin, 2019b, p. 633).

The results of this study confirm that studying perception of target communities can inform science and policy about rural (livelihood) needs that evidently influence the success and sustainability of restoration intervention (cf. Bakx, 2020; Farley & Bremer, 2017; Joslin, 2019b; Wiegant et al., 2020). The interviews with community members revealed that it is of utmost importance for them to feel heard and considered. For example, in San Francisco de Cruz Loma, where community members felt largely considered and included in decision-making processes with FONAG, the community showed high levels of ownership with regards to the restoration processes. In Oyacachi, however, where community members felt that externally contracted technicians undermined the local expertise of executing works, community members were much more critical with regards to the usefulness of FONAG's intervention in the community. In general, it can be said that restoration processes can only be successful if backed by the local land stewards who ultimately need to agree to adapting their livelihoods based on changing land use. Especially in literature on water funds, too much focus has been laid on the structural aspects of the financing mechanism, while lacking empirical studies that address the perception of target communities on the social outcomes (Bremer et al., 2014, pp. 149–150). Future initiatives should monitor the outcomes of restoration through studying perception.

Addressing scale challenges in the governance of landscape restoration remains a complex challenge for restoration practitioners. Not last, because scholars acknowledge that there is no 'right' or 'adequate' scale or level at which scale challenges can be anticipated beforehand, as landscapes span "many sectors, systems, and scales" (Mansourian, 2016, p. 271). Similarly, the case of FONAG showed that lasting and fixed solutions to such scale challenges do not exist, as each case and local reality is different. What works in the context of an indigenous community might not be feasible for a peri-urban community. Hence, continuous adaptation as well as a constant refitting of the governance and ecological scales is needed (Cash et al., 2006, p. 9; Termeer & Dewulf, 2014, p. 50). Therefore, future landscape restoration initiatives should focus on adaptive management in restoration governance (Farley & Bremer, 2017, p. 378; Termeer & Dewulf, 2014, p. 50). This means, restoration should neither be planned top-down with large hectare-based targets that lack implementation approaches and are not embedded in the local context (Mansourian et al., 2017, p. 2; Wiegant et al., 2020, p. 10), nor should restoration stay regional as in the case of FONAG, where intervention areas are only attributed to the benefit of one constituent (Joslin & Jepson, 2018, p. 18). Instead, a long-term multilevel and adaptive governance approach is needed (Bakx,

2020, p. 66; Termeer et al., 2010, p. 11), in which there is room for "practice [to] learn from theory and theory [to learn] from practice" (Goldman-Benner et al., 2012, p. 55). At last, future restoration initiatives should anticipate scale challenges that could be observed in already existing studies (cf. Bakx, 2020; Wiegant et al., 2020) and possibly counteract them through scale-sensitive governance (Termeer & Dewulf, 2014, p. 39).

5.3 Implications for scaling theory

The application of scaling theory in this study raised some considerations about the theory itself, which will be discussed in the following. First of all, scaling theory can be considered as an appropriate and practical tool to make sense of governance systems in landscape restoration. In this study, scalar thinking (i.e. identifying scales, levels and dimensions in a given socio-economic system) significantly contributed to the systematic narrowing down of the angle of analysis. The definition of guiding concepts, as well the general understanding of the theory reached relative consensus among scholars (cf. Cash et al., 2006; Termeer et al., 2015; Termeer & Dewulf, 2014).

More ambiguity occurred with the application of scale-sensitive governance to the case study. First, it became apparent that Termeer & Dewulf's (2014) scale-sensitive observing, acting and enabling features cannot always be separated neatly. Although for the sake of clarity, a distinction was predominantly made in this study, situations of overlap were observed. For example, one response to the temporal blind spot in the second scale challenge (i.e. lack of consideration of short-term livelihood losses when starting long-term restoration processes) was that FONAG adapted its activities to the local context. Although the 'adaptation' itself should be classified as an action strategy, it does build on scale-sensitive observing, because the basis of action was FONAG's effort to understand local needs and to react to those in its intervention activities. Thus, it can be argued that scale-sensitive observing conditions are at the base of scale-sensitive acting. Similarly, it became apparent that situations classified as scale-sensitive enabling can be action strategies at the same time. The case study revealed that action strategies often stem from processes of active listening and observing of the needs of actors on different levels. An example is FONAG's effort to advocate a national water fund at the national level of governance. The strategy was classified as an enabling strategy, because the creation of an overarching water fund essentially enables regional water funds to overcome challenges of dependency on electoral cycles. Yet, this also remodels the governance system in which restoration currently occurs and could thus be an action strategy. The fundamental observation in this example is that FONAG identified a situation of cross-level political dependency and acts because of that, hence, the basis for action is scale-sensitive observing.

In other words, elements of scale-sensitive observing, acting and enabling as categorised by Termeer & Dewulf (see Table 2) were in part blurry and overlapping, when they were applied to this empirical case study. This is not to undermine its usefulness for theoretical considerations of scale-sensitive governance. However, a more tangible approach in which scale-sensitivity is seen as a connected process with feedback loops can benefit future application of scaling theory in research. To this end, a *process of scale-sensitive governance* is proposed (see Figure 12), which suggests that scale-sensitive observing is the fundamental starting condition upon which actors apply scale-sensitive action strategies. Building on that, action and enabling strategies might overlap, however enabling strategies include a somewhat lasting change while facilitating openness and flexibility to constantly adapt the governance system. Seeing the different elements of scale-sensitive governance as a *process*, rather than individual and separable strategies enables restoration practitioners to better understand scale-sensitive elements in real-life situations. Moreover, by highlighting the connectedness and dependency of observing, acting and enabling elements in scale-sensitive governance, the concern toned by Termeer et al. (2015), that too little attention is paid to observing and enabling conditions of governance arrangements, is addressed (p. 682).

