INCENTIVES FOR COLLECTIVE ACTION IN EBA GOVERNANCE.

A Case Study on a Watershed in the Colombian Andes.

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Abstract

Few concepts have gained as much attention in recent climate change adaptation efforts as ecosystem-based approaches (EbA). EbA holds not only the potential to jointly address climate change adaptation and the conservation of ecosystems but is also advocated for offering benefits for local communities by diversifying livelihood opportunities. Despite these promises, EbA remains often a pilot project and is not yet implemented on a large scale. I argue that in order to upscale EbA, it is necessary to design incentives for collective action that build upon the specific socio-economic and historical pathways of a community. Building upon the New Institutional Economics scholarship, I analyze EbA in a socio-ecological system and identify the enabling relationship between reputation, trust and the cognitive framing of social interdependencies as the foundation for collective action in EbA. A watershed community in the Colombian Andes has been analyzed to see how the concepts of reputation, trust and cognitive framing of social interdependencies are represented in a territorial setting building on the data of a qualitative case study and experimental game. A political ecology perspective contributed to understand the development pathways of the investigated community and to construct a critical approach to payment for ecosystem services.

Key words: ecosystem-based adaption to climate change (EbA) – collective action – rural development – trust – reputation – cognitive framing of social interdependencies – payment for ecosystem services

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Abbreviations

CAR	Local Environmental Authorities (Spanish: Corporaciones Autónomas Regionales)
MADS	Ministry of the Environment and Sustainable Development (Spanish: Ministerio de Ambiente y Desarrollo Sostenible)
MinCiencias	Ministry of Science, Technology and Innovation (Spanish: Ministerio de Ciencia Tecnología e Innovación)
CBD	Convention on Biological Diversity
CFSI	Cognitive framing of social interdependencies
CBD	Ecosystem-based adaptation to climate change
EbA	Socio-ecological systems
ES	Ecosystem service
FAO	Food and Agriculture Organization of the United Nations
ICCP	United Nations Intergovernmental Panel on Climate Change
NEI	New Institutional Economics
PES	Payment for ecosystem services
POMCA	River Environmental and Spatial Management Plan (Spanish: Planes de Ordenación y Manejo de Cuencas Hidrográfica
SES	Socio-ecological system

1. Introduction

Recently, ecosystem-based adaptation to climate change (EbA) has received much attention by providing solutions to address the twin crisis of global climate change and the degradation of ecosystem services (Munang et al., 2013; IUCN, 2012). Ecosystem-based solutions represent a way to confront climate change by reinforcing ecosystem services (ES) and can be seen in diverse contexts ranging from coastal to landslide protection (Andrade Pérez et al., 2010). This is particular true for many countries in the global South where livelihoods and local economies are closely related to the provision of ES meanwhile those are increasingly under pressure due to changes in land use patterns and rising global temperatures (Vignola et al., 2015). However, until now EbA is only implemented on a low-scale and often not in strategically important ecosystems where they would be needed the most (Keesstra et al., 2018).

EbA involves local decision-making about natural resource management and often stands in conflict between economic interests and environmental protection (Wamsler and Pauleit, 2016). Inappropriate governance arrangements, diverging interests of local stakeholder and missing incentives for long-term commitment demonstrate major barriers towards initiating EbA processes (GIZ, 2019). In this context, collective action has been described as a key mechanism to share benefits and costs of natural resource management and a rich literature of case studies has shown how ES can be managed sustainable via collective action arrangements (Ostrom 1990; Ostrom 2010a). Hence, to effectively initiate EbA, incentives need to be created to guarantee the multi-stakeholder participation and long-term commitment in such a process. Yet, governance tools for EbA have been largely thought from a or state-based or market-based perspective while mechanisms to strengthen collective action have gained much attention (Vignola, 2009; Barnaud et al., 2018; Wamsler and Pauleit, 2014).

This thesis aims to contribute to closing this theoretical and practical gap by finding ways of how governance tools for EbA can be designed that trigger collective action within local communities. It does so by building upon the insights from the New Institutional Economics (NEI) scholarship on governance arrangements that enable collective action (Ostrom 2010; Cardenas et al., 2011). I argue that this is addressed best by creating favorable conditions for *reputation*, trust and the 'cognitive framing of social interdependencies (CFSI) (Barnaud et al., 2018) that reinforce each other in an enabling relationship strengthening collective action for EbA (**Figure 1**).

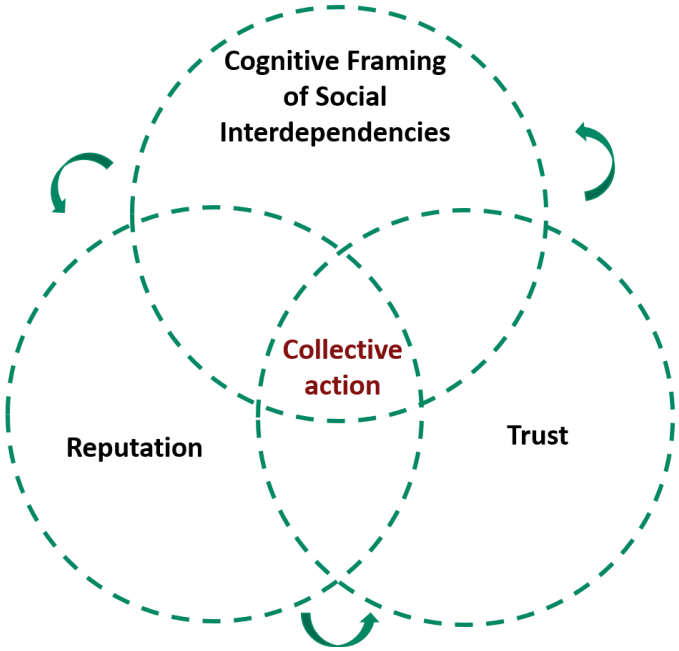

Figure 1: Enabling Relationship between Reputation, Trust and CFSI for Collective Action in EbA

This key collective action theories are combined with a political ecology perspective to address two main points: First, to build on the rich literature on payment for ecosystem services (PES), yet with a critical approach following Muradian's (2013) conceptualization of 'incentives for collective action' that sets the foundation to alternatives to a market-based approach to PES. Second, political ecology allows to understand the wider socio-ecological context of the case study and to address questions of identity that determine the relationship between the local community and ES. I follow Shapiro-Garza et al. (2020) that advocates for a more grounded, historically situated and inclusive approach to PES (p.3). Based on these conceptual underpinnings, I follow the hypothesis that specific ecological, socio-political, and economic processes shape the ways in which incentives unfold in a determined community.

Hereupon, a two-fold research strategy was chosen: First, a single case study that follows a "no size fits it all" perspective in the NIE that consisted of an exploratory fieldworks and interviews with local stakeholders. Second, an experimental game that that is based on a socio-ecologic dilemma in a watershed context[1] requiring collective action be solved. The empirical part of this thesis builds upon the thematic analysis of ten interviews with local stakeholders that are involved in natural resource management and two conducted game sessions with a total of ten participants.

[1] In this thesis, watershed context is defined as geographical space characterized by a river which connects upstream and downstream users via their water access. This watershed context is further defined by a high interdependency between among water users with significant spillover effects of an individual action (Cardenas et al., 2011).

In this thesis, I focus on the potential for collective action in EbA in an upstream and downstream community in a watershed in the Colombian Andes. This context is interesting from three perspectives: From an EbA perspective, communities in high-mountain systems are a "hot spot" of climate change adaptation as watershed dynamics provide many ES to downstream areas and major cities including water consumption, irrigation for agriculture or hydrologic power production (Salzman et al. 2016, p.9). From a NIE perspective, watersheds have played an important role in understanding the formation and challenges for collective action (Cardenas et al., 2011; Lubell et al., 2002). Finally, in political ecology, mountainous watersheds are often described as peripheric spaces (Bétrisey, 2016) that remain excluded from many infrastructural and other development services and hence EbA could represent an opportunity to diversify livelihoods in these areas. The case has hence the potential to contribute to the state of art of all these three research fields.

1.1 Research Objective and Research Questions (150)

The main research objective of this thesis is to provide new insights on how to design incentives for collective action in the EbA context considering the socio-historical and ecological context of local communities. This objective is two-fold: From an academic stand of view, I contribute to a better understanding of socio-ecologic and community-historic understanding in the design of PES and especially incentives for collective action. From a policy perspective, I aim to contribute to a more inclusive decision-making in natural resource management in the context of EbA that not only involves local stakeholders but actively integrates their development trajectories, community understanding and socio-economic needs into ecosystem service management.

Based on this objective, the overarching research question addressed in this thesis is:

Overarching Research Question: How can incentives for collective action be operationalized in EbA contexts?

Thereupon, three sub-questions were developed:

- **Research Sub-question 1:** To what extend does reputation influence the precondition for incentives for collective action?
- **Research Sub-question 2:** How can the necessary conditions for trust be created in incentives for collective action in EbA contexts?
- **Research Sub-question 3:** How can the cognitive framing of social interdependencies contribute to the design of incentives for collective action in EbA?

1.2 Outline of the Thesis

This thesis contains five chapters, including this introduction and a following context description (**Chapter 1**). The following chapters are structured as followed: In **Chapter 2**, the conceptual design of the thesis is described by outlining the main concepts and theoretical underpinnings of EbA and its governance (2.1), collective action for EbA (2.2) and incentives for collective action (2.3). **Chapter 3** outlines the methodological design by presenting two case study strategies based on an exploratory fieldwork and interviews as addressed by a thematic analysis. In addition, the design of an exploratory game for collective action for EbA in watershed context is provided. Thereupon, **Chapter 4** analysis the data set through the conceptual and methodological lenses focusing on how *reputation*, *trust* and the *CFSI* are shaped by the investigated community and the exploratory game. Based on these empirical findings, **Chapter 5** presents the conclusions of this thesis by addressing the research questions. Ultimately, the contribution and limitation of this research are presented as well as recommendations for future research and policymakers in EbA governance.

1.3 Context: Micro Watershed in Colombia's Sumapaz Province

Colombia's Sumapaz province is characterized by a multitude of micro and small watersheds that are nourished by the Sumapaz Paramo[2]. The province is characterized by a diversity of ecosystems, steep hillslopes, microclimates and seemingly abundant water resources (Montes-Pulido et al., 2017). These micro watersheds are of strategic importance for Colombia, as they flow into principles rivers (including the Sumapaz river and Magdalena river,) that supply water to the cities located downstream, irrigation for agriculture and hydroelectricity (Molina, 2003). Despite its socio-economic importance, these watersheds face critical dynamics of environmental degradation especially during dry season imposing challenges to local authorities and communities to improve their management (Torres Rojas and Díaz-Granados, 2018). As climate change is expected to put Colombia's water resources under pressure, these micro watersheds need to be protected (IDEAM and UNDP, 2014).

EbA has been promoted by the national and departmental Governments as one of the key climate change adaptation strategies to maintain water resources in the Andes (MADS et al., 2018). Yet, there are only few pilot projects and no policy instruments to support the implementation of EbA (Richerzhagen et al., 2019). For the adaptation to climate change of (mountainous) watersheds, the Colombian Ministry for Environment and Sustainable Development (MADS) recommends integrated

[2] "Páramos are highmountain wetlands, ranging from northern Peru to Ecuador, Colombia and Venezuela, and occur in isolated patches in Panama and Costa Rica. They are usually located above the Andean forests, at elevations over 3,000 m above sea level" (Andrade 2013, p. 23). . Throughout the Andes in Latin America, páramos play a fundamental role by sustaining through their ecosystem services the water supply of around 40 million people, including mayor cities such as Bogotá, Quito and Cali which is used for (pre-)urban use, agricultural irrigation and hydropower generation (Fecht, 2018)

watershed management approaches as well as several types of regenerative agriculture[3] including agroforestry and permaculture as key EbA strategies (MADS, 2018).

In this thesis, I focus on La Victoria micro watershed as a case study that represents the typical socio-environmental conditions of watersheds in the Sumapaz province and that offers the conditions to implement EbA via collective action. La Victoria passes the two neighboring villages Victoria Alta (upstream) and Victoria Baja (downstream) in the municipality of Silvania (**Map 1**) before it flows into the Subía River, one of the principal rivers of the Sumapaz province. La Victoria has its source in the protected forest reserve La Mistela in the immediate surrounding of the Sumapaz paramo. The main economic activity in La Mistela is agriculture, yet differently pronounced in up- and downstream areas. In upstream areas, farms are smaller and dominated by a colder and foggy climate. In downstream areas, agriculture tends to be more intensive and the climate is significantly warmer with coffee being the main crop.[4]

Map 1. Silvania, Cundinamarca – Colombia
Source: Municipality of Silvania, 2016

La Victoria watershed can be characterized as a 'peripherical space' (Bétrisey, 2016) which objectively can be seen in a lack of infrastructure and other development indicators and subjectively in the feeling of the inhabitants of being "left alone" by public authorities (see Chapter 4.1). While the two villages belong to the municipality of Silvania, there are important community institutions, including the Community Action Council (Junta de Acción Comunal), campesino groups and grassroot organizations. As elsewhere in the Colombian Andes the community has constructed and maintained aqueducts that represent the main water source for its inhabitants (Cardenas et al. 2011). However, changing land use patterns, a growing population and more extreme weather condition have put these arrangements under pressure and EbA represents an approach to adapt to the changing conditions.

Climate change and related extreme weather events as expressed in landslides, inundations and draughts in the lower part of the watershed, put additional pressure on the watershed. Considering

[3] Regenerative agriculture is "an alternative form of food and fiber production, concerns itself with enhancing and restoring resilient systems supported by functional ecosystem processes and healthy, organic soils capable of producing a full suite of ecosystem services" of which many have climate change adaptation benefits such as improved soil and water quality (Gosnell et al., 2019)

[4] Description based on observations during the explorative fieldwork (see Chapter 3.1).

socio-ecological conditions in La Victoria, the suitable EbA measures are integrated river watershed management (Watson, 2004) and agroforestry (Verschot et al., 2007) that both build a case for collaboration among local stakeholders.

2. Conceptual Framework

This chapter presents the conceptual underpinnings and heuristics of this master thesis. As followed, I first conceptualize EbA and lay out the governance challenge(s) that on-ground implementation confronts. Second, I address collective action for EbA from the NEI focusing on the enabling factors of reputation, trust and CFSI. Third, I add a political ecology perspective on payment for ES (PES) and concepts for a deeper understanding of the socio-historic contexts of the case study.

2.1 Ecosystem-based Adaptation to Climate Change

EbA has been initially defined in the Convention on Biological Diversity (CBD) as the "use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change" (CBD 2009, p. 41). EbA is anchored in theories of ES managing (Perrings, 2010). ES have been defined as "benefits that human recognize as obtained from ecosystems that support directly or indirectly, their survival and quality of life" (Harrington et al. 2010, p. 2781). ES are typically categorized into four sub-services: (1) provisioning services (e.g. water); (2) regulating services (e.g. flood or pest protection); (3) supporting services (e.g. nutrient cycling) ; and (3) cultural services (e.g. spiritual and recreational benefits) such as recreational, scientific, spiritual and other nonmaterial benefits (Constanza et al., 1997; Constanza, 2015).

EbA builds upon the strong relation between climate change, degradation of ecosystems and increased disaster risk which represent an imminent threat to humans and their livelihoods (ICCP, 2014): Anthropogenic climate change increases the frequency and intensity of extreme weather events and causes ecosystem degradation (ICCP, 2014). This threatens the resilience of ecosystems and human livelihoods against the impacts of climate change and increased risk of disaster (Munang et al., 2014). In turn, degraded ecosystems lose their capability as a natural carbon sink that exacerbate this trend (ICCP 2019, ICCP 2014). This relationship creates a 'vicious spiral' and increases the vulnerability of local communities, as (simplified) illustrated in **Figure 1** (Munang et al., 2014).

Against this background, EbA creates linkages between ecosystem service planning, climate change adaption and disaster risk reduction which, if managed in the right way, can create synergies among each other by: (1) increasing climate change resilience of human and natural systems; (2) providing protection against diverse climate-related hazards (e.g. landslides and storms) and slow-onset effects (e.g. rising sea levels); and (3) supporting the natural carbon sink of ecosystem thereby contributing to climate change mitigation (Munang et al. 2014, p. 49). Hence, EbA builds on an reinforcement of the regulating ES, for instance, mangroves forests can act as a 'natural shields' in flood protection (Das and Vincent, 2009) with diverse side effects including carbon sequestration and breeding sides (Colls et al. 2009; Martin and Watson, 2016). Therefore, EbA demonstrates a paradigm shift away from hard

structures (e.g. dams) and has been promoted for its multiple co-benefits contributing to avoid 'maladaptation' and as a 'no regrets' approach to confront climate change (Salzman et al., 2016).

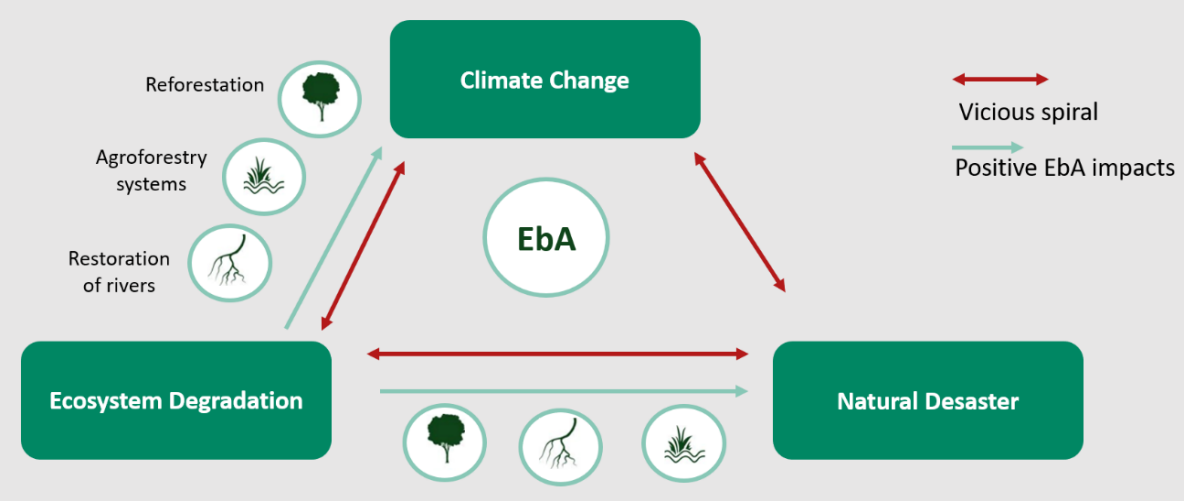

Figure 2: *Interaction between climate change, ecosystem degradation and increased disaster risk*

adopted from Munang et al. (2014, p. 48).

2.1.1 EbA Governance Challenge

While the importance of EbA is increasingly understood, the approach only slowly gets incorporated into regional adaption and development plans (Iza, 2019). The governance challenge in the implementation of EbA are multi-faced and often require collective action to be solved:

First, as a territorial approach, EbA requires cooperation and long-term commitment of ES providers, beneficiaries, and intermediaries (e.g. environmental or water authorities) (Barnaud et al., 2018). Here, collective action is pivotal as EbA relies ES management and the production and the sharing of EbA benefits that need to be collectively approached (Vignola et al., 2009). Therefore, EbA requires a discussion among trade-offs, such as the transition towards agroecology which requires monetary and time efforts which may generate winners and losers (Barnaud and Antona, 2014).

Second, EbA needs to be operationalized in a way that it becomes tangible for local stakeholder (Barnaud et al. 2018). This requires a transition towards land-use practices that reinforce ES and requires coordination among the multiple land users shaping these territories (Duru and Therond, 2015; Smith et al., 2005). Yet, EbA is often implemented in the "periphery" where local communities depend on natural resources for their livelihood (Richerzhagen et al., 2019). Therefore, EbA needs be

useful for the local community, improving their livelihoods and consider their socio-economic realities[5] (Vignola et al. 2015, p. 129).

Third, this challenge is particularly pronounced in watersheds and high-mountain systems (Swallow et al., 2006). These ecosystems are characterized by a vertical water access[6], heterogeneity among stakeholders as well as a distance between ES providers and users (Cardenas et al., 2011). Collective action in watersheds contexts is especially relevant as "actions of individuals often have widespread spillover effects" in combination with strong interdependencies among water users across different geographic locations of a watershed (Cardenas et al. 2011, pp. 275-276). This dynamic is also pronounced in climate change adaptation measures in mountainous regions (Salzmann et al., 2016).

2.2 Collective Action for EbA

In this thesis, collective action is defined *as a voluntary process of cooperation among local stakeholders addressing a common EbA management problem in a local (hydro-social) territory*[7] (adopted from Barnaud et al. 2018, p.3). The implementation of EbA in local territories can be addressed from a socio-ecological system (SES) perspective. SES are "complex integrated system in which human are part of nature (Ostrom, 2009). To implement EbA in SES, the interdependencies between livelihoods and ES need to be considered as interlinked in a SES. SES are typically approached from polycentric governance, that beside market- and state-based mechanisms highlights the necessity to create mechanisms to integrate local stakeholder via collective action (Ostrom 2010).

How to govern SES through collective action has widely been addressed in the NEI and there is a rich literature about underlying variables that influence collective action. There are three nested dilemma that confront collective action in SES (Janssen and Ostrom 2006, p. 61: i) over-appropriation by multiple users of a common-pool resource what has been famously described by Hardin (1968) as the "tragedy of the commons"; ii) the time and effort spending on establishing a set of rules to govern the resource and iii) the monitoring and sanctioning of these rules.

In this context, the notion of free riders – someone that contributes "little or nothing toward the cost of the good, while enjoying its benefits as fully as any other group member" (Kim and Walker, 1984) – are important to consider. This involves that in collective action dilemmas, actors tend to follow self-

[5] An added value for local communities is possible, for instance, in the case of smallholder farmers by promoting a biodiversity-based agriculture (e.g. agroforestry) with positive side effects including increased food security, income generation and livelihood diversification (Schroth, 2009; Vignola et al., 2015).

[6] Watersheds are by nature vertical what produces asymmetries in water availability between upstream users – who can access the water resource first – and downstream users which are necessarily affected by the water management of respective upstream users (Swallow et al., 2006).

[7] In the frame of this thesis, (hydro-social) territory is approached from the political ecology scholarship as defined as a "spatial configurations of people, institutions, water flows, hydraulic technology and the biophysical environment that revolve around the control of water" (Boelens et al. 2006, p.1).

interested strategies with higher returns on the short term (Nash equilibrium), but which will create significantly lower outcomes on the long-term than the joint approach and a social optimum can be only be created via cooperation (Ostrom, 2010a; Cardenas et al, 2013). Yet, rather than following a model of rationality, leading scholars follow a theory of "bundled rationality norm-based human behavior" to explain why individuals engage in collective action (Ostrom 2010, p. 156).

The NEI comes to the conclusion that governance arrangements tend to be more effective solving socio-environmental dilemmas when building on institutional arrangements based on reputation and trust as interlinked by indirect reciprocity as demonstrated in **Figure 2** (Ostrom, 2007; Ostrom, 2010b). The challenge is hence to analyze how these individual and structural variable work together in a collective action dilemma and how such a situation can be overcome.

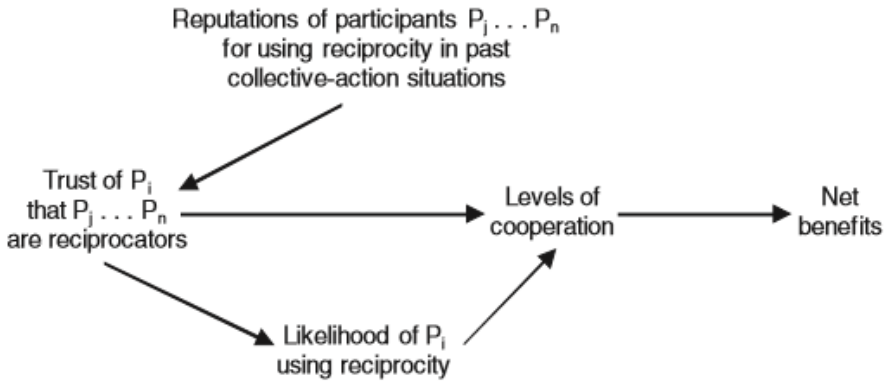

Figure 3. The Core Relationships at the Individual Level Affecting Levels of Cooperation in a Social Dilemma *(Source: Ostrom 2007, p.200)*

As followed, I conceptualize reputation and trust being two central variables in the core relationships that affects levels of cooperation in ES dilemma as linked through indirect reciprocity. Indirect reciprocity is the process when individuals have the "possibility to decide whether to help others, and thereby base their decisions on […] reputation" (Sommerfeld et al. 2008, p. 2529).

Instead of 'common pool resources' as commonly used in the NIE, I follow an ES perspective to explain the underlying dynamics to create collective EbA agreements. While common pool resources are clearly defined goods, ES include a jointness of several common pool resource and the services that they produce ranging from land slide protection, to draught resilience or pollination services (Barnaud et al., 2018). ES are hence more diverse and dynamic referring to underlying ecological processes and "through ES, the welfares of different stakeholders are interconnected" (Murudian 2013, p. 1160). Based on this perspective, a new variable is presented – the CSFI (Barnaud et al., 2018).

2.3.1 Reputation

In line with Ostrom's model (2007), reputation in this thesis is understood as *a perception that stakeholders have of another's intentions and norms in ES management in a local territory based on group identity, gossip and previous interactions*. This reputation is understood as a 'multi-agent system' that can exist on an individual level between two stakeholders, at group-level within different social groups, or between one actor and a social group in local territory (Lui et al., 2002).

Reputation cognitively collects information about a history of interaction in a territory and has the benefits to allow ES users to judge whether to cooperate with others (Kreps and Wilson, 1982). At the same time, reputation motivates stakeholders to be honest or "play the rules" as having a poor reputation (e.g. in the case of free riders) is likely to prevents others to interact or to exclude them (Liu et al., 2002).

I differentiate between three different variables that determine reputation: First, reputation often builds on the creation of *group identity* and respective normative feelings (Cardenas et al., 2011) or more generally, "identities that individuals create which reflect their intentions and norms" (Semmann et al., 2004; Ostrom, 2003). Second, *gossip* – a conservation about social information especially of third parties – is regarded as an important phenomenon for reputation (Sommer et al. 2007, p. 17435): i) "gossip is a tool for social control to hold the community together; ii) "gossip is a means of social learning and strengthen social bonds", however, iii) gossip can also "promote self-interest and individual benefits" and might be used to damage the social status of others and can hence also divide groups (Sommer et al. 2007, p. 17435). Third, prior positive or negative experience in the interaction and governance of ES.

2.3.2 Trust

In this thesis, I use the commonly cited definition of Rousseau et al. (1998) to define trust as the "intention to accept vulnerability based upon positive expectation of the intentions of the behavior of another" (p.395). The governance of ES necessarily involves trust as arrangements usually comprise rules restricting access in their interaction with a given ES on which a livelihood depends (David and Goldman, 2019). There is hence the necessity of trust in other involved stakeholder to follow the same rules and without the required level of trust individuals are unlikely to engage in a risky cooperation strategy (Janssen and Ostrom 2006, p. 68).

I follow the thesis, that the initial level of trust is influenced by equity in the share of benefits in EbA projects as well a perceived fairness between investment and takeout was tested (Cardenas et al., 2011), following this logic: 1) greater redistribution leads to increased confidence; (2) greater

confidence; more contribution to the common ressource; (3) the greater the contribution to the common ressource, the more confidence.

2.3.3 Cognitive Framing of Social Interdependencies

In this research, I integrate an alternative concept – CFSI – as proposed by Barnaud et al. (2018) to Ostrom's (2007) core relationship determining collective action. From an ES perspective: "As people impact and are impacted by […] various ecosystem services, the ES concept has the potential to highlight social interdependencies among people".

In line with the above, I define social interdependency as the cognitive *framing of a stakeholder that he/she is dependent on other people in the provision or benefiting of an ES*. These interdependencies can exist between ES providers that co-produce, preserve or degrade; ES beneficiaries; and intermediaries as demonstrated in **Figure 3**. In a watershed context, for instance, the decision of upstream users of how much water to use for irrigation not only benefits downstream farmers but also affects the water quality, the loss of biodiversity or the interest of tourists to visit this river. To cognitively frame this social interdependency is important for collective action as stakeholders need to mutually interdependent to cooperate and to see that a solution to ES problem lies in the cooperation with others (Barnaud et al., 2018; Leeuwis, 2000).

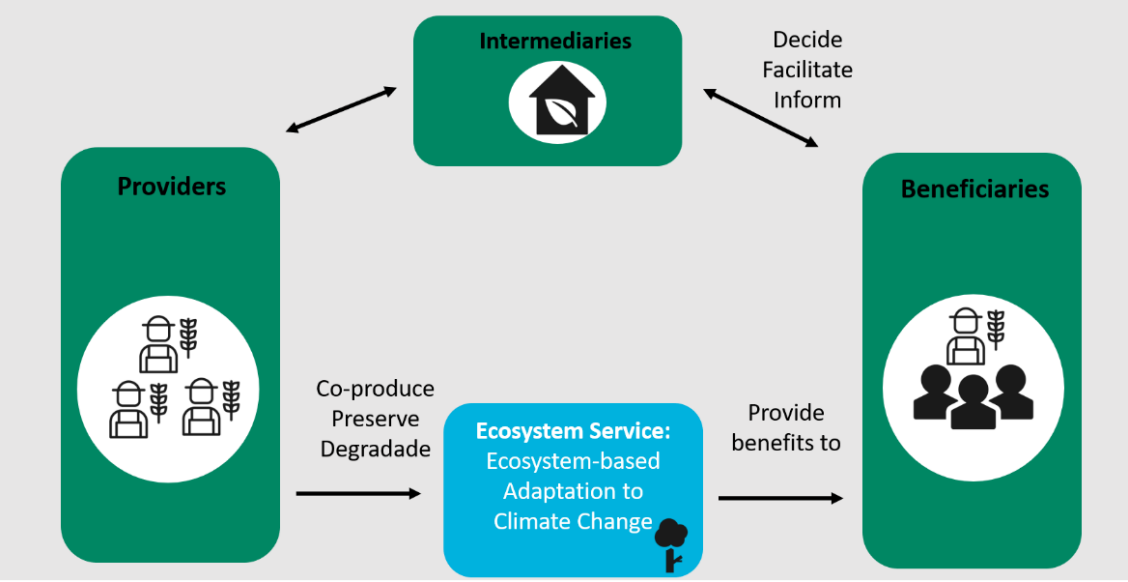

Figure 4: Social Interdependencies in ES Management

(adjusted from Barnaud et al., 2018)

2.3 Incentives for Collective Action

The ES approach integrates ecological principles into policy and economic decision making (Wamsler et al. 2014, p. 64) with the aim to address two main issues: i) to help solve the tension between

economic development and environmental conservation and ii) to influence the decisions made by the users of a resource base, so that they align their pacts with the interests of beneficiaries of ES (Muradian and Rival 2012, p.94). From an environmental policy perspective, incentives are a suitable approach to support socio-environmental transformation (Muradian et al., 2010).