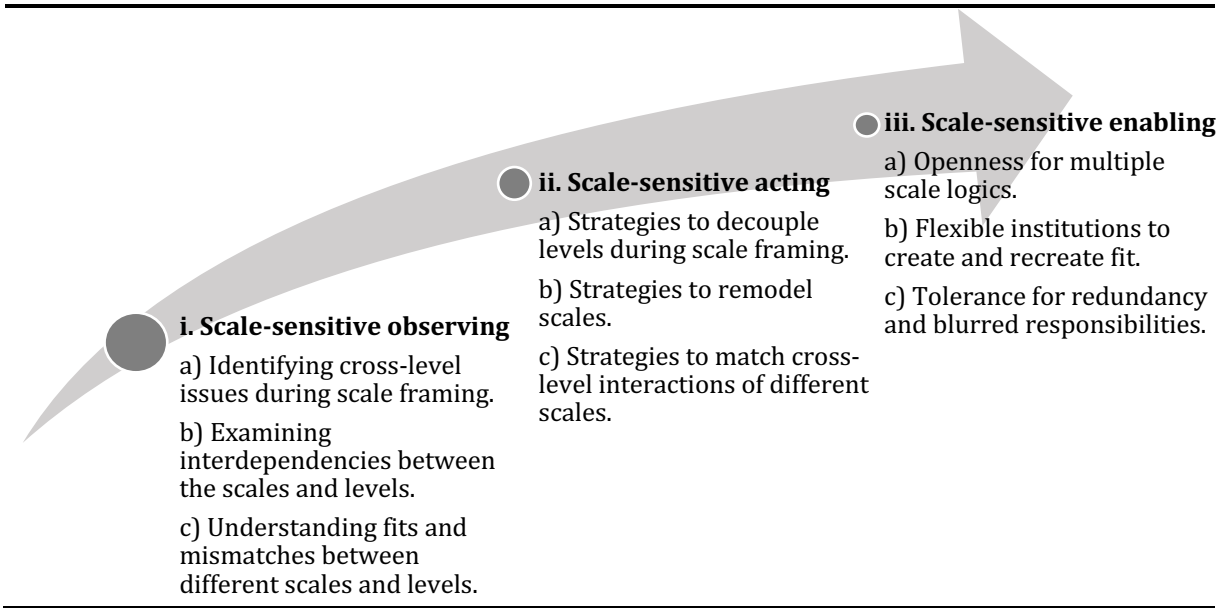


Figure 12: Process of scale-sensitive governance

Scaling theory is still being developed, as it gains importance in governance literature. Termeer & Dewulf's scale-sensitive governance (observing, acting, enabling) builds on earlier thoughts of Cash et al. (2006), who identified responses to scale challenges focused on institutions in a governance system. In this case study, some scale-sensitive responses were classified as institutional interplay, co-management and bridging organisation. Similarly like with scale-sensitivity, also here classifications overlapped. For example, one of FONAG's responses to the fourth scale challenge (i.e. lack of consideration of upstream water needs while downstream water needs are targeted) was to conduct a hydrosocial study before starting passive and active restoration strategies in the area. This study takes place during scale framing, defines actors, conflicts and challenges and thus inevitably holds elements of scale-sensitive observing. At the same time, FONAG assumed the role of a bridging organisation while conducting the study, as it brought together the needs of the community members and the aims of EPMAPS in the same watershed. Hence, a narrow divide between Termeer & Dewulf's scale-sensitive governance and Cash et al.'s institutional interplay, co-management and bridging organisation is not feasible when applying them to an empirical case study. Yet, it can be concluded that Cash et al.'s approach best applies to institutions acting in a governance arrangement, while Termeer & Dewulf's scale-sensitive governance can be applied more broadly, and to actors on different levels. Both approaches mutually reinforce each other and the clear classification of strategies holds the danger to oversimplify the value of scale-sensitive governance responses. Conclusively it can be said that both approaches were useful and applicable in the case of FONAG. More attention should be paid to the ambiguity and overlap between them.

5.4 Limitations

This section sheds light on the research limitations of this study by evaluating the validity of the results, or in other words, the accuracy of the measurement (Bernard, 2011, p. 85). To do so, a critical reflection on general concerns of validity will be given, followed by an assessment of both, the credibility (i.e. internal validity) of data as well as the transferability (i.e. external validity) of the results to other contexts (Kumar, 2011, p. 172).

Critical reflection of validity

Scale challenges are continuously evolving, dynamic and non-exhaustive in restoration governance (Cash et al., 2006, p. 4; Wiegant et al., 2020, p. 10). Therefore, this study only identified the four most outstanding scale challenges observable in the case study. With more time, a broader research scope and different (or more) studied communities, presumably other and/or more scale challenges could have been found. Moreover, the scale challenges that have been identified in this study did not occur in isolation. Rather, they are intertwined with an infinite number of other challenges, that do not necessarily originate from the interaction of scales and levels along the governance and ecological scales. Phenomena such as corruption, nepotism, indigenous uprise, but also climate change are an integral part of the complex Ecuadorian governance system and influence the scale challenges and corresponding responses by restoration practitioners. Joslin (2019b) dedicated an entire article to the problem of detecting causal relations in FONAG's restoration interventions in communities. She finds a discrepancy between FONAG's success narrative and the actual causal implications for rural communities based on local perceptions. Interestingly, Joslin identifies many of FONAG's activities that have been praised as novel, to coincide with already preexisting community activity, land use arrangements and practices (Joslin, 2019b, p. 633). This means, much of what is presented as cause-and-effect can in fact not be simply attributed to the specific strategies or activities by FONAG. For example, this study revealed that in both communities, a shift to community tourism could already be seen before FONAG started its intervention, which challenges the extent to which one can argue that FONAG 'introduced' an alternative livelihood. Instead, local trends and activities take place regardless of the intervention of restoration practitioners, and the latter rather support ongoing community activity based on scale-sensitive observing. As the restoration processes analysed in this study are complex and lengthy and actors, sectors as well as opinions intertwine, accurate projections of cause-effect phenomena are unrealistic.

Furthermore, measuring the impact of livelihood changes remains challenging, as there are no widely agreed criteria that indicate success or failure in securing livelihoods (Mansourian et al., 2017, p. 4). This is problematic, because the measurement of impact is essential to understand the magnitude of success and efficiency of any intervention, while at the same time influencing future application in other communities (Mansourian et al., 2017, p. 4). In addition, FONAG only actively applies livelihood-sensitive restoration since 2016. It is still early to measure the impact of the relatively new approach in target communities (see Section 4.2). A first step towards evaluation has been undertaken by FONAG through the implementation of the hydrosocial study at the beginning of any intervention. This study may act as baseline data, upon which evaluation can be based (Mansourian et al., 2017, p. 4). Yet, the comprehensive evaluation needs to be based on concrete indicators in the future (Erbaugh & Oldekop, 2018, p. 78). The scope of this study was limited to measuring local perception with regards to livelihoods as roughly 'satisfied' or 'dissatisfied'. Systematic evaluation of livelihood outcomes based on indicators by researchers, or the water funds themselves, is still pending.

Lastly, a critical reflection of the choice of tourism as an alternative livelihood was beyond the scope of this study. Although a detailed analysis of the risks associated with tourism is not possible at this point, at least some considerations are appropriate. According to the definition of Chambers & Conway (1992), a livelihood is sustainable if it "can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the short and long term" (p. 6). Members of both communities reported that on a daily basis, tourism is dependent on weather conditions, while in the long run, climate variability, political unrest and economic recessions can put pressure on the influx of tourists. Since the sustainability of landscape restoration intervention highly depends on the extent to which the community profits financially from its livelihoods, the risk of diminishing tourists for tourism is to be taken seriously. For example, during the fieldwork phase, a nation-wide strike led by the indigenous population paralysed the country and led to a complete breakdown of the tourism sector, for at least some weeks. Accordingly, the community was completely dependent on external factors. It remains debatable in how far community tourism is resilient enough to recover from external shocks to be the main driver and incentive for landscape restoration.

Limitations of credibility

The credibility of the results refers to the extent to which perceptions of the respondents are portrayed in a way that they feel represented. Three limitations should be recognised. First, a separation of the researcher's values and opinions from the study is nearly impossible (Bernard, 2011, p. 279). That is to say, the interpretation of the data based on the researcher's socially constructed reality is inevitable. Second, a language barrier existed between the researcher and the respondents, as Spanish was a foreign language for the researcher. Third, the time constraint of the study potentially biased the respondent sampling. Due to the short amount of time spent in the rural communities, respondents were partly sampled through snowballing. Since snowballing in rural contexts often means being referred to family members or friends who have similar opinions and experiences, a representative perception of the whole community could be biased (Bernard, 2011, p. 147).

The limitations have been attempted to be offset by (1) thoroughly noting down field observations to reflect on the personal impressions and feelings of the researcher when interpreting the data. Further, (2) the language barrier has been attempted to be reduced with a four-week intensive Spanish language course, prior to the start of the research. The researcher attained a certified Spanish level of B1, which steadily improved throughout the fieldwork. Although it cannot be entirely precluded that language-based misunderstandings existed during the interviews, the extent to which this can potentially bias the results is estimated to be minimal. The amount of 43 interviews is large enough to draw valid conclusions about observed trends in the answers. Lastly, (3) a selection bias during respondent sampling was countered by searching respondents that represent different groups of the community, including a gender and age balance. Something that could not be cancelled out is the fact that merely respondents within one community have been selected. Positive or negative livelihood outcomes for neighbouring communities must be captured in future studies.

Limitations of transferability

Transferability refers to the extent to which the study is replicable for future research as well as the extent to which the observations are generalisable for similar studies in the field (Kumar, 2011, p. 172). This is especially relevant considering the expected trend in landscape restoration

governance to increase LSR strategies. The possibility to replicate this study in other rural contexts is crucial to further inform future restoration practitioners about what works and what does not. The primary strategy in ensuring transferability is the neat documentation of decision-making along the research process (see Section 3.3), documentation of the field research phase itself (see Appendix C: Interview guide) and documentation of the data analysis method (see Appendix B: Code tree – simplified). Although documentation can to a large extent ensure that the decisions of the researcher are comprehensible and replicable, it still needs to be recognised that this case study was unique. Identical replication is impossible, as the exact time and context at which the research took place has an impact on the collected data. For example, the national strike of indigenous communities ended only some days before the researcher entered the Oyacachi community. It can be expected that the perspectives of the community members on community tourism as an alternative livelihood were largely influenced by the recent political happenings. Should the study be replicated in the future, it is likely that the current global pandemic, which did not yet exist at the time of data collection, would be a dominating theme guiding rural perceptions.

Both, time and context-specific outcomes of the study cannot be avoided. However, this study has attempted to enable future research at FONAG and the two communities by having fostered and maintained a fruitful working relationship. FONAG has proven to be a welcoming institution for researchers and did its utmost possible to grant access to the field. Likewise, the communities have been utterly welcoming and a trustful and honest relationship was built. This is anticipated to pave the way for future research in the communities, as much is yet to be understood when it comes to livelihood outcomes in landscape restoration.

Lastly, it is debatable to what extent the specific scale challenges, scale-sensitive responses and rural perceptions are generalisable for similar studies in the field of restoration governance. On the one hand, the observations are based on unique case studies in one specific region of Ecuador where rural realities, land tenure systems and cultures are specific. On the other hand, general observed trends can be guiding when comparing the case of FONAG with other restoration initiatives. The discussion (see Section 5.1) demonstrates that a number of similar scale challenges and scale-sensitive approaches could be observed in different cases. For example, the lack of recognition of rural livelihoods was repeatedly recognised (cf. Bakx, 2020; Wiegant et al., 2020). At the same time, FONAG's LSR approach might be a valid answer to address the livelihood challenges in those cases. The strategies and experiences of landscape restoration initiatives should therefore be exchanged, and general trends and solutions should be considered to facilitate practicioners and communities to learn from each other.

6. Conclusion

By studying both FONAG's strategies towards landscape restoration and the perceptions of two rural communities with regards to their livelihood changes, this study has contributed to offset the lack of empirical research of the implementation of landscape restoration by water funds. The objective of the study was (1) to understand cross-scale and cross-level governance challenges in the process of restoration, (2) to understand how FONAG addresses those challenges and (3) to understand the consequences for rural livelihoods; to be able to answer the main question: *How does FONAG change rural livelihoods in the process of overcoming scale-challenges in landscape restoration?*

This study began with the analysis of FONAG's landscape restoration strategies and found (1) generation of hydrometeorological and socioeconomic data, (2) the declaration of conservation areas through voluntary conservation agreements, (3) passive and active restoration of degraded *páramo*, (4) environmental education as well as (5) the hiring of *guardapáramos*. The study then went on to investigate the occurrence of scale challenges in the case study. Among a variety of governance challenges that could be observed, four scale challenges stood out: (1) a temporal mismatch between short-term election cycles and long-term restoration timelines, (2) a temporal blind spot in considering short-term livelihood losses in long-term restoration processes, (3) a spatial mismatch as restoration interventions provoke a displacement of the problem to another area and finally (4) a spatial blind spot in EPMAPS' failure to consider upstream water needs while downstream water needs are targeted. FONAG uses a variety of scale-sensitive governance strategies to address those challenges, which include elements of scale-sensitive observing, acting and enabling. Thereby, observing sets the basis for most action and enabling strategies and is therefore attributed special importance. It could be seen that although the observing and enabling elements are understudied, they are deeply connected with action strategies and mutually reinforce each other. Further, the analysis shed light on FONAG's role as an institution, by being a bridging organisation and promoting institutional interplay and co-management. Although the scale challenges and responses found were specific to the context of this case study, other studies addressing scale challenges in Ecuadorian restoration initiatives showed similar trends (cf. Bakx, 2020; Wiegant et al., 2020). Thus, despite scholars acknowledging that there is no 'right' or 'adequate' scale or level at which scale challenges should be analysed, there is a potential for future restoration initiatives to adapt their strategies by considering reoccurring scalar problems in other cases (Goldman-Benner et al., 2012, p. 55; Mansourian, 2016, p. 271).