In environmental policy and economics, PES have had a remarkable spread and are currently the most common environmental policy instrument to address the trade-off between conservation and economic development (Shapiro-Garza et al., 2020; Grima et al., 2016). PES is commonly defined as "voluntary transaction where a well-defined ES (or a land-use likely to secure that service) is bought by an ES buyer from an ES provider if and only if the ES prover secures ES provision" in a market-like setting (Wunder 2005, p. 3). This 'Coasean approach' to PES has been criticized as 'green capitalism' and for promoting Western and utilitarian views of nature (Brockington and Duffy, 2011). Yet, PES has also created "momentum among researchers and decision makers on the importance of biodiversity and ecosystems for societies" and therefore, a "critical but constructive" perspective of this concept will be elaborated in this paper (Barnaud et al. 2018, p. 7).

In response to these critics, Muradian (2013) argues that PES should be framed as incentives for collective action. Muradian (2013) brings insights from the NEI by i) framing the governance of ES as a social dilemma (and not an externality issue as in Cosean PES); ii) by integrating hybrid structures into PES governance and iii) and emphasizing the distinction between incentives and other monetary policy instruments (rewards and markets). Incentives add "extrinsic monetary consideration" to already existing motivation of the resource user to maintain the ES but may support a "tipping point" in changing environmental behavior or may cover important cost or capacity building to transform to a more bio-biased economic model (Muradian and Rival 2012, p. 97).

With the purpose of finding alternatives to Cosean PES schemes, a growing body of political ecology scholarships have investigated the interplay between socio-historical contexts, development pathways and question of justice underlying incentives for collective action (Shapiro-Garza et al. 2020, p. 10). Shapiro-Garza et al. (2020) advocates for a more grounded, historically situated and inclusive approach for the conformation of PES (p.3). Therefore, local development pathways need to be understood as

"Co-produced by the interaction of human activity and natural processes and inevitably influenced by historically built and evolving rules and norms, livelihood strategies, culture and worldviews, and underpinned by state policies, markets and changing environmental conditions"

(Shapiro-Garza et al. 2020, p. 12)

To understand the development pathways of the territory addressed in the case study, I present three main concepts to enrich the political ecology perspective of this thesis.

2.3.1 Campesinos

Closely related to socio-historical contexts and social justice in rural contexts in Latin America are the concepts of rural livelihoods (Bebbington, 1999). Campesinos (Spanish for peasants) have been victims of land grabbing and several violent confrontations throughout the 20th century which forced them to settle in isolated areas that often have challenging climatic conditions, such as high mountain systems (Le Grand, 2016). Colombia's rural areas in which campesinos live have widely been ignored by policy makers and have significantly lower development indicators than urban spaces, such as literacy rates, basic medical services and poverty (Duarte and Segura, 2016).

Due to their historical context in the center of Colombia's violent conflict and their proper way of rural livelihoods, campesino's have been described as a social class and culture in Colombia (López, 2015). Beside indigenous and afro-Colombians communities, campesinos belong to Colombia's most marginalized groups, pleading currently for the acceptance of special rights in the Colombian institution (Lederach, 2017).

In the scientific debate around EbA, and ES more generally, campesinos and other local communities have an important role by contributing 'traditional ecological knowledge' (TEK) to Western conservation science (Nalau et al., 2018; Mercer et al., 2012). TEK is commonly described as "a body of knowledge and beliefs transmitted through oral tradition and first-hand observation" (Dene Cultural Institute, as cited in Stevenson 1996, p. 281).

2.3.2 Rural Gentrification

Historically, there has been a strong migration from rural areas to urban centers in Latin America in the search for better livelihoods opportunities (Duarte and Segura, 2016). Recently, there has been the countertrend of an urban middleclass that relocates to rural areas. In this thesis, I focus on neo-rurals in the context of agroecological antagonism to neo-liberal globalization as global phenomena particularly pronounced in Latin America (Gúzman and Martinez-Allier, 2006). As defined by Méndez Sastoque, neo-rurals "have the interest to contribute to the improvement (or restoration) in the rural host communities values contrary to those of the capitalist market logic […] as guides of relationship with others and the environment" (Méndez Sastoque 2013, p. 28).

The notion of "neo-rurales" gives the opportunity for a reinterpretation of urban-rural dynamics in Latin America (Parra Delgadillo, 2018). In recent years, new motivations to move to rural areas have been added, including "entrepreneurial neo-rurals" that are interested to develop innovative business

proposals in rural areas different from those traditionally agricultural including agritourism, alternative medicine or 'green businesses' (Méndez Sastoque, 2013).

Closely related to this is the notion of rural gentrification that describes dynamics beyond a simple counter-urbanization "emphasiz[ing] not only demographic aspects but the broader social, economic and cultural transformations involved in the process" (Solana-Solana, 2010). The term rural gentrification focuses critically on influence of middle-class urban citizens on transforming rural areas resulting from "individual and group efforts at social differentiation by gentrified, as well these actors' search for a rural idyll and consumption alternative based on nature, tradition and agricultural values" (Alonzo Gonzalez, 2016). The commercialization of cultural (rural) heritage is a big part of this trend and often excludes the native population (Latour, 2013).

2.3.2 Social Justice in PES

In the PES literature, justice and equity is prominently represented as many have had the hope that PES schemes could be an opportunity for a more inclusive rural development (Wegner, 2016). This ranges from formalizing land rights of marginalized people, the access of minorities to PES schemes and the question if recipients were able to increase their incomes or diversify livelihoods (Mahanty et al., 2013; Grima et al., 2016). The large majority hence focus on a "fairness of distribution" as in justice theories following Rawls (Bétrisey et al., 2018). In line with Bétrisey et al. (2018) and Nelson et al. (2020), I argue that beyond redistributive justice, recognition should be considered in alternative PES schemes: "injecting the notion of recognition allows a better depiction of complex local power dynamics and situations of (in)justice" (Bétrisey et al. 2018, p.1).

Fraser (1995) argues that recognition and redistributive justice need to go together to overcome social inequalities. Fraser's theory of social justice that considers social recognition as an instrumental condition of social justice if it is directed toward increasing people's participation and integration in in social life (Fraser, 2000). Social recognition "of the different" is recognized by each other "as peers, capable of participating on a par with one another in social life, then we can speak of reciprocal recognition and status equality" (Fraser 2006, p. 28).

2.4 Summary

In this chapter, EbA has been embedded in the wider governance context and challenges in its implementation on the territorial level were listed. To implement EbA, collective action is a useful concept to communicate between the different stakeholders, negotiate wins and trade-offs and reach long-term commitment and cooperation. Insights from the NEI are useful to address EbA governance in SES. In particular, dynamics of trust, reputation and CFSI are at the center of this thesis. This is

supported by a political ecology perspective helped to change the perspective from a Cosean PES to incentives for collective action. Finally, I argue that local development pathways and socio-historical contexts need to be considered when designing governance arrangements for EbA.

3. Methodological Consideration

This chapter lines out the research strategy and methodological consideration underlying this thesis. The research strategy is understood as a way to articulate different techniques to systematically answer the research questions and thereupon accomplish the research objective (Verschuren and Doorewaard, 2010). The methodological choices should be consistent with the conceptual and epistemological orientation of a research project (Perreault et al., 2015).

A research strategy aiming for qualitative and empirical knowledge was selected: a single case study which permits to investigate in depth the SES of La Victoria watershed. The methodological strategy consists of three methodological stages: i) an exploratory fieldwork; ii) a content analysis of interviews conducted with local stakeholder and iii) an experimental game. On the one hand, the content analysis permits to understand in depth the rationalization of people, without the need for a direct interaction with other actors. On the other hand, the experimental game is a way to collect information that allows to understand the interaction between up and downstream users' actors in the territory and capture how they make intuitively decision related to collective action.

3.1 Exploratory Fieldwork

During the thesis, I joined as a visiting researcher the agroecology research group of the University of Cundinamarca (Colombia) and participated in the project "Geospatial Tool for the Construction of the Cocio-environmental Diagnosis of the Territorial Development Plan of the Municipality of Silvania – Cundinamarca"[8] financed by Ministry of Science, Technology and Innovation (MinSciencias). This research project focuses on La Victoria watershed and thanks to the opportunity to become familiar with the territory and its community, I selected the same case for this master thesis project. The related activities within this research project included a transect walk through the watershed organized by community members, community water quality assessment activities and two meetings with community organizations. During this two meeting, this thesis research project was presented (**Appendix 1**).

During this research internship, I conducted an exploratory fieldwork aimed at: i) gathering information on the socio-ecological conditions in La Victoria watershed; ii) establishing practical conditions to conduct the two other stages of the fieldwork methodology; iii) ethnographic observations that contributed to understanding the wider context of the interviews. While this fieldwork is not a central part of the analysis in Chapter 4, the content analysis is complemented by the impressions gained during the various activities in the field related to this research project.

[8] Spanish Translation: *Herramienta geoespacial para la construcción del diagnóstico socioambiental del Plan de Desarrollo Territorial del municipio de Silvania -Cundinamarca*

3.2 Content Analysis

The semi-structured interviews were constructed based on analytical categories derived from the theoretical approach focusing collective action and natural resource management. The interviews represent the main mode of data collection and structured in seven thematic blocs: i) basic personal data; ii) interaction with the watershed and existing socio-environmental conflicts; iii) perception of climate change; v) reputation, vi) trust and vii) CFSI (the interview guide can be found in **Appendix 2**). In addition, there were individualized questions depending on the profession of the interviewees such as whether they were water managers or farmers.

The data set compromises interviews with ten inhabitants from the two villages who were selected based on their experience in local agriculture, water management and community organization. As will be further explained in the analysis, the social group – campesinos or neo-rurals – to which interviewees identify was another important differentiation. **Table 1** *gives a brief overview of the interviewees highlighting relevant aspects for the analysis.* In accordance with the ethical guidelines of the University of Twente[9], the participants are anonymized by giving them other typical Colombian names. In the text, it is referred to the interviews with the name of the respective interviewee and direct citations are numbered and can be found in **Appendix 3**.

The topic of this thesis, research questions and data collection method all suit thematic analysis – "a method for systematically identifying, organizing, and offering insight into pattens of meaning (themes) across a data set" (Braun and Clarke 2012, p. 57). Thematic analysis permits to see and understand the collective meanings and experience across a data set (Gavin, 2008). Rather than focusing of on single findings it is used to find patterns throughout the data set that contribute to the research questions (Guest, 2011).

Considering that the research questions are experimental and theory proving, the thematic analysis was exploratory. The analysis followed a combination of an inductive and deductive approach to thematic analysis: Inductive in the way that the majority of themes are directly derived from the experience of the interviewees and deductive because these findings are theoretically grounded in the NIE and political ecology scholarship to uncover problematics that interviewees did not explicitly mentioned.

[9] The ethical consideration of this thesis, including the contact with local communities and interviewees were approved by the BMS Ethics Committee on September 25th 2019.

Overview of Interviewees					
Nr.	**Interviewee**	**Sex**	**Occupation**	**Years living in La Victoria**	**Group**
Victoria Alta					
1	**Maria**	F	Campesino and president of the JAC	>50 (native)	Campesino
2	**Pedro**	M	Farmer	>10	Neo-rural
3	**Jorge**	M	Water manager	>50 (native)	Campesino
4	**Teresa**	F	Farmer	<5	Neo-rural
5	**Manuel**	M	Plumber and farmer	>50 (native)	Campesino
Victoria Baja					
6	**Juliana**	F	Water manager	<5	Neo-rural
7	**Marco**	M	Farmer and community leader	>10	Neo-rural
8	**Pepe**	M	Farmer	> 20	Campesino
9	**Arturo**	M	Farmer	> 40 (native)	Campesino
10	**Luisa**	F	Farmer	>5	Neo-rural

Table 1: Overview of Interviewees

I follow Braun's and Clarke's (2012) approach to content analysis following six phases: i) familiarization with the data set; ii) generating initial codes; iii) searching for themes; iv) review of potential themes; v) defining and naming themes; and vi) writing. A theme "captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set" (Braun and Clarke 2006, p.82).

In order to guide the content analysis, the derived main codes were grouped according to three stages of analysis reputation, trust and socio-ecological interdependencies of which the three most relevant sub-themes to answer the research questions are presented in the empirical findings as presented in the following chapter and are summarized in **Figure 5**.

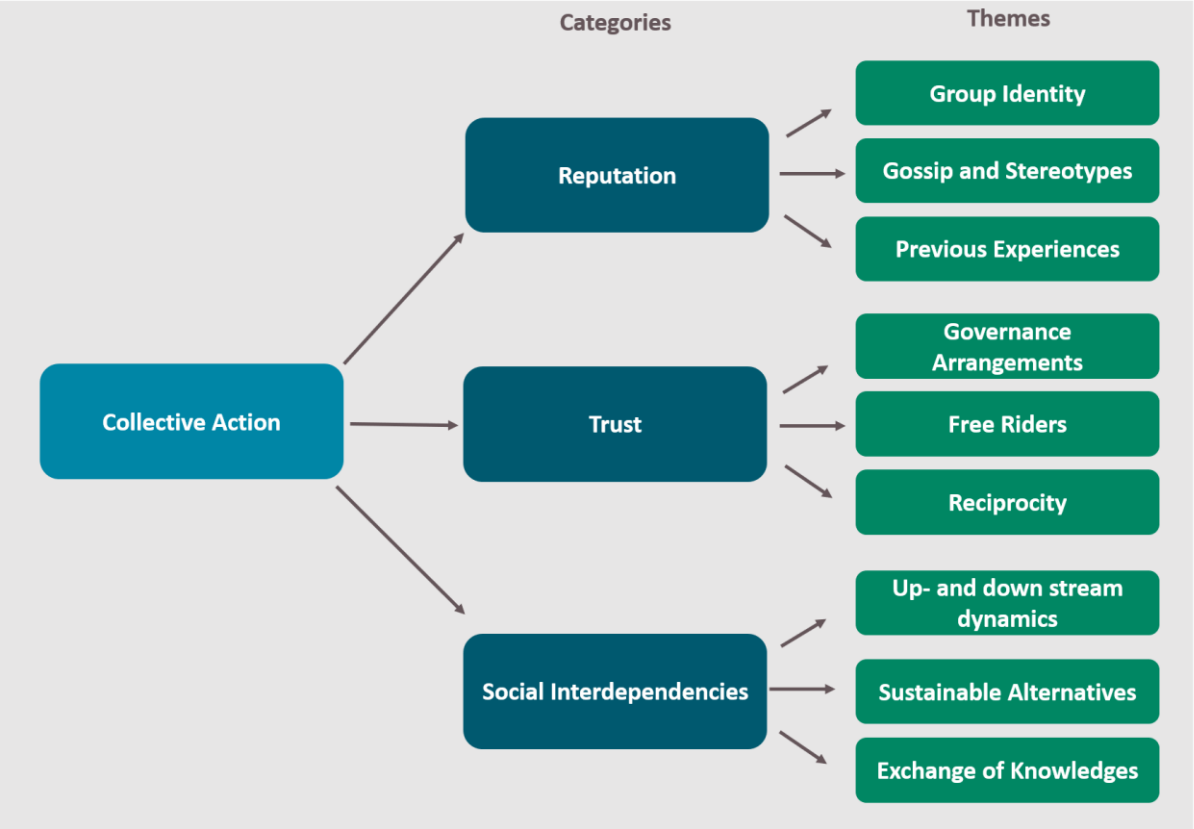

Figure 5: Established Themes of the Thematic Analysis

3.4 Experimental EbA Game

In the NIE, there is a long tradition of common-pool resource experiments inspired by the ground-breaking work of Ostrom, Gardener and Walker (1994). Experiments "can be designed to test the effectiveness of alternative institutional options for stimulating collective action by strengthening [the] critical variables" of reputation, trust and reciprocity (Cardenas et al. 2011). This thesis builds upon these concepts, using an experimental approach to assess the behavioral effects of incentives on reputation, trust and the CFSI among participants in SES. Further, such an experimental approach contributes to the "need to enhance our knowledge about how incentives may induce changes in the rules governing collective action in the management of natural resources" (Muradian and Rival, 2012, p. 98). Most of these experiments follow a static non-linear common resource dilemma that is experienced by different player in which the social optimum could uniquely be achieved if participants involved decide to cooperate by selecting strategies which go beyond the Nash equilibrium (Cardenas et al., 2013; Ostrom, 2010).