Reflecting on the findings in this study, four main takeaways (see Table 8) could be identified: First, FONAG manages to address typical challenges in FLR governance, because it employs innovative and flexible restoration strategies. Second, FONAG attempts to downscale the execution of restoration activity to the lowest level, while acting as a bridging organisation between different levels of governance. Third, LSR creates a win-win situation for upstream and downstream water users since it safeguards the community's long-term willingness to participate in restoration. And fourth, political and financial dependency still limit FONAG's ability to follow a landscape-approach in the restoration of watersheds and call for national mainstreaming.

Looking back at the initial research problem, some final reflections can be made. First, this study started off under the assumption that the *páramo* landscape surrounding DMQ is a socio-ecological landscape, in which actors on different levels of the governance scale negotiate and interact. By making sense of the governance arrangement using scaling theory, it was confirmed that scalar

governance challenges inherent to environmental governance do exist in the case of FONAG. Recognising that only few scholars dedicated themselves to a critical analysis of potential (governance) challenges inherent to landscape restoration in Ecuador, this study answered the need to get a better understanding of how reconciliation between ecological and human needs can take place. The case study showed that landscape restoration initiatives can benefit from applied scaling theory (i.e. defining scales, levels and dimensions for analysis), because it constitutes a feasible and applicable tool to spot challenges that potentially compromise the success of restoration interventions. As cross-scale and cross-level challenges are deeply rooted in the governance system of restoration, anticipating such challenges before setting up a restoration initiative, such as a water fund, can make an important contribution to the successfulness of it. Moreover, it can be concluded that scale-sensitive observing, acting and enabling elements in governance are non-static and interdependent. That is to say, rather than applying them as individual or separable strategies, they should be seen as a reinforcing process of scale-sensitive governance. Thereby, scale-sensitive observing sets the basis for action and enabling strategies.

Second, this study anticipated that changing land-use and livelihood activities has a large impact on the daily lives of people in the upstream. This is of critical importance as communities, or rural land stewards, are seen as the key determinants for success in *páramo* restoration (Bremer et al., 2016, p. 230; Stanturf et al., 2019, p. 49). The results of this study suggest that FONAG, as opposed to other restoration actors in Ecuador, integrates the consideration of rural livelihoods in its restoration intervention to a large extent. Given the impact on the success and sustainability of restoration initiatives, this thesis coined the term livelihood-sensitive restoration. LSR refers to the *conscious reconciliation between local needs to secure livelihoods and restoration activities at different scales and levels in the governance of landscape restoration*. LSR is a novel, but promising approach with the potential to find synergies between restoration activities that benefit the ecological systems vs the social systems in a landscape. Unfortunately, measuring the impact of livelihood changes remains challenging, as there are no widely agreed criteria that indicate success or failure in securing livelihoods (Mansourian et al., 2017, p. 4). FONAG's application of LSR in the intervention area is still young, and evaluations by researchers or FONAG itself are therefore absent to date. The scope of this study only permitted measuring local perception with regards to livelihoods as roughly 'satisfied' or 'dissatisfied'. Future research in this area is encouraged to apply an indicator-based, systematic evaluation of livelihood outcomes.

Third, another research problem in this study was the presence of a lack of understanding of experiences lived by Andean communities who participate in restoration initiatives. To date, only Farley & Bremer (2017) and Joslin (2019b, 2019a) explicitly recognised the importance of rural perceptions in Ecuador as a central part of empirical case studies. More recent research in Ecuador also recognises that local perceptions of communities are frequently ignored, which leads to poorly designed restoration strategies (cf. Bakx, 2020; Wiegant et al., 2020). This study therefore made an important contribution by deliberately giving rural communities the room to express their perceptions, concerns and needs in the context of landscape restoration. Ultimately, the experiences lived by many of the respondents became part of the narrative in this research. This study therefore confirms that considering perceptions of target communities can inform science and policy about rural (livelihood) needs that evidently influence the success and sustainability of restoration intervention.

To conclude, ecosystem degradation and deforestation are global environmental challenges that require a landscape approach of restoration. The negative effects of inaction will be felt by everyone, but most prominently by the poorest in the world. With the United Nations Decade on Ecosystem Restoration, an important step has been taken to draw the attention of policy makers to the restoration of ecosystems for natural and human well-being. As investment and efforts are likely to increase in the next decade, it is important to consider the governance systems in which landscape restoration takes place. Addressing scale challenges remains a complex challenge for restoration practitioners, as there is no such thing as a lasting or fixed solution. Instead, a long-term multilevel and adaptive governance approach is needed, that should be embedded in the local context. Only then will it be possible to reconcile healthy ecosystems and flourishing livelihoods under landscape restoration.

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Appendix A: Overview of respondents

Research stage 2: Quito

#	Place	Respondent group	Language	Duration	Interview code
1	Quito	Research Institution	English	01:22:04	RI_KSU_ENG
2	Quito	Water Utility	Spanish	00:45:40	WU_EPMAPS_ESP
3	Quito	Non-Governmental Organisation	Spanish	00:45:26	NGO_FEPTCE_a_1_ESP
4	Quito	Non-Governmental Organisation	Spanish	00:40:41	NGO_FEPTCE_a_2_ESP
5	Quito	Regional Water Fund	English	00:23:33	RWF_FONAG_a_1_ENG
6	Quito	Regional Water Fund	English	01:40:51	RWF_FONAG_a_2_ENG
7	Quito	Regional Water Fund	Spanish	00:42:54	RWF_FONAG_b_1_ESP
8	Quito	Regional Water Fund	Spanish	00:53:18	RWF_FONAG_b_2_ESP
9	Quito	Regional Water Fund	Spanish	00:27:17	RWF_FONAG_b_3_ESP
10	Quito	Regional Water Fund	Spanish	00:15:33	RWF_FONAG_c_1_ESP
11	Quito	Regional Water Fund	Spanish	00:27:16	RWF_FONAG_c_2_ESP
12	Quito	Regional Water Fund	Spanish	00:42:19	RWF_FONAG_d_ESP
13	Cuenca	Regional Water Fund	Spanish	01:09:16	RWF_FONAPA_ENG
14	Loja	Regional Water Fund	Spanish	01:34:41	RWF_FORAGUA_ESP
15	Quito	Environmental Consultancy	Spanish	01:12:27	EC_AN_a_1_ENG
16	Quito	Environmental Consultancy	Spanish	01:15:53	EC_AN_a_2_ESP
17	Quito	State Institution	Spanish	01:22:32	SI_MAE_ESP
18	Quito	Environmental Consultancy	English	01:03:14	EC_ED_ENG
19	Loja	Non-Governmental Organisation	Spanish	01:01:14	NGO_NCI_ESP
20	Quito	Non-Governmental Organisation	Spanish	01:25:24	NGO_FL_a_1_ESP
21	Quito	Non-Governmental Organisation	Spanish	01:32:50	NGO_FL_a_2_ESP
22	Quito	State Programme	English	00:57:11	SP_PROA_ENG
23	Quito	State Institution	Spanish	00:32:32	SI_SENAGUA_a_1_ESP

24	Quito	State Institution	Spanish	01:03:32	SI_SENAGUA_a_2_ESP
25	Quito	Research Institution	English	01:41:27	RI_WUR_ENG

Research stage 3: Community Oyacachi

#	Place	Respondent group	Language	Duration	Interview code
26	Oyacachi	Oyacachi Community	Spanish	00:29:18	OYA_GP_ESP
27	Oyacachi	Oyacachi Community	Spanish	00:23:06	OYA-Le_a_ESP
28	Oyacachi	Oyacachi Community	Spanish	01:01:18	OYA-Le_b_ESP
29	Oyacachi	Oyacachi Community	Spanish	00:28:14	OYA-Lo_a_ESP
30	Oyacachi	Oyacachi Community	Spanish	00:30:42	OYA-Lo_b_ESP
31	Oyacachi	Oyacachi Community	Spanish	00:55:07	OYA-Lo_c_ESP
32	Oyacachi	Oyacachi Community	Spanish	00:55:54	OYA-To_a_ESP
33	Oyacachi	Oyacachi Community	Spanish	00:34:23	OYA-To_b_ESP
34	Oyacachi	Oyacachi Community	Spanish	01:13:40	OYA-To_c_ESP

Research phase 3: Community San Francisco de Cruz Loma

#	Place	Respondent Group	Language	Duration	Interview code
35	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	01:15:42	SFCL-GP_ESP
36	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	01:30:07	SFCL-Le_a_ESP
37	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	00:18:33	SFCL-Lo_a_ESP
38	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	01:19:06	SFCL-Lo_b_ESP
39	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	00:38:36	SFCL-To_a_ESP
40	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	00:27:32	SFCL-To_b_ESP
41	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	00:39:51	SFCL-To_c_ESP
42	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	00:55:09	SFCL-To_d_ESP

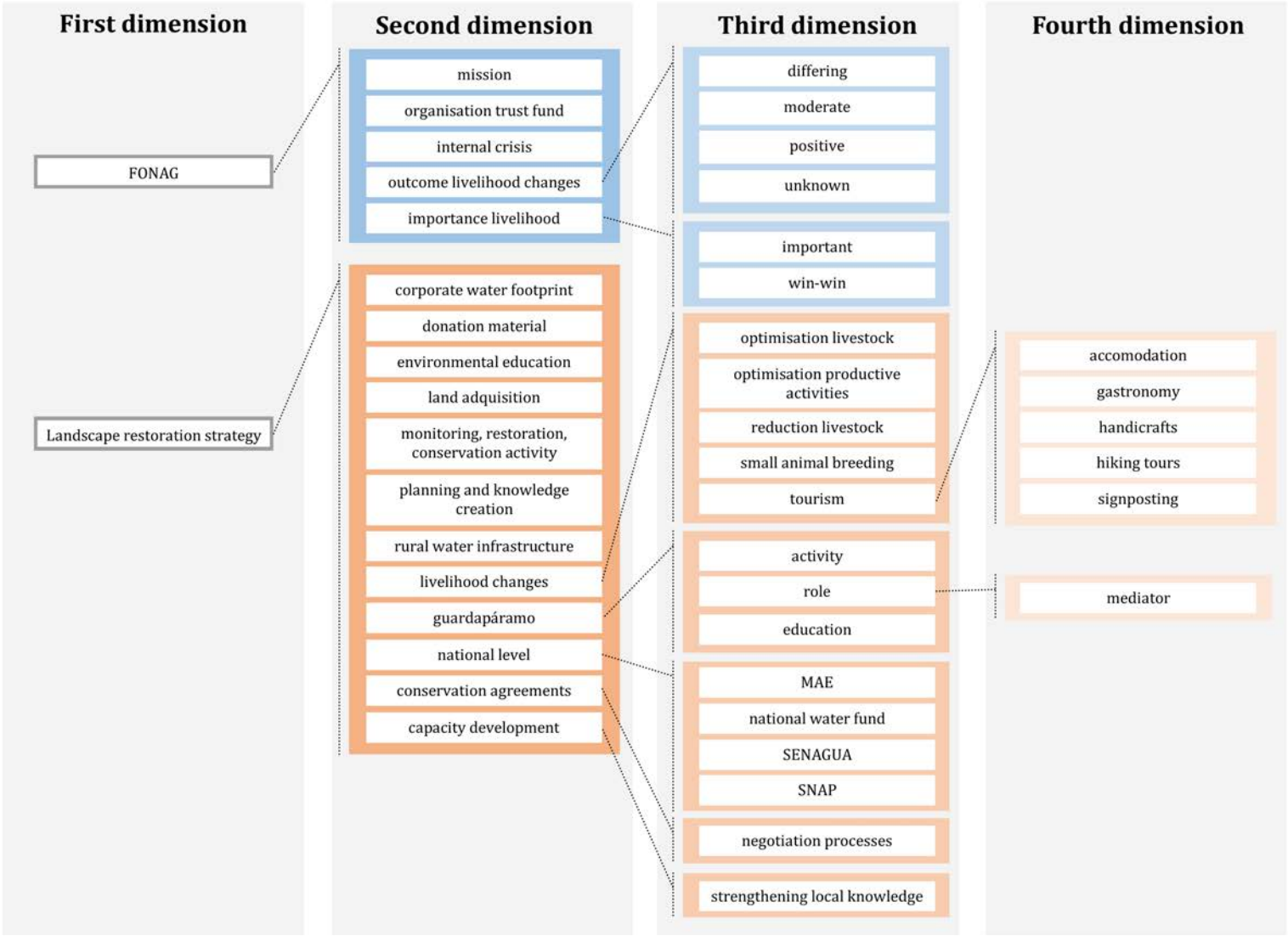
43	San Francisco de Cruz Loma	San Francisco de Cruz Loma Community	Spanish	01:13:05	SFCL-Le_b_ESP