With this background, the experimental EbA Game is adopted from the "Irrigation Game" as presented in Janssen et al. (2012) and Cardenas et al. (2013) that focuses on how to solve the dilemma of an unequal access to irrigation through collective action. This game is suitable for the purpose of this research as it has similarities in the ES dynamics and dilemmas underlying the governance of EbA in

the Victoria watershed, namely: i) similar to irrigation management, EbA is only successful if stakeholder contribute jointly and share benefits; ii) as the focus of this research is on ES providers and receivers in a watershed, asymmetries as considered in the Irrigation Game between up-and downstream agents are pivotal; and iii) it is possible to integrate the structural variable underlying this research (reputation, trust and CFSI) as well as to test different incentive schemes. In addition, the "Irrigation Game" has widely been implemented in different irrigation contexts and countries, including multiple experiments in Colombia (Janssen et al. 2012; Cardenas et al., 2013). The results of previous studies following the "Irrigation Game" offer the additional advantage that the generated results can, to a certain extent, be comparable with the results of previous studies.

The EbA Game follows this basic structure: Five farmers[10] are situated in an imaginary watershed from up- to downstream and need to adapt to climate change via EbA. In each of the total four rounds, they need to cultivate a field and have to choice whether to practice conventional agriculture – that is more profitable but vulnerable to weather shocks – or agroforestry – requiring more work and expenses while being more drought-resilient[11]. In addition, the players can invest into an "Integrative River Management Fund" (IRM fund) that collectively constructs an EbA structure in the watershed. Players do so by contributing tokens to the IRM fund that can be multiplied if sufficient players participate in this contribution. In the subsequent step, starting from upstream, players can access this fund. How much to contribute to the fund and how much each player takes are secret choices.

The IMR fund represents a collective action problem where the Nash equilibrium means that no player is willing to invest and the social optimum is only achievable when all players actively invest. Other socio-ecological dynamics integrated in the game are: i) droughts; ii) the difference between landowners and tenants and iii) the vertical water access. During the game, three incentives that aim to increase adaptation and collective action are introduced (in round 2-4): i) social infrastructure, a harvest cooperative and conditioned landownership as shown in **Figure 6**. The game gives hence the opportunity, to analyze collective action based on reputation, trust, and CFSI under changing variables.

An in-depth description of the game and game explications for the participants can be found in the ***Appendix 4*** *and* ***Appendix 5.***

[10]I follow the number of participants as introduced in the "Irrigation Game" that offers the advantage to clearly differentiate between upstream (player A and B) and downstream users (player D and E) with a relatively low number of participants.

[11] All participants watched a video before starting the game that informs about the EbA and its strategies as provided by the MADS. The video can be found here.

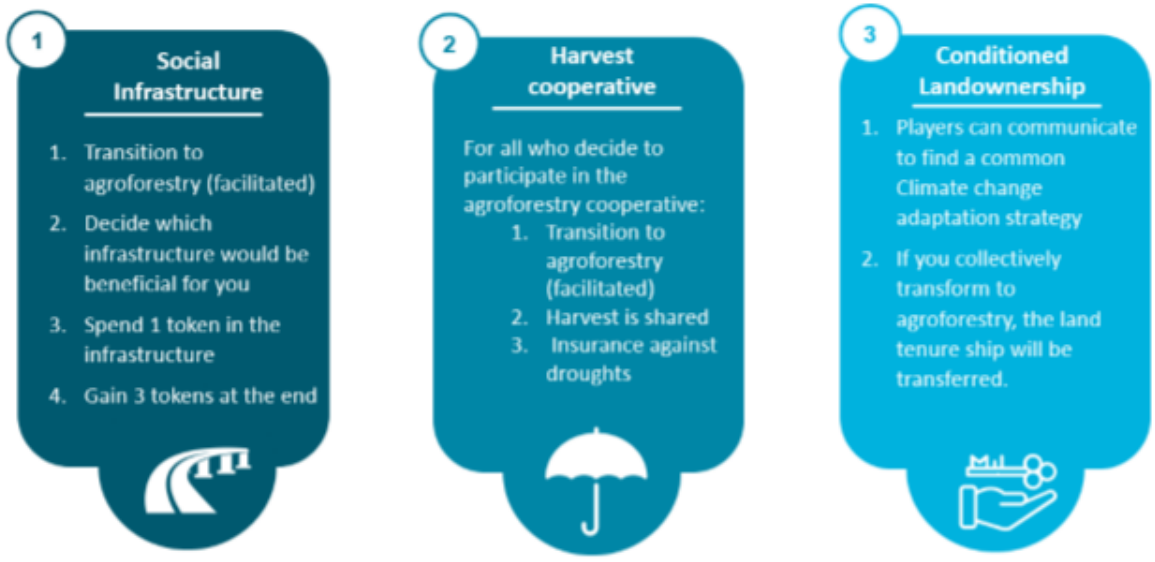

Figure 6. EbA Game - Overview of Incentives

3.4 Final Remarks

The data gathering was heavily affected by the COVID-19 restrictions that led a countrywide quarantine in Colombia from mid-March 2020 to present (24.07.2020). The experimental game, originally designed as an in-person workshop, had to be transformed into an online game. This implied that the online version was narrower version of the originally designed game with the aim to play within a timeframe of no longer than two hours. Most importantly, despite several attempts and strategies to onboard participants, it was not possible to conduct the game with stakeholders form the Victoria watershed and instead researchers from the University of Cundinamarca and with MSc. Students participated in the game. In the case of the University of Cundinamarca, each of the game participants were part of the above-mentioned research project and were hence familiar with the dynamics of La Victoria watershed and more generally with the management of ES. In both groups, the gender balance were three women and two men.

Despite these shortcomings, the insights gained from the experimental game are still meaningful to answer the research questions and from a methodological point of view: First, it allows to understand the interaction between up and downstream users actors in the territory and capture how they make intuitive decision related to the three categories of analysis. Second, this game-setting gave interesting insights from a methodological point of view as it showed a translation towards an EbA context as well as an online setting to the game developed by Cardenas et al. (2008). However, due to this shortcoming the game has a less central role in answering the research question and rather functions to support the findings in the content analysis.

4. Analysis and Empirical Findings

This chapter is dedicated to present the analysis of the two data sets: the interviews as analyzed via a content analysis and the experimental game that has been addressed statistically in the context of previous games based on social dilemma around ES governance. In a final step, the empirical findings of these two analyses are summarized and common features are highlighted.

4.1 Content Analysis

As followed, the results of analysis of the interviews conducted with farmers, local water managers and the community action committee of Victoria Alta and Victoria Baja are presented. The narration follows themes representing variables that explain reputation, trust and the CFSI.

4.1.1 Reputation

The three most striking themes grouped under reputation are (1) group identity, (2) gossip, and (3) prior experiences with public authorities in environmental management are presented.

4.1.1.1 Group Identity

In the watershed, reputation is closely linked to the social group that a community member belongs to. These two groups are described by the community members as “campesinos” and “neo-rurals” (Quote 1). Notably, there has been no specific reputation or identity linked to the inhabitants from Victoria Alta or Victoria Baja or a differentiation between upstream and downstream users.

The notion of campesino is given to the farmers families that are native to the two villages. A community leader described campesinos as “a women or a men that lived her/his whole life in the rural world, that lives from the land that works with the land who has cows and crops and that needs to take care of by her/his own” (Maria). The relationship between a campesino and the land is central in the self-identification of the campesino as well as the importance of ancestors or the “campesino family” (Arturo; Quote.2; Quote.3)

Since about ten years, a “remarkable dynamic” in the watershed is the growing number of so-called “neo-rurals” that came from the capital with their families to start a new life in the countryside (Interview.3). Most of them bought land to “reconnect with nature” (Interview.2), revitalize (Interview.4), or to “fly from all the traffic and dirt and a world that finally doesn’t work” (Interview.6).

The interviewed campesino and neo-rurals can also be differentiated by the type of agriculture they practice and what part of their life this affects. Campesinos, on the one hand, typically have agriculture as their only income. They usually sell their harvest to middlemen who come with the transporters to the village and bring it to the major markets in Bogotá. In turn, neo-rurasl indicated to practice organic

agriculture including agroforestry (Interview Luisa, Interview Pedro). Some of them are entrepreneurs having their own brand that takes over different steps across the agriculture value chain (Quote.4).

4.1.1.2 Gossip and Stereotypes

These two group identities are associated with gossip and stereotypes. For many campesinos, neo-rurals are "hippies" that "only let the grass grow" (Interview Pedro). Neo-rurals are further qualified as "new rich people" who do not live from agriculture and "do not have the same struggle as we have" (Interview Edgar). In the context of environmental protection, a campesino stated that "for the neo-rurals, it is easy to be environmentalists because they do not have much to lose, they do not need to feed their families with what they grow" (Interview Arturo). Another stereotype seems that the neu-rurals are "somehow hypocritical" (Interview Maria, Quote.5; Quote.6) and "always know how to do everything better" (Interview Pepe).

The stereotypes that neo-rurals attribute to the campesinos were less implicit. Yet, statements including "campesinos have a fundamental role for the well-being of the country and their work is really admirable, however, they could be more conscious" (Interview Teresa) underline a critical opinion about campesinos. Further, campesinos were criticized by neo-rurals for burning their waste and damaging the water and soil quality by using pesticides (Quote.7; Quote.8). Finally, the neo-rurals attribute the campesino a certain degree of stubbornness about environmental improvements. "We have tried so many different things to convince them of agroecology, this has not been an issue of misinformation" (Interview Luisa). "They [campesinos] do not dream about the territory on the long-term. They are only interested in their immediate survival" (Pedro).

Beyond these stereotypes, "jealousy" between social groups has been indicated regularly throughout the interviews (Interview Maria, Manuel, Jorge, Luisa). For example, some neo-rurals started to develop agritourism projects that are criticized by the campesino for being exclusively for neo-rurals and for not having an added value to the community. "What sort of agritourism is that? A land without campesinos?" (Interview Maria) or "Just putting a label on it, does not make it campesino" (Interview Pepe).

4.1.1.3 Previous Experience in Cooperation

Another important aspect of reputation is the interaction between the community (ES providers) and the local environmental authority and municipality (intermediaries).

First, among the campesinos, the CAR has the reputation for being only called when there is trouble (Interview Maria, José, Teresa). A campesino leader reported that once a campesino had to pay a disproportionately high fee for cutting down a tree. Since this incident, the campesino community is a

extremely skeptical about cooperating with the CAR. Also, many campesinos are afraid to lose self-determination and the right over their territories (Interview Manuel, Maria).

Second, the CAR and the municipality of Silvania have contradictory development priorities. For instance, while proceeding against small-scale deforestation they also allowed a mining project in a forest reserve where the Victoria river originates. This mining project has awakened wide dismay and protest among the local population (Quote.21). “La Mistela is part of the paramo that represents life and our mother earth, how could you start a mining project there?” (Pedro).

Finally, the community feels left behind by the municipality of Silvania as many basic services including roads, electricity in some areas and a school building are missing (Maria, Pedro). While during election there are regular promises to improve this situation, many community members have lost hopes (Interview Arturo, Jorge). Much of the infrastructure such as the main road and the aqueduct were built and are maintained by the community itself (Jorge, Manuel).

4.1.2 Trust

As followed three themes that uncover (dis-)trust between community members and public authorities are described, namely: (i) difficulties to find water governance arrangements; (ii) different kinds of free riders; and (iii) reactions to environmental projects initiated by the CAR.

4.1.2.1 Water Governance Arrangements

As described above, a growing population, intensification of agriculture and other anthropogenic interventions in nature have changed the socio-ecological conditions in La Victoria and new water governance agreements are needed (Quote.12). There is an ongoing discussion about new arrangements, but it has been impossible to find a consensus. While the level of trust in the current water manager is high (Quote.9; 10; 11), disputes and distrust between campesinos, neo-rurals and missing support by public authorities represent barriers to find new arrangements.

This is exemplified in the diverging position about the installation of a water treatment plant and stronger environmental regulation for wastewater that is predominantly represented by neo-rurals (Pedro; Juliana; Teresa). However, many of the campesinos disagree because they are afraid to not be able to bear the additional costs and fear to lose the control over the community-managed aqueduct (Manuel, Maria, Quote.20). “It would not be the same community aqueduct anymore that we all build together” (Interview Manuel). Neo-rural complain about lack of transparency for which purposes the current user fee of the aqueduct is used (Quote.13). This reaffirms the level of distrust in the currently institutional water arrangement making it “difficult to have an unbiased and open communication” (Jorge).

The second proposed governance arrangement is an "River Environmental and Spatial Management Plan"[12] (POMCA) being mostly represented by neo-rurals (Jorge, Pedro). According to Pedro who follows this "vision" for ten years, the POMCA would be a way to create a long-term environmental plan for the community and a "gift" to future generation. The POMCA "would visualize the community on a map, and a visible community is empowered, more autonomous and more resilient" (Pedro). Yet, beyond discussion with the municipality and the CAR, this plan has never been brought to the next level partly because some of the community members do not see the benefit of a POMCA and are afraid that there will be restrictive land use policies and as after "publicity events" the interest of the public administration (the mayor of Silvania) became less (Interview Pedro).

4.1.2.2 Free Riders

The fact that currently there are no clear rules in place in how to use the aqueduct and what residual water can be returned into the watershed, creates a situation which makes it easy to individuals to overuse and underinvest in the aqueduct and the watershed more generally. Three different groups of potential free riders have been identified during the interviews with different implications on trust:

First, the community connects the growing number of industrialized farms in Victoria Baja (e.g. livestock farms) and increased use of pesticides in Victoria Alta (e.g. blueberry fields) with a lower quality and deforestation (Quote.14). It has been observed that this strong pollution is only a few days a month which is interpreted as way to hide the source of pollution (Interview Luisa[13]). The livestock holders "hide all the dirt that the produce, also the tents that they have, nobody really knows how many pigs they have" (Interview Pepe).

Second, people that come only for weekend and rent holiday houses in the two villages. Agritourism is a "new trend" often accommodated in farmhouses bought and renovated by "people from the city" (Interview Marco). These weekend tourists are criticized for using a lot of water (e.g. pools) but to not return "anything" to the community (Quote.15; 16; 17).

Third, there are illegal aqueducts along the river that are often poorly installed returning polluted water into the river. Some interviewees expressed their concerns about the negative affect of these illegal aqueduct on the water quality and missing means to measure the water quality (Luisa, Juliana). One interviewed campesino shares with his neighbors such an illegal aqueduct. The campesino emphasized that he lost hope that the municipality would build an aqueduct and that he lacks the

[12] *Plan de Ordenación y Manejo de Cuencas Hidrográficas* (POMCA) is a formalized spatial planning instrument in Colombia.
[13] "I think the livestock farmers on purpose just throw their dirt occasionally, so that I cannot be tracked back to them"

financial means to pay for a formalization. “Our field just give us the minimum live, we do not have any money nor the work force to start the process to build a formal aqueduct” (Arturo).