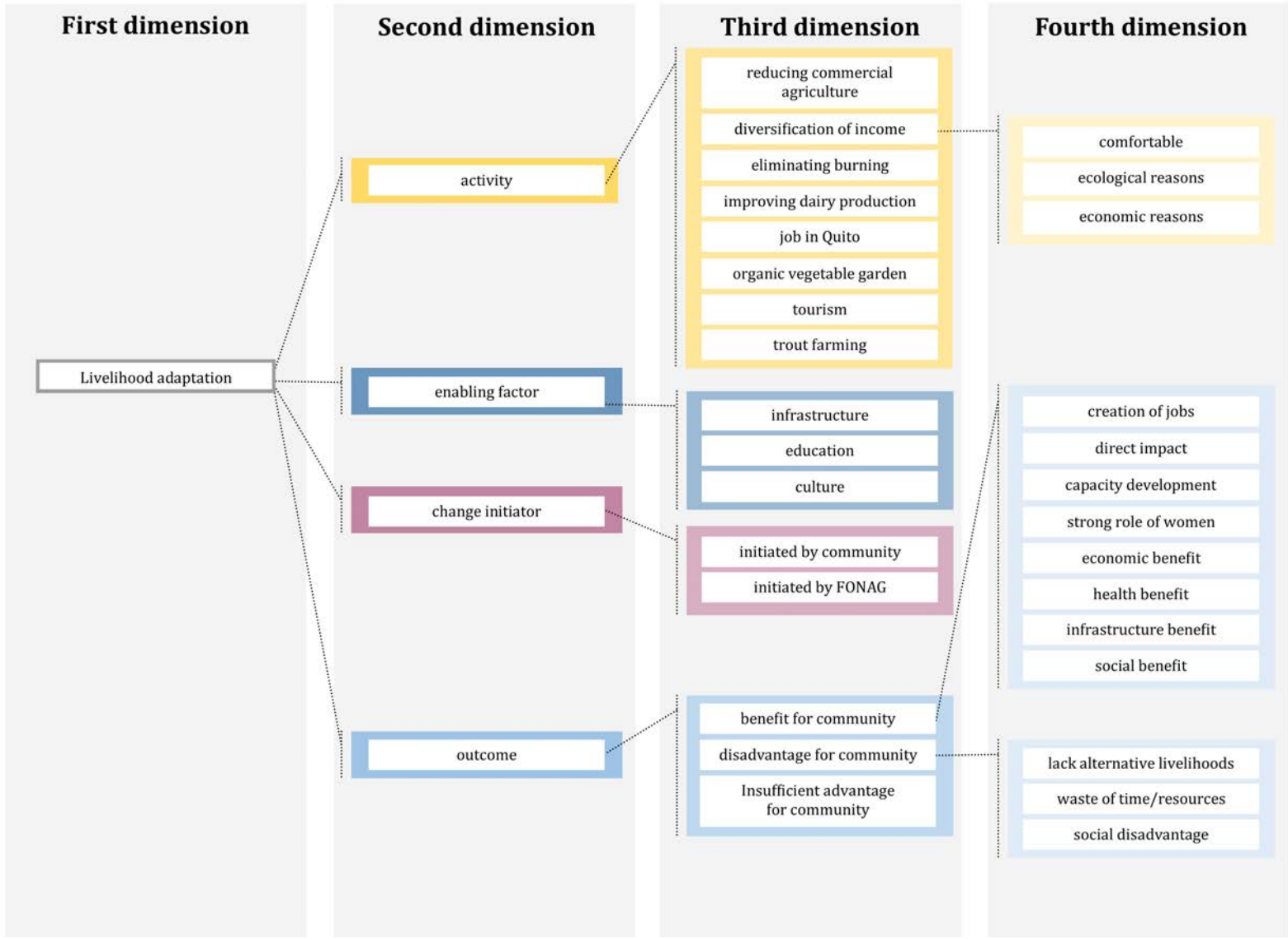
Table 9: Overview interviews

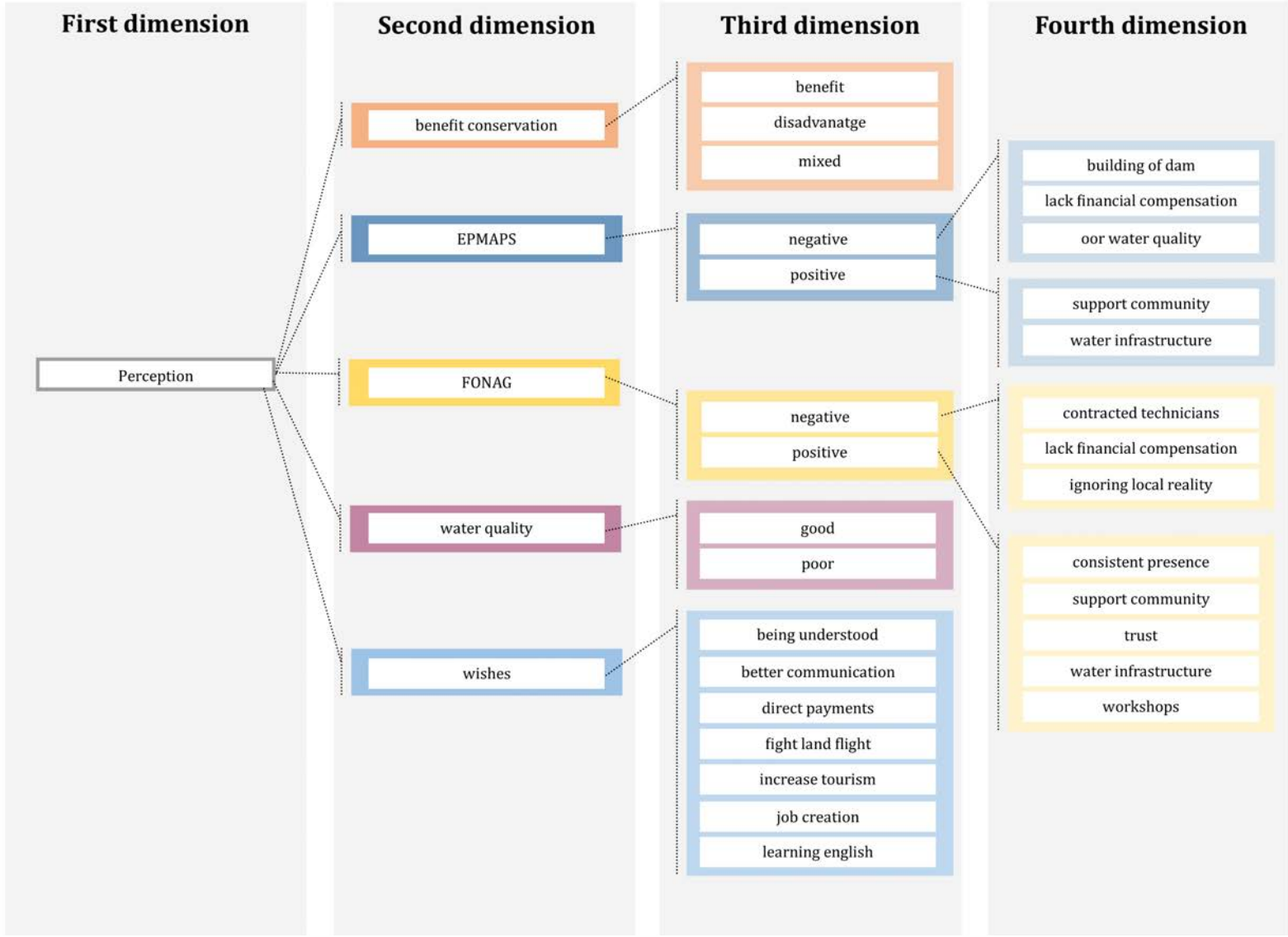
Respondent group	**Number of interviews**	**Number of respondents**
State Institution/ Programme	4	3
Research Institution	2	2
Water Utility	1	1
Regional Water Fund	10	7
Non-Governmental Organisation	5	3
Environmental Consultancy	3	2
Oyacachi Community	9	9
San Francisco de Cruz Loma Community	9	9
Total	**43**	**36**

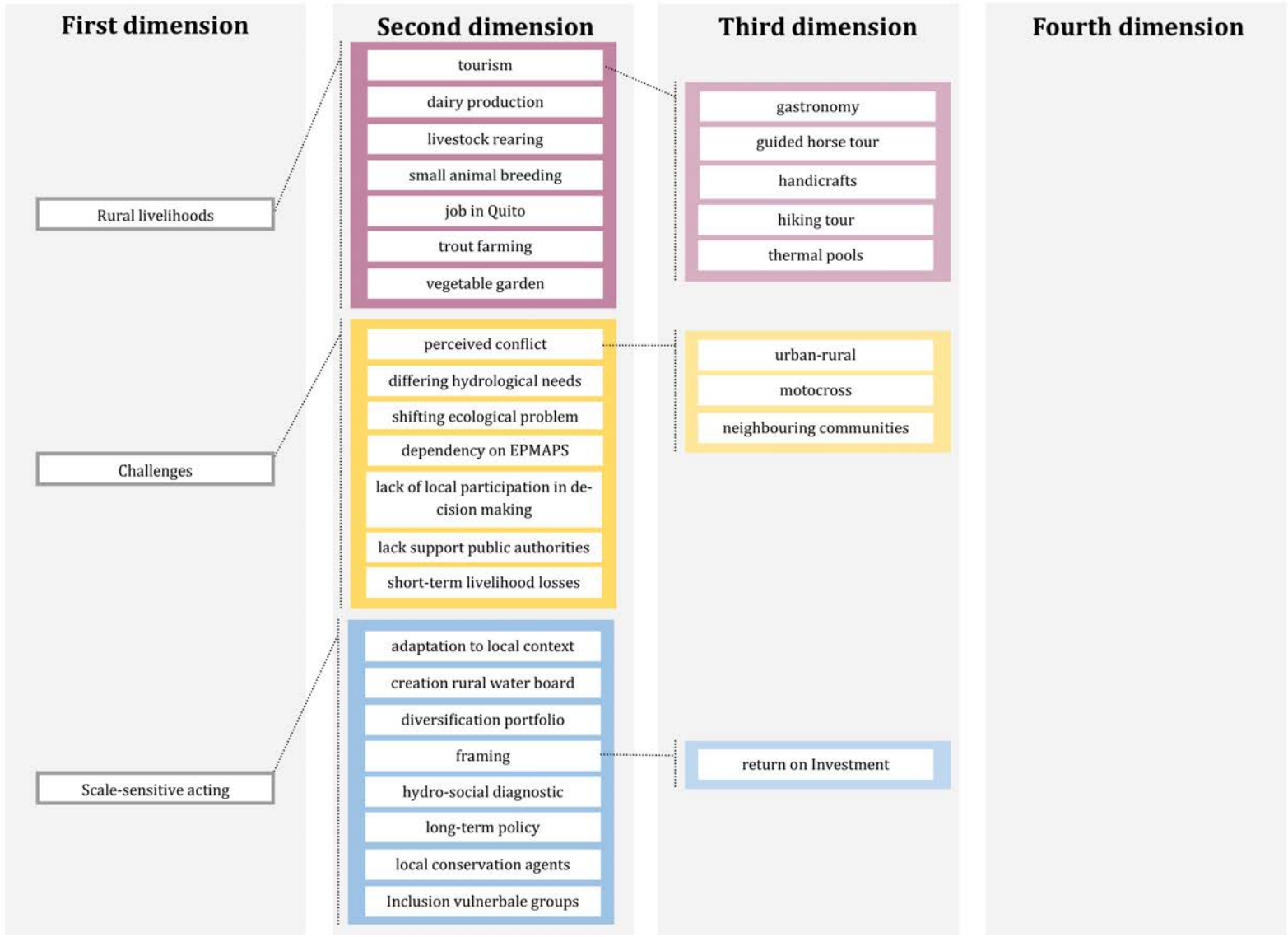
Table 10: Number of interviews by respondent group

Appendix B: Code tree – simplified




First dimension
Second dimension
Third dimension
Fourth dimension
Livelihood adaptation
activity
enabling factor
change initiator
outcome
reducing commercial agriculture
diversification of income
eliminating burning
improving dairy production
job in Quito
organic vegetable garden
tourism
trout farming
infrastructure
education
culture
initiated by community
initiated by FONAG
benefit for community
disadvantage for community
Insufficient advantage for community
comfortable
ecological reasons
economic reasons
creation of jobs
direct impact
capacity development
strong role of women
economic benefit
health benefit
infrastructure benefit
social benefit
lack alternative livelihoods
waste of time/resources
social disadvantage


First dimension
Second dimension
Third dimension
Fourth dimension
Perception
benefit conservation
EPMAPS
FONAG
water quality
wishes
benefit
disadvanatge
mixed
negative
positive
negative
positive
good
poor
being understood
better communication
direct payments
fight land flight
increase tourism
job creation
learning english
building of dam
lack financial compensation
oor water quality
support community
water infrastructure
contracted technicians
lack financial compensation
ignoring local reality
consistent presence
support community
trust
water infrastructure
workshops


First dimension
Second dimension
Third dimension
Fourth dimension
Rural livelihoods
Challenges
Scale-sensitive acting
tourism
dairy production
livestock rearing
small animal breeding
job in Quito
trout farming
vegetable garden
perceived conflict
differing hydrological needs
shifting ecological problem
dependency on EPMAPS
lack of local participation in de-cision making
lack support public authorities
short-term livelihood losses
adaptation to local context
creation rural water board
diversification portfolio
framing
hydro-social diagnostic
long-term policy
local conservation agents
Inclusion vulnerbale groups
gastronomy
guided horse tour
handicrafts
hiking tour
thermal pools
urban-rural
motocross
neighbouring communities
return on Investment

Appendix C: Interview guide

A total number of 43 interviews with 34 respondents were conducted during the fieldwork. In the preparation phase of the fieldwork, the interviews were prepared with guiding topics and questions. After arriving in the field, they were adjusted to the local reality. Because of the large amount of respondent groups and the diverging background of them, interview questions needed to be adapted in preparation to each interview. This allowed for target-specific questions fitted to the individual respondent. For example, only one interview was held with an employee of EPMAPS and accordingly, the questions were adapted.