4.1.2.3 Involvement in Reforestation Project

How reputation can influence trust and the decision whether to involve in collective action can be seen in the attempt of the CAR to cooperate with the community in environmental projects and the different interaction with campesinos and neo-rurals.

Trust as precondition to engage and create collective can be observed in the implementation barriers of a reforestation project that was initiated by the CAR and should be executed by the campesino community. The elected campesino leader was provided with trees and the responsibility to evaluate important hydrological points to plant them (Maria). Yet, many campesinos that own the selected land refused to participate in the project as they were afraid to lose property and that their land would be transformed into a “nature reserve” (Arturo). In addition, there were few campesinos that wanted to engage in planting the trees due to the ongoing conflict for the perceived unfair treatment (Maria)[14]. Therefore, the trees had to be planted with a lot of effort of a few community members and it is not guaranteed that the trees will be raised adequately.

The second initiative is a PES program[15] that is initiated by the CAR and requires a complex process for agroforestry projects to be approved. In the watershed, only neo-campesino participate in this program. Typically, they have agroforestry farms and a general have close contact to the CAR. Arguably, most of the campesino do not have the skills to apply for this PES scheme (Maria). In addition, many neo-rurals receive funding from other environmental programs such as biodiversity initiatives from MinCiencias while campesinos either feel excluded from these spaces or are not aware about the opportunity (Maria, Pedro, Manuel).

4.1.3 Cognitive Framing of Social Interdependencies

Three themes are presented to show how CFSI are framed in the context of ES in La Victoria: i) upstream-downstream dynamics; ii) sustainable alternatives and iii) different kind of knowledge.

4.1.3.1 Upstream-Downstream Dynamics

In La Victoria, upstream-downstream dynamics are framed in multiple ways. For many interviewees, the river represents social tights connecting them with families and friends (Maria, Marco). Therefore, there is a feeling of responsibility to take care of the water for downstream users (Juliana). Water is

[14] “Nearly no campesino wanted to participate, they are still angry with the CAR because they think that they have been treated unfair”.
[15] The CAR Cundinmarca developed the payment for ecosystem service program – BanCO2 – in 2016. The BanCO2 is a “is an incentive to peasant families who have strategic ecosystems within their properties and are willing to conserve them (CAR n.d.)” More information about the program can be found here.

also framed as central for the community and family well-being. “Our richness here is the water, it is the water that I want to give to my children one day, and it has been seriously under threat” (Pepe). However, beyond the awareness of the asymmetries in the water access there are limited interaction in improving the watershed governance.

Importantly, there are no formal interchanges between the aqueducts of the two villages. The president of Victoria Baja said that she has never spoken with a manager of the upstream aqueduct, even though that she thinks that this could be an important step to initiate more comprehensive water management (Interview Juliana). The water managers expect that the municipality should have the lead to initiate such as space, but which has not finally taken over the role (Juliana, Jorge).

An exception of this has been a common protest the mining project in La Mistela. In the protest, community members of both villages and campesino and neo-rurals jointly and the “fight against the mining and for the water” (Teresa) remains in the collective memory of the community (Jorge, Manuel). Taking conclusions from the interviews, this protest has been an important process of trust building among community members. One of the interviewed neo-rurals stated that “this was the first time that I felt being part of the community” (Teresa). “It showed me how strong we can be when we work as a community together and I also met many new community members during the protest” (Maria).

Beyond the two villages, there is no further CFSI with downstream users. The Victoria river crosses the center of Silvania and then feeds the river Subía. The interviewees yet see no links between the water in the center in Silvania and their usage. “We only know that we live in the water factory of Silvania for the last three years” (Manuel).

4.1.3.1 Sustainable Alternatives

A common CFSI is the opinion that environmental change is only possible via cooperation. In the framing of sustainable alternative to the current agriculture and water management regime, related ecosystems services are able to uncover otherwise “hidden social interdependencies” (Barnaud et al., 2018) between ES providers and beneficiaries.

The interviewed campesinos that use chemical pesticides for their crops indicated that it would not be possible to switch towards more natural farming on their own (Arturo, Pepe, Marco). “If you are the only one who does not use pesticides, the insects will kill all your plants” (Arturo). This makes that while knowing the negative environmental impacts (“the water and soil quality is much worst now”) as well productive limits (“before my blackberry plant rested [*didn’t produce* fruit] for ten years now only two”) of agrochemicals, farmers have the feeling that on their own it is difficult to change (Pepe). Natural pest control could hence open the possibility to interconnect the farmers to act collectively.

This is strengthened by other external factors. For instance, middlemen do not differentiate between organic and conventional harvest and so there is not additional return for the farmers making organic farming less competitive (Pedro). While there is a significant market for organic agriculture – for instance in Bogotá or for exportation – local campesino do not easily find access.

The changing climate and environmental problems are framed as a result from anthropogenic interventions. For instance, a trend that is regularly been described is the "parceling of land", hence the process when a family divides their land among their children leading to a transition from relatively big to relatively small farms.

How a sustainable transition could look like shows the collective Kunagua that has been formed in the aftermath of the mining protest with the aim to protect the watershed via conservation activities. Kunagua is Muysccubun[16] and means "The water in the hands of everyone". "We want to have a diversity of people, practices and opinion to participate. We want do dream the territory collectively", describes Pedro Kunagua. In Kunagua participate both Campesino and Neo-Rurals. There have been several performances that the collective organized to raise awareness of the interconnectedness that the La Victoria creates. For instance, in once performance participant had each a bamboo pipe which they had to connect so that water run from through it representing the La Victoria and the community within it.

4.1.3.2 Exchange of Knowledge

Social interdependencies were also cognitively framed between campesinos and neo-rural in the reflection that united they become a stronger and capacitated community. The interviewees underlined the potential to bring together the individual knowledges and strengths of the two groups. "We can only become strong when we learn to live like a community, learn to hear the others, help to listen to other's opinions and appreciate the knowledge of the others" (Interview Pedro).

Many interviewed neo-rurals emphasized in the interviews that they came to the countryside to learn about nature also from the campesinos. They described that the campesino knowledge about native species, medicine, agriculture practices and the territory itself would be highly valuable (Quote.18). However, the campesino often get the feeling that their knowledge it not appreciated or needed anymore (Quote.19).

In turn, the campesino acknowledge that the neo-rurals "bring new knowledge to the community" (Interview Pepe) and appreciate the "entrepreneurial spirit that some of them have" (Interview Jorge). Beyond the "jealousy" that they reported they also think that the trend of green business and

[16] Muysccubun is the native language of the Muisca indigenous people that are native to the current territory of Silvania (Giraldo Gallego, 2013)

agritourism could be an opportunity for La Victoria. If campesinos would be integrated in this process this could be an important way to create jobs and increase income (Interview Jorge).

Next to Kunagua, there is another example of bringing the knowledge of the campesino and neo-rural together. In a school project for environmental education, both groups plan monthly activities about the watershed in the form of nature walks, workshops about plants, animals and traditional medicine. “I think education children is really important to show them from little on how to treat the environment. The environmental education for children is a really nice project” (Maria).

4.2 Experimental Game

The game allows to make conclusions on the collective and individual strategy that player followed when confronted under a collective action dilemma in EbA. Generally, the Nash strategy was only followed twice and there was only one case of free riding in the eight rounds during the two sessions. This in line with Ostrom’s (2009) understanding of “emotional rationality” denying the perspective of a fully rational player as considered by noncooperative game theory. As followed, the most important game results about reputation, trust and the CFSI are described.

4.2.1 Reputation

The distinction between landowners and tenants significantly influenced the evaluation of reputation during the game. Typically, the tenants have attributed less reputation to the landowners and hence, the evaluation that a landowner “has not much contributed” to the community well-being was significantly higher. In turn, this distinction is not recognizable in the reputation evaluation of the landowners. Notably, good reputation increased during the game: In the first rounds, this was particularly significant while under Incentive 3 this relation became nearly invisible. This is in line with the incentive that gives the landownership to the tenants and in that way creates more equal condition in the game. Notably, in the side-game discussions with both groups, there have been jokes about the “poor land tenants” and it was always a “moment of drama” when the tenants had to pay the rent. Notably, landowners also did not contribute more tokens to the public fund under the condition when they have three more tokens available.

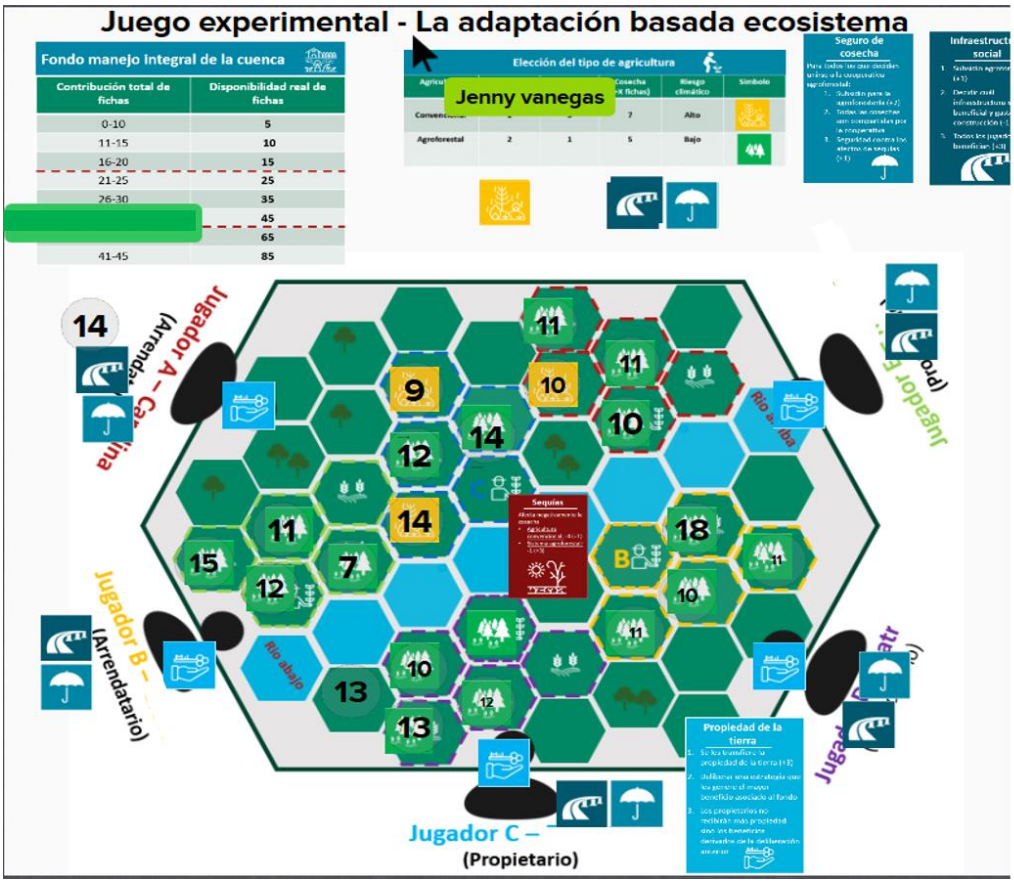

Figure 7. *EbA Game Setting*

Another observation of reputation was that the players who gained significantly more than the other players (three tokens or more) received a bad reputation. In the post-game discussion one player claimed that "it is impossible to receive significantly more tokens if you play fair". Further, the post-game discussion has shown that participants were able to feel intuitively the contribution and distribution of their "neighboring players" so they felt whether they got an equal share of the fund or not. Beyond these aspects of fairness, the players reported that they evaluated other players with a positive reputation when they made "smart decisions" that contributed the whole group.

4.2.3 Trust

There has been a strong correlation of 0,84 between the expectation of trustworthiness (as measured in a pre-questionnaire) and the initial contribution to IWM fund representing the level of cooperation to implement integrated water management in the watershed as a strategy for climate change adaptation. In the following rounds, the trustworthiness that the players have in the EbA fund as the level of investment in the fund each round. This also confirms that there is a relation between reputation and trust. Having the feeling that the other players contribute to the community well-being creates trust which makes the player to invest into the IWM fund which was visible after high contributions to the IMW fund and in the post-game discussion.

On the group level, this dynamic relationship between trust and contribution to the IWM fund can be investigated calculating the correlation of the Gini coefficient and the investment in the next round. As a result of the above, the incentive that leads the most equal distribution among players would, hence, create the highest perceived trustworthiness in the implementation of a cooperative EbA strategy on the landscape level. As can be seen in **Graphic 8**, incentive 3 creates a perfectly equal distribution. Unfortunately, no following round was conducted so the impact on the next round is not possible to measure. Yet, the post-discussion with the two groups give interesting insights on this dynamic: The student group described that they found incentive 3 most convenient, because it allowed to set a common goals and strategy, as well as get an explanation of the other players. Similarly, the group of researchers communicated that it was valuable to create a "space of communication" for a common strategy.

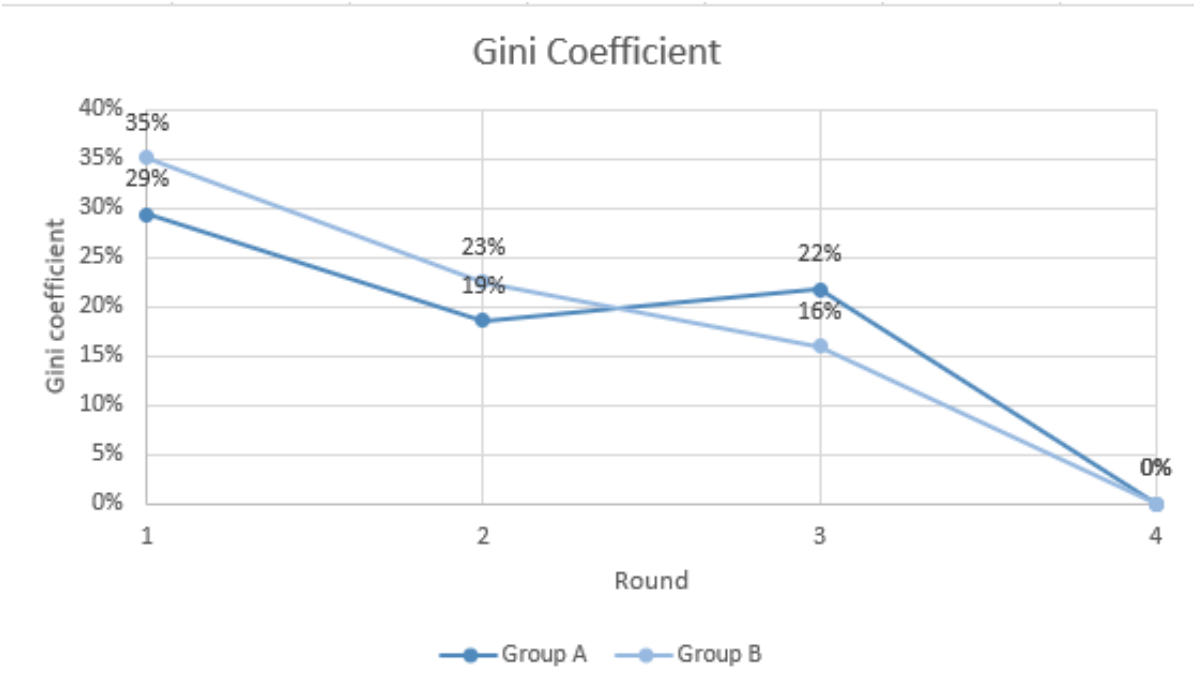

***Figure 8**. Gini Coefficient of Distribution of the IWM Fund*

Beyond this, free riders have impacted trust dynamics in the EbA game. While there was only one clear case of free riding during the entire game, it had a significant impact on the following rounds. In the first round of Group B, player D who had only contributed 1 token to the IWM fund, extracted all the remaining 9 tokens leaving 0 tokens to player E who had contributed 6 tokens to the fund. That player D committed free riding was uncovered in the results of the round with player D having 13 tokens while player E only had two tokens. While this was the only time that player D played in this way, the trust of player E in other rounds was damaged. In the two subsequent rounds, player E did not contribute to the fund at all and in the final round he only contributed the necessary tokens to reach

the agreed goal of 36 tokens. Hence, this example shows in a simplified way how freeriding can impact long-term trust and negatively affect collective action.

4.2.3 Cognitive Framing of Social Interdependencies

To invest in IWM fund, the participants need to cognitively understand that a social optimum is only possible if they cooperate. Therefore, it is important to find answers to the question of what determines the level of investment in the IWM fund, and why on the individual level upstream players decide to leave tokens to downstream players and why downstream player keep investing in the fund while receiving unequal payouts.

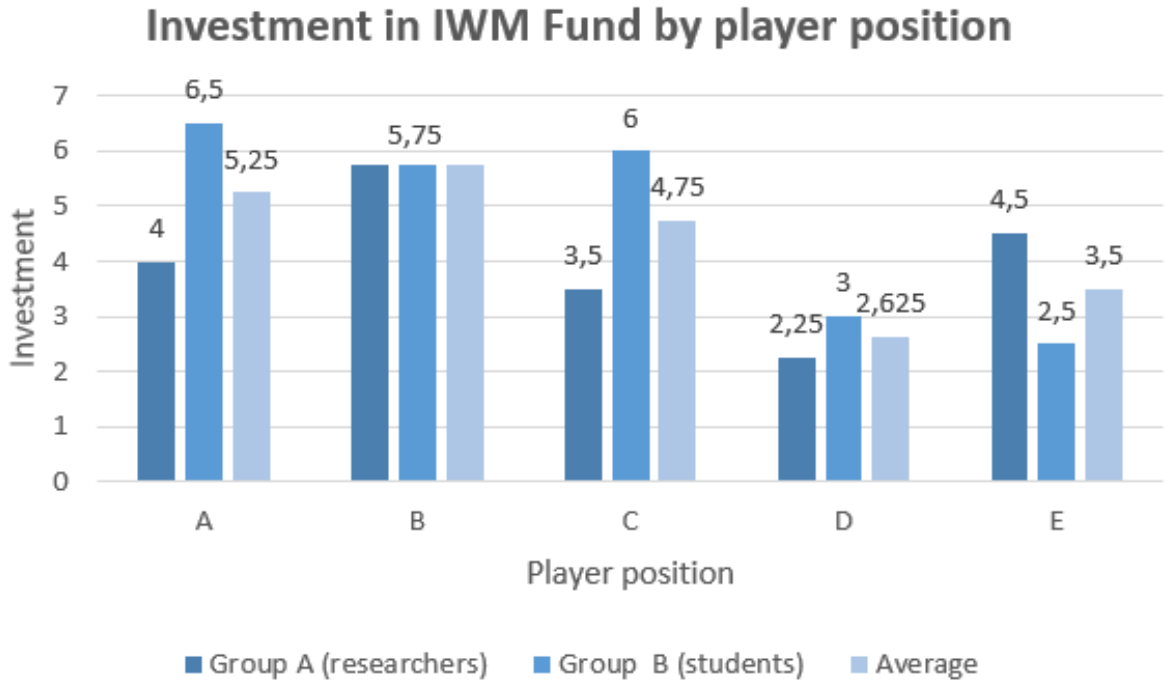

Figure 9. *Average Investment in the IWM fund by Player Position*

On the group level, the difference between the contribution to the fund under Incentive 3 is the most relevant difference. Group A invested an average of 4,2 tokens while group B invested an average of 7.2 tokens (as can be seen in **Figure 9**). This can be retraced to the discussion about a common climate change adaptation strategy that was part of Incentive 3. Here, the main difference between the two groups was that in Group B, one player (player A.B) took over leadership role in presenting a strategy that seemed for all players beneficial. In addition, another player (player E.B) calculated the strategy and told the other players how much tokens each player had to contribute to reach the common goal. The combination between leadership and (mathematical) knowledge seems hence to be the advantage of group B over A leaving to a significant higher outcome close to the social optimum.

The losses in efficiency in group A seem to be compensated by the gains in distribution. This seems relevant when comparing group, A and B with each other excluding the final round, as group A has contributed comparatively more in the previous rounds. The level of investments was moreover affected by both position and return on investment in the previous round. This may also confirm the thesis of Pretty and Ward (2001) that in an irrigation context where resource users can develop their own rules there are higher levels of contribution and equity. Yet, under the condition there is a degree of leadership and know-how.

The role that player A takes within the game seems to be of importance for the overall collective action dynamics in the game. In both games, player A took relatively few tokens from the fund and on average less than he/she contributed. In the post-game discussions, both participants who had been players A said that they "felt responsible for the other players" and said that the fund would be distributed unequally since the beginning, the other players would be demotivated to invest in the fund in the following rounds. Hence, this behavior of player A seems to be guided by a high level of cognition of social interdependencies and was important to maintain the overall collective action dynamic.

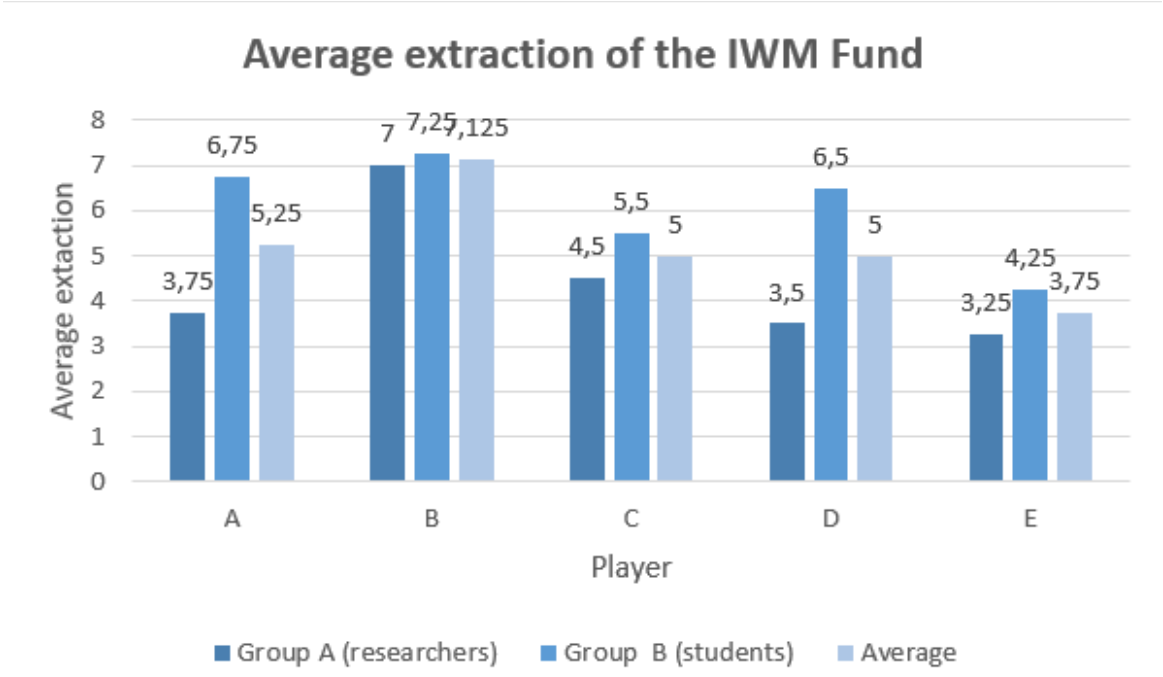

Figure 10. Average Extraction of Tokens from the IWM Fund by Player Position

4.3 Empirical Findings

Based on the fore-going thematic analysis of the stakeholder interviews and the experimental games, the following empirical findings were derived.

Reputation

Identity is important for reputation as pronounced in the case study between campesinos and neo-rurales reflecting the socio-historic contexts of the territory (Shapiro-Garza et al., 2020). This is comparable with the results of the EbA Game during which players intuitively evaluate reputation based on their status as tenants or landowners. This evaluation is hence also based on group identification as described by Semmannet al. (2004), yet, simplified in the game setting.

The heterogeneity resulting from the different group identities within the watershed affects negatively collective action. Framing this heterogeneity through the lenses of gentrification, allows to uncover power dynamics (Latour, 2013) that are perceived as unfair by the campesino and which hence reject to be involved in environmental projects that could further determine this power relation (Solana-Solana, 2010). The EbA game also reflected different socio-economic status and high finals results were perceived as "unfair" as evaluated with low reputation score, similar to the dynamics analyzed under "rural gentrification" in the content analysis.

Yet, the EbA game also showed that this initial reputation changes over the game and that in subsequent rounds factors such as "intelligent choices" or leadership are rewarded with a positive reputation. Similar patterns can be found in the content analysis. For instance, the protest against mining-built bridges between campesinos and neo-rurals. Cooperation is hence an opportunity to overcome negative reputation and pave the way for collective action.

Trust

The crucial relationship between reputation and trust over (indirect) reciprocity is confirmed by both analyses yet pronounced differently. In the interviews it becomes clear that group identification and related reputation determines the positions in respect of decisions regarding the water management and that it seemingly impossible to find consensus for a new institutional agreement because each side believes that the other is out for its own benefit. This correlation has been described by Cardenas et al. (2012) as a vicious relationship in which inequality in distribution of benefits and reduced efficiency enforce each other (Cardenas et al. 2012, p. 71).

Based on this initial finding, the hypothesis that the initial level of trust is influenced by equity in the share of benefits of the IWM fund as well a perceived fairness between investment and takeout was tested, following this underlying logic: 1) greater redistribution; increased confidence; (2) greater confidence; more contribution to the common; (3) the greater the contribution to the common, the more confidence.

Finally, the most important determinantfor trust according to the two analysis is the perceived level of fair conditions in natural resource management. This is well demonstrated in the attitude towards the CAR that has the reputation to act unfairly when punishing campesinos for deforestation which leads to distrust and finally the unwillingness to engage in the reforestation project. Similar dynamics can be found in the EbA game: An unequal distribution of tokens lower the willingness to invest into the common source – to collectively engage – in the next round.

Cognitive framing of social interdependencies

Several patterns in the context of CFSI were notable in the analysis: First, a common goal or vision seems be particularly important: This can be a common thread that requires cooperation as represented in the game by climate change or in the interviews the mining project. A positive example would be the vision of green businesses that can build upon the numerous ES of the watershed including its rich biodiversity, cultural heritage, and recreation potential. Such visions can transform the CFSI in collective action especially if the go beyond environmental sustainability and are also socially inclusive.

Second, an important aspect of CFSI is the existence of spaces for communication enabled through one or various leaders. In the content analysis, it has been shown that the water managers, for instance, see their interdependencies with other water managers but that there are no spaces for communication. In turn, grassroot groups (e.g. collective Kunagua) that offer an alternative to public agencies, benefit from leaders that “beyond only dreaming the territory put the dreams into action” (Interview Pedro). This necessity for a leader who proactively directs the communication into pathway triggering collective action has also been key in the game highlighted in the difference in the social optimum between the two groups under Incentive 3.

Third, the CFSI can be interpreted in different ways and collective action can benefit by taking advantage of diverse knowledge. This is well-demonstrated in the different perspectives of which new institutional arrangements for water governance for water would be adequate in the content analysis, but also in the different approach to “green businesses”. Also, in the EbA experiment, it was able to see that leadership is most affective when enriched by knowledge of other players.

5. Conclusion

In this thesis, I set out to *analyze how incentives for collective action can be operationalized in EbA contexts*. I did so through a case study research on how community member in a watershed in the Colombian Andes express reputation, trust and the CFSI in the context of water management under a changing climate scenario. The empirical findings build upon an exploratory fieldwork, interviews and an experimental game. Conceptually, this research was approached from the NEI scholarship as supported by a political ecology perspective.

As followed, the section 5.1 of this chapter presents the answers to the research questions as set out in Chapter 1. In section 5.2, I address the contributions and limitations of this thesis. In addition, recommendation for policy makers to create incentives for collective action for EbA is provided in **Appendix 6**.

5.1 Key Findings and Answer to Research Questions

In the following sub-section 5.1.1. to 5.1.3, I present the conclusions drawn from the empirical chapter in response to the research sub-questions addressing reputation, trust, and the CFSI. Finally, the sub-section 5.2.4, I synthesis these conclusions to answer the overarching research question of this thesis.

5.1.1. Answer to Sub-question 1

Based on the interviews as underpinned by the EbA game, it is possible to draw conclusions on question: "*To what extent is reputation important for incentives towards collective action in EbA?".*
Three main findings underpin the answer to the research sub-question 1:
First, negative reputation of public (environmental) authorities is translated into skepticism towards new environmental projects and policies that create barriers to engage with the community. Based on the case study, it was possible to group three kinds of experiences that create such negative reputation:

i. *Negative incentives* that are perceived as unfair, damage collective action to the extent that affected community members will not engage in future projects;
ii. *Preoccupation to lose self-determination* results in the rejection of community members to conducts conservation activities on their own territory that are in the center of many EbA projects; and
iii. Contradictory development priorities and undermine promises damage the reputation of public authorities on the long-term and results in general deny of the State to solve dilemmas.

Second, heterogeneity in territory can be observed as multiple group identities that determine practices, capabilities, and opinion in environmental resource management. The content analysis has

shown that such group identities can easily create negative reputation and stereotypes that divide a community and restrict the formation governance arrangements. In the NIE, heterogeneity is a central factor impacting collective action while the literature comes to different conclusions whether this positively impact collective action (Ruttan, 2008; Adhikari and Lovett, 2006). Based on the case study, two conclusions can be made: On the one hand, heterogeneity within a community challenges reputation as it impacts aspects of the community live that are reason of conflict such as environmental protection versus economic development. On the other hand, it became visible that the reputation of public authority varies from actor groups in the territory. By involving only one actor group, it is likely to create a split within the community and may create countermovement damaging the potential for collective action in the long-term.

Third, integrating a political ecology perspective allows to uncover historical trajectories and power dynamics that underlie reputation. Integrating this perspective, allows to address "bad reputation" from the roots and integrate solutions in EbA incentives that lay the path for collective action. This is exemplified in the concept of rural gentrification. Yet, in the context of EbA it is key to overcome this divide in the community what has not yet been sufficiently studied.

5.1.2. Answer to Sub-question 2

Based on the empirical findings, it is possible to draw conclusions *about how trust would influence incentives for collective action in EbA contexts (research sub-question 2)*.

First, free-riders damage trust in environmental governance arrangements (Marshall, 2008). Yet, it needs to be differentiated between three different kinds of free riders that impact the conditions for trust in EbA contexts:

I. Big polluters (such as commercial pig farms in the case study) give other actors the impression that breaking the rules slightly does not make a difference.
II. ES beneficiaries that do not contribute to maintaining ES evoke distrust and the local community is likely to perceive that they should not be allowed simply take advantage of this ES. This is well demonstrated in agritourism in La Victoria that does not offer financial benefits to the local community but contributes to water pollution. This dynamic build a typical case for PES.
III. Some actors have no other choice than free riding as expressed in a lack of to access infrastructure, resources, or capacities to "play by the rules". This shows that the necessary conditions and capacities need to be created to prevent freeriding. This supports the necessity of the sub-sequent finding.

Second, the empirical findings are line with NEI that reputation influences mutual trust and the decision to involve in collective action for ES (Ostrom) showing how this theoretical interaction is seen in on-ground dynamics. While the case study has builds on dynamics of how bad reputation can turn into long-term distrust hindering collective action, it has also shown how this can be interrupted and the "cycle" can be initiated through social capital and trust building. The case demonstrated examples of how leadership, intelligent choices and adaptive capacity can support to overcome old stereotypes and contribute to trust building in ES governance. An important insight has been that distrust can be overcome when jointly addressing a threat, what is also a likely scenario for climate change adaptation.

5.1.3. Answer to Sub-question 3

Based on the insights gained of the empirical findings, it is possible to address the question of "*how the* CFSI *can contribute to the creation of incentives for collective action"* (research sub-question 3):

First, in the case of La Victoria, CFSI between up and downstream users is a social construct build upon family ties and recognition. In the case study, community members framed the interdependencies that the watershed creates as linkages between personal relationships such as between families or friendships. Accordingly, adequate water management and maintaining a good water quality is hence understood as a social responsibility. Especially upstream users see a strong responsibility to maintain water quality and quantity, a connection that has been respectively lower with downstream users. Based on the empirical finding, I conclude that the CFSI as the upstream and downstream can only be a powerful tool when institutionalized and when ecosystem service providers (the upstream communities) receive social recognition.

Second, many of the issues associated with climate change and ES were directly connected by participants in the case study to local anthropogenic activities including an intensification of agriculture, deforestation and migration that put additional pressure on ES. Beyond this, there is also a cognitive framing that it needs collaboration to adapt these changes and sustainable transition at the territorial level more generally. However, many of these ecosystem-based solutions are restrained by: i) markets that offer low prices and do not differentiate between organic and conventional produce or a significant market potential for organic produce from which the local population is excluded and; ii) lacking capacities and awareness of alterative (biodiversity-based) form of agriculture which would enhance livelihood opportunities. As climate change is not yet framed as a common threat, more central issues for the community, such as water provision ES give an alternative entrance for ecosystem-based approaches and to make the concept more valuable to the community.

5.1.4. *Answer to Main Research Question*

On the basis of conclusions drawn from the literature review, case study and experimental game, it is possible to answer the overarching research question of this thesis: *What should alternatives to traditional PES consider in order to create incentives for collective action in EbA*?

The case study has confirmed that EbA in watersheds confronts important barriers to collective action: a vertical water access, heterogeneity among stakeholders as well as a distance between ES providers and users (Cardenas et al., 2011). In order to overcome these barriers, the concepts of reputation, trust and CFSI proved to not only uncover the dynamics of a specific SES, but also to find answers which more generally (but carefully) should be considered in the design of incentives for collective action in EbA:

First, the case study has shown that reputation is directly linked to group identity and associated gossip and stereotypes. The heterogeneity of a local community, as shown in the case study, can create gridlocks in the discussions of new arrangements in environmental governance that need to be overcome in order to create the pre-condition for an unbiased discussion about community involvement in EbA projects. Therefore, it would be a mistake to see communities as a 'black box' and power structures, socio-economic status, and identities within a heterogenous local community need to be understood to enter a territory. This implies on the one hand, to create neutral spaces for communication to design EbA projects but also to support an open discussion about the potential wins and trade-offs that EbA may impede among these diverse groups.

Second, the case study has shed light on how profound inequalities in the Colombian countryside impact levels of trust as seen in feelings of jealousy within a community and of being forgotten against public authorities what ultimately creates important barriers to collective action. To address these barriers, incentives for collective action should consider aspects of redistributive justice and inclusive development agendas: incentives should be all-inclusive and address community members beyond their socio-economic status, for instance, by not making a differentiation between landowners and tenants.

Third, the concept of CFSI has proven as a relevant concept to uncover ties within the SES that motivate for a more conscious ES management on the personal and community level. Yet, the full potential of the concept is restrained by social ties, a lack of recognition and missing institutions. At the same time, the case study detected that the CFSI can be reinforced by community building, shared imaginaries about sustainable alternatives and leadership. Based on these outcomes, incentives for collective action should address strategies for these three enabling factors. For instance, during workshops before starting with the EbA project that give the opportunity for community building and to

collectively “dream” about collective territories. Also, rather than selecting staff for paid position within the EbA projects should consider social capital and community organization skills. Finally, incentives should “create new narratives and channels of recognition” (Bétrisey et al., 2018) for communities engaged in EbA. Creative solutions such as conservation festivals elsewhere could work as a leading example.

To conclude, the case of La Victoria demonstrated that the rural world is in transition showing that old imaginaries about countryside as peripheral spaces are not valid anymore. To access community and be capable to trigger collective action, practitioners should take the time and effort to get to know the community in its diversity, development pathways and socio-ecological imaginaries in-depth. Only in this way, the foundation for designing incentives for collective action is built.

5.2 Contributions and Limitations

The objective of this master thesis is to provide new insights on how to design incentive for collective action in EbA contexts considering the socio-historical and ecological context of local communities. It does so by building on the NIE scholarship and political ecology to shed light on how to create incentives for collective action in EbA contexts by considering development trajectories. This thesis builds upon the illustrative case of water management in one single community and the data is not sufficient to make general conclusions while some observations can be translated to other contexts.

From a conceptual point, this thesis contributes to the NIE scholarship by giving a better understanding of the challenges that EbA incentives need to confront in the on-ground implementation. Framing this challenge as a collective action issue opens the opportunity to directly engage with local stakeholder and to make the concept valuable for them. Such an in-depth analysis of EbA through the NIE lenses is new in the emerging EbA field. In addition, the traditional variables for institutions for collective action – reputation, reciprocity and trust – were enriched with the concept of CFSI. CFSI contributes to bring ES dynamics and how would influence they influence social ties within and beyond a community into collective action research.

At the same time, this thesis has shown that the NIE scholarship can be enriched with political ecology concepts. Without considering the socio-historic context and development pathways of a community, it would be impossible to understand enabling factors and barriers to collective action. This has been well-demonstrated in this study by the notion of rural gentrification uncovering underlying power structures within the community that present an important barrier to collective action.

Beyond these conceptual contributions to EbA incentives, the methodologic strategy that combines a case study with an experimental game offers an approach that on the one hand, allows to design incentives according to the specific territorial conditions of a community. On the other hand, the opportunity to test different incentives and see in a game setting how these influence the enabling

conditions of reputation, trust and CFSI. Hence, this methodological strategy contributes to the research aim to find ways of a more inclusive and deliberative approach to incentives for EbA and PES more generally.

Yet, in the methodology also lay the limitation of the research. Heavily affected by the COVID-19 restrictions, it was not possible to give the experimental game the role it should have when designed so having solely a supporting in underpinning the findings of the case study. At the same time, the data set for the content analysis of ten interviews is respectively low and it would be wrong to generalize the findings of this research.

A limitation of the case selection of La Victoria watershed is that the community does not frame climate change as a direct threat yet. In the case of communities that are already heavily affected by climate change – such as coastal communities affected by rising sea levels – the relationship between climate change adaptation and collective action could have become stronger. However, this thesis contributed to understanding of how downstream and upstream dynamics influence collective action and how the CFSI between water users are pronounced and thus shows the relevance of this concept as introduced by Barnaud et al. (2018).

Finally, collective action is a complex social phenomenon and is likely to be impacted by large variety of factors that difficult to measure (Ostrom, 2010a). In this frame of this research, it was not possible to address all these factors and some relationships had to be simplified. Most importantly, power relationships were only able to analyze to a certain point via the concepts of political ecology as demonstrated in the conflictive relationship between campesino and neo-rurals. Yet, the political ecology perspective in this paper remains rather narrow. Rather than framing the investigated case from political ecology since the beginning, this frame was developed throughout the research inspired by experience and conservation on the field.

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5.3 Recommendations for Policymakers

Based on the answers to the research questions and reflections on the contributions and limitations of this master thesis, I give two main recommendations for future policymakers. I hereby further address the objective of this thesis to contribute to the design of incentives for collective action and towards a more inclusive decision-making in EbA governance.

I. Rural gentrification is global phenomena and is likely to play a role in environmental management onwards impacting collective action. Finding ways to bring together traditional rural actors and newcomers is hence an important challenge for EbA in rural areas, especially in the outskirts of metropolitan centers. Possible success projects that could address the conflict of rural gentrification are:
   - The participation of both – traditional rural actors and neo-rurals – can be facilitated in an inclusive environmental decision-making and engagement process. For instance, the community could decide collectively how the benefits of an EbA project should be distributed and who would receive the highest benefits. As shown by Richerzhagen et al. (2019), such an inclusive decision-making process in EbA projects led to projects results that were perceived as fair by the community. In this process, power asymmetries should be kept in mind and it should be continuously be proved if the position of traditional rural actors is sufficiently integrated.
   - The creation spaces of knowledge exchange between the EbA implementing organization traditional rural actors and neo-rural can serve to create recognition between the different groups (Thomasberger, 2020). To create ties between the local community and the EbA project, traditional environmental knowledge and scientific EbA knowledge should be equally integrated into the EbA project as well as sensitivity to the local cultural understanding of nature and agriculture.
   - Building on the experience of environmental projects in urban gentrification context, often grassroot (environmental) organization and are actively involved to give the local community a voice (Gould and Lewis, 2016). This measure can be translated to the rural context by actively involving famers cooperatives and community leaders in the design and implementation process of EbA incentives.

II. Distrust into EbA can be created by building environmental governance system that create or reinforce inequality in environmental governance that prevent collective action. To be prevent distrust, incentives for EbA need to be inclusive and create benefits for the whole community, specifically for marginalized community members (e.g. campesinos or women). Ideally, EbA projects should go beyond adaptation benefits and equally focus on

a diversification of livelihoods and ways of how to increase social recognition of community members involved. Such co-benefits could be created by:

a. Provide jobs to local community members that could increase their social recognition and perceive appreciation by the rest of the community (Richerzhagen et al., 2020).
b. Festive activities that celebrate advances of the EbA project and that make it accessible for community members that are not directly involved such as children (see Bétrisey et al., 2018).
c. Provide EbA inputs that are beneficial for the whole community and that support in the livelihood diversification. For instance, rather than supporting single farm measures or farm pilot projects, living fences or buffer zones in the whole community could be provided and jointly build.

III. The EbA project should facilitate market access for a local bioeconomy in order to become economically self-efficient on the long-term and trigger measures that have an impact across the value chain:

- Offer capacity building for bioeconomy production models and offer new income and entrepreneurship opportunities (Aguilar et al., 2018). Such products in the EbA context could include organic fruits and vegetable but also processed products including essential oils.
- Facilitate the creation of cooperatives that can bring traditional rural actors neo-rurals together and that combine the knowledge and capacities of both. For instance, neo-rural could support in the marketing and connection to the city while campesinos could integrate traditional farming techniques and plants into the production.
- Improve the market access for the distribution of EbA-based production models. For instance, a community participating in EbA product could directly be connected to organic, supermarkets, restaurants or export markets. In this way, the EbA project could receive wide support within the community and become economically self-efficient on the long-term.

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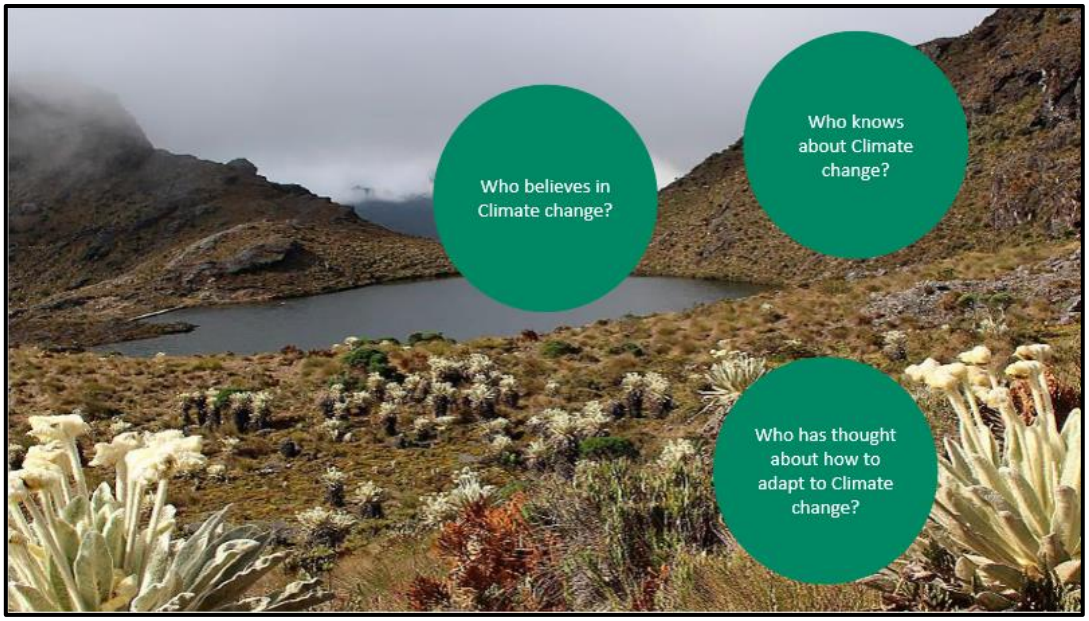
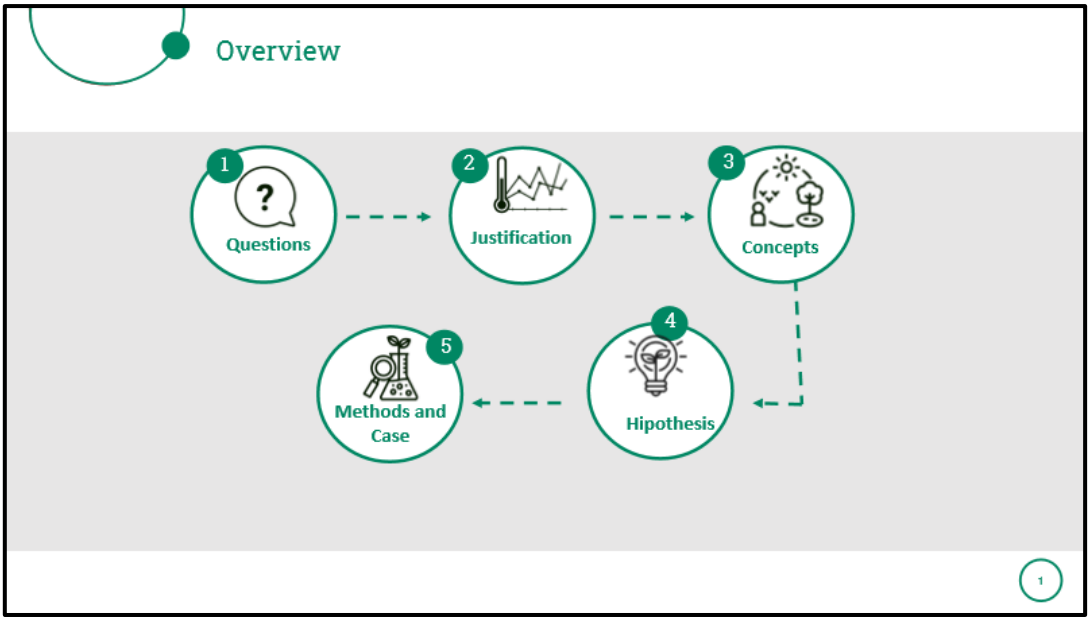
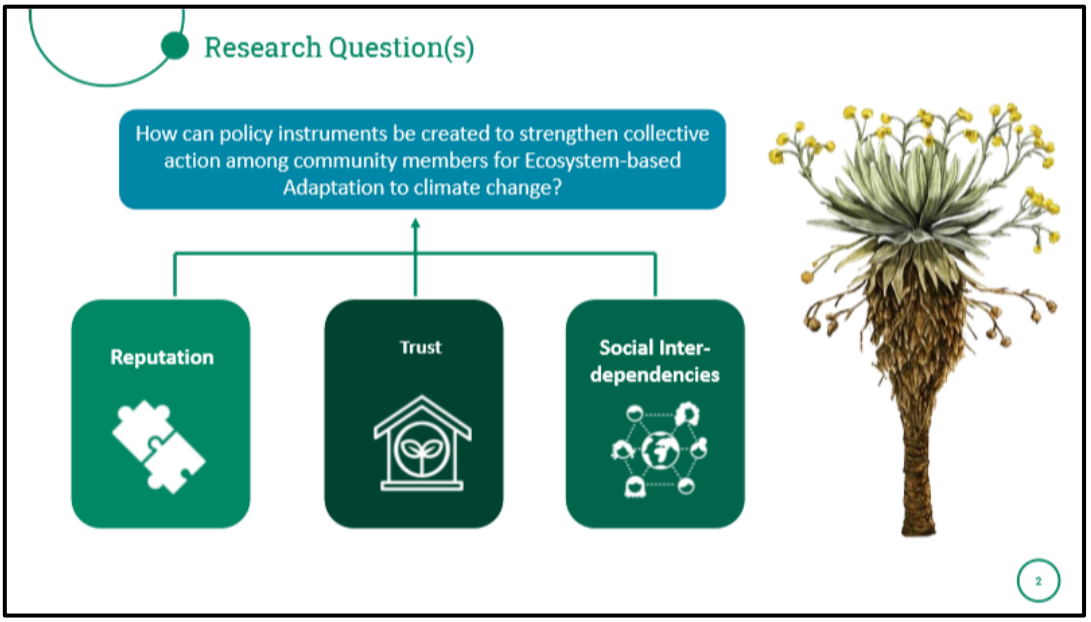
Appendices

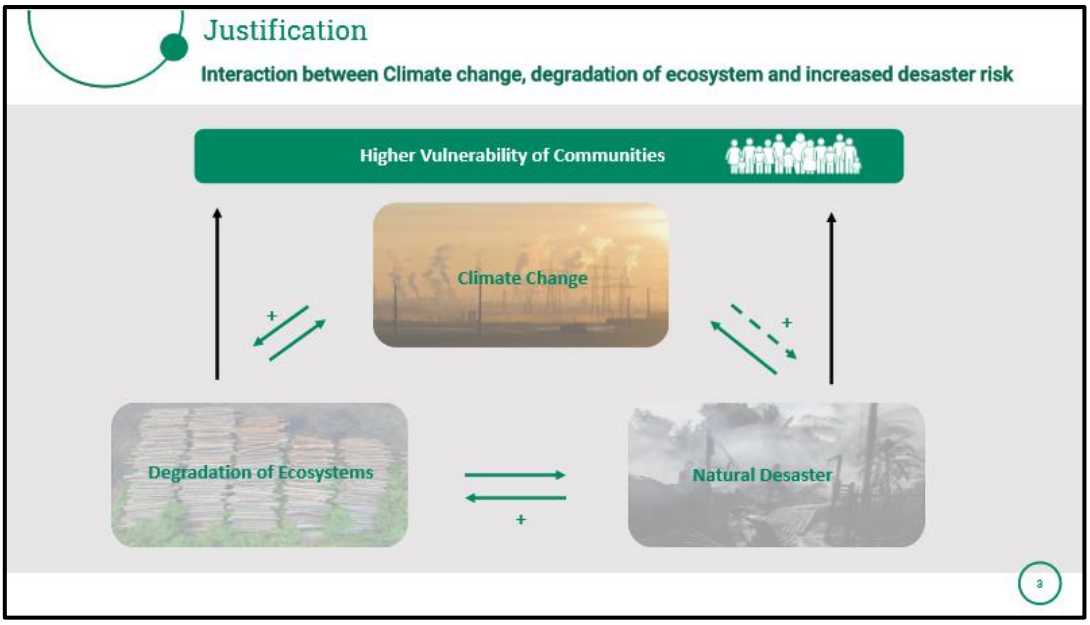
Appendix 1: Presentation for Community Representatives[17]

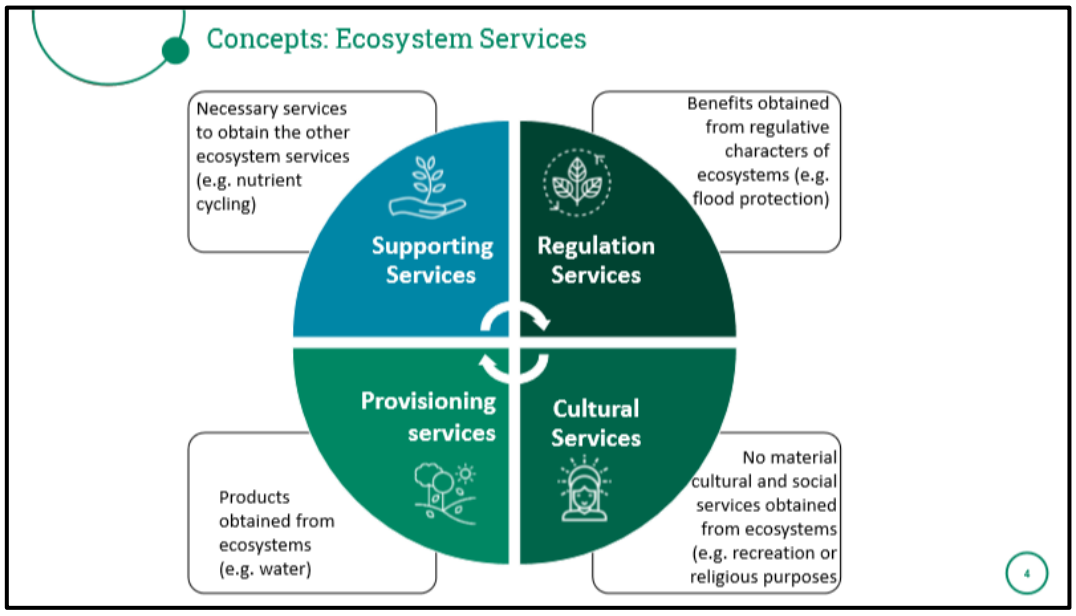


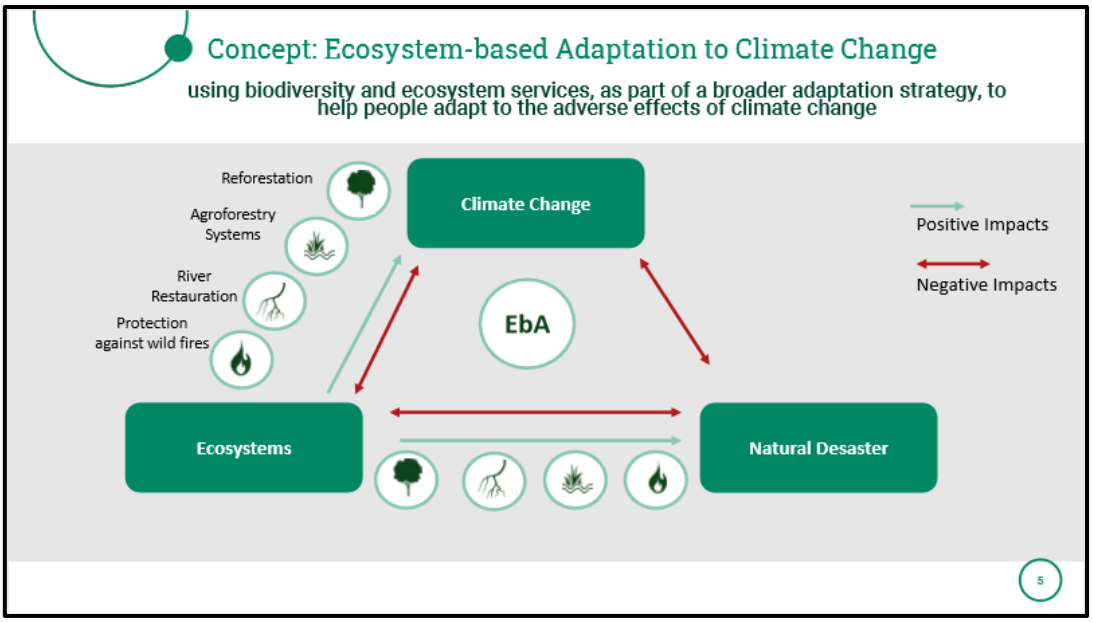
[17] The presentation is translated from Spanish.

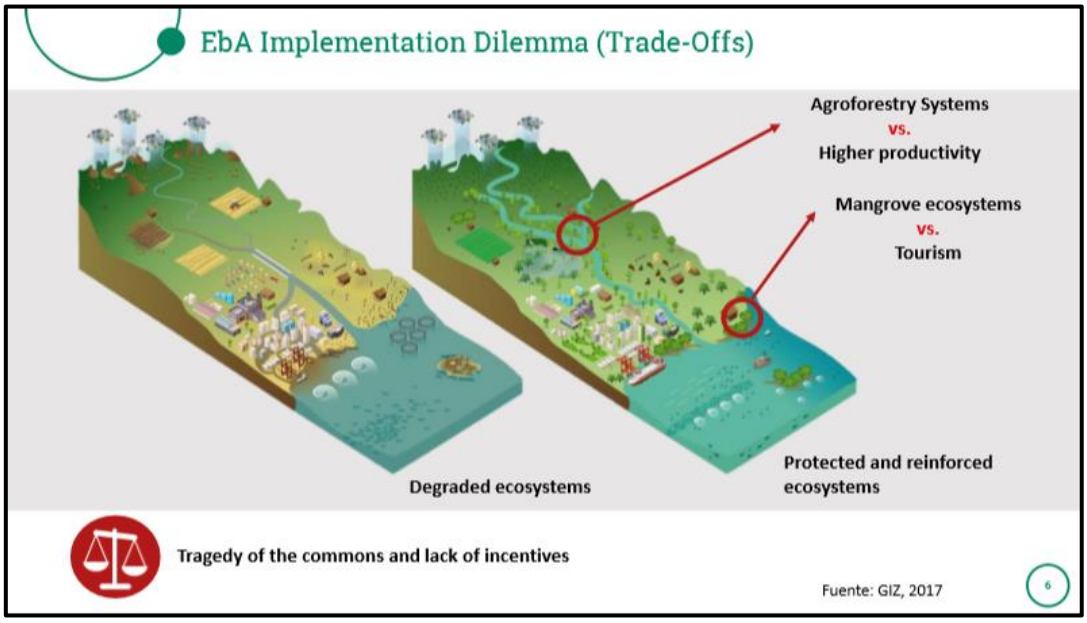

Overview
1
Questions
2
Justification
3
Concepts
4
Hipothesis
5
Methods and Case
1

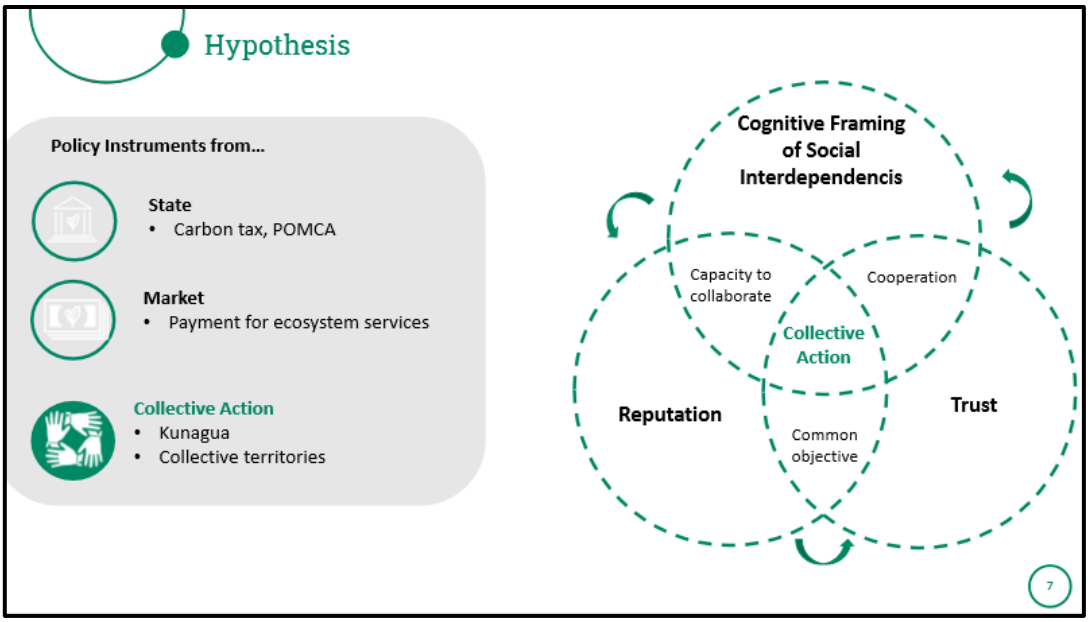

Research Question(s)
How can policy instruments be created to strengthen collective action among community members for Ecosystem-based Adaptation to climate change?
Reputation
Trust
Social Inter-dependencies
2

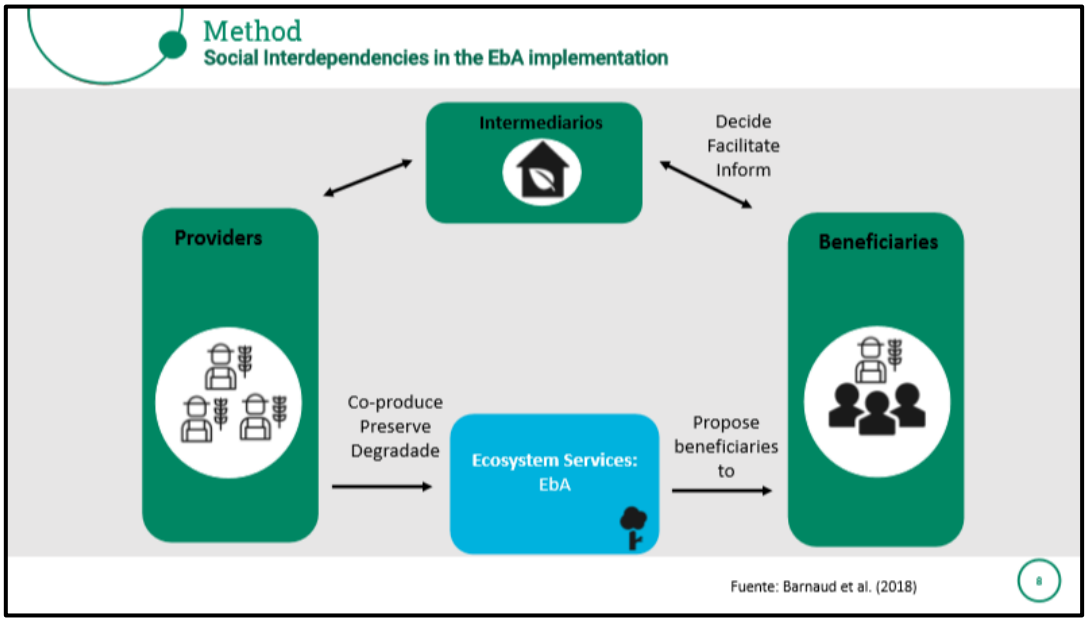

Justification
Interaction between Climate change, degradation of ecosystem and increased desaster risk
Higher Vulnerability