Although the interviews were conducted following the rough outline of guiding topics and questions, enough space for the respondents to bring up their own topics, interests, concerns and perspectives was left. Since this study follows an inductive approach of research, this was of utmost importance. In the following, the respondent groups are clustered into four interview groups who were asked similar questions (see Table 11). Then, the interview questions per interview group and topic (see Table 12) can be found. Table 12 is therefore not to be seen as an accurate replica of each interview, but rather as an illustration of the interview structure.

Interview group A	Regional Water Fund
Interview group B	Water Utility
Interview group C	Oyacachi Community
	San Francisco de Cruz Loma Community
Interview group D	State Institution/ Programme
	Research Institution
	Non-Governmental Organisation
	Environmental Consultancy

Table 11: Clustered interview groups

	Interview topic and corresponding question
Interview group A	**General information**
	What is your position within the water fund?
	What is FONAG's objective?
	How does FONAG's financial and operative mechanism work?
	What changes in the objectives and priorities of FONAG did you observe in the last years?
	Landscape restoration strategy
	What landscape restoration strategies does FONAG use?
	How have the landscape restoration strategies changed over time?
	How do these landscape restoration strategies differ per community/actor in the field?
	What challenges have you observed with regards to landscape restoration strategies?
	What does FONAG do to tackle those challenges?
	Interaction with communities
	How does FONAG collaborate with rural communities?
	How are decisions for restoration activities taken?
	How are restoration activities executed?
	How is a conservation agreement negotiated?
	What challenges have you observed in the collaboration with communities?
	What does FONAG do to tackle those challenges?
	Interaction with constituents
	How does FONAG collaborate with its constituents?
	How is FONAG's relationship with EPMAPS?
	How are decisions for restoration activities taken?
	What challenges have you observed in the collaboration with constituents?
	What does FONAG do to tackle those challenges?
	Reconciliation with rural livelihoods
	What role do rural livelihoods play for landscape restoration?
	How has FONAG's approach towards rural livelihoods changed in the last years?
	How have rural livelihoods in community X changed since FONAG started collaborating?
	How does the community benefit from alternative livelihoods?
	How does FONAG choose an alternative livelihood to be promoted?
	How does FONAG monitor the implementation of alternative livelihoods?
	What challenges do you observe in the process of changing livelihoods?
	How does FONAG tackle those challenges?
	Future outlook
	Where do you see room for improvement in the future?
	How will FONAG develop in the future?

Interview group B	
	General information
	What is your position within EPMAPS?
	What is EPMAPS' objective?
	What changes in the objectives and priorities of EPMAPS did you observe in the last years?
	Landscape restoration strategy
	What is EPMAPS' vision with regards to the restoration of páramo?
	What strategies does EPMAPS use to restore the páramo?
	How have the landscape restoration strategies changed over time?
	How do you define EPMAPS' social responsibility towards rural communities?
	What challenges have you observed with regards to landscape restoration strategies?
	What does FONAG do to tackle those challenges?
	Interaction with FONAG
	How does EPMAPS collaborate with FONAG?
	How has the relationship between EPMAPS and FONAG changed over time?
	How are decisions for restoration activities taken?
	How does EPMAPS deal with conflicting views of other constituents?
	What challenges have you observed in the collaboration with FONAG?
	What does EPMAPS do to tackle those challenges?
	Future outlook
	What will be the future water challenges for Quito?
	Where do you see room for improvement in the future?
	How will FONAG develop in the future?

Interview group C

General information
What is the history of the community?
Since when is the community inhabiting this land?
Does your family own land? If yes, how many hectares?
Has the land use changed in the last years?
Interaction with FONAG
What is FONAG's objective?
How does the community collaborate with FONAG?
How are decisions for restoration activities taken?
Have you observed resistance within the community with regards to FONAG?
Have the community's needs been considered by FONAG in the past?
What challenges have you observed in the collaboration with FONAG?
What does FONAG do to tackle those challenges?
Rural livelihoods
What are the principal livelihoods of the community?
How have livelihoods changed in the last years?
Is your livelihood dependent on the land that you use?
Are you satisfied with the changes in livelihood?
How many people directly benefit from alternative livelihoods?
Has the community's living standard changed as a result of changes in livelihood?
Rural water supply
Do you have continuous access to high quality potable water?
Does EPMAPS hold water catchments/ intakes on the community land? If yes, how does this impact the community?
Has the rural water supply in the community changed as a result of working with FONAG?
Are you satisfied with the rural water supply in the community?
Community tourism
How has the idea of community tourism developed in the community?
What was FONAG's role in the development of community tourism as alternative livelihood?
Do you have other means of income next to community tourism?
How does the community benefit from community tourism?
What challenges have you observed in community tourism?
What does FONAG do to tackle those challenges?
Future outlook
Where do you see room for improvement in the future?
How will community tourism develop in the future?

Interview group D	**General information**	
	What is your position within your institution/ organisation?	
	How is your institution/ organisation involved with FONAG in landscape restoration?	
	How does FONAG's financial and operative mechanism work?	
	What changes in the objectives and priorities of FONAG did you observe in the last years?	
	Landscape restoration strategy	
	What landscape restoration strategies does FONAG use?	
	How have the landscape restoration strategies changed over time?	
	What challenges have you observed with regards to landscape restoration strategies?	
	What does FONAG do to tackle those challenges?	
	Interaction between FONAG and communities	
	How does FONAG collaborate with rural communities?	
	How are decisions for restoration activities taken?	
	How are restoration activities executed?	
	How is a conservation agreement negotiated?	
	What challenges have you observed in the collaboration between FONAG and communities?	
	What does FONAG do to tackle those challenges?	
	Reconciliation with rural livelihoods	
	How does FONAG change rural livelihoods in communities?	
	How has FONAG's approach towards rural livelihoods changed in the last years?	
	How do communities benefit from alternative livelihoods?	
	How does FONAG choose an alternative livelihood to be promoted?	
	How does FONAG monitor the implementation of alternative livelihoods?	
	What challenges do you observe in the process of changing livelihoods?	
	How does FONAG tackle those challenges?	
	Future outlook	
	Where do you see room for improvement in the future?	
	How will FONAG develop in the future?	

Table 12: Interview group, topic and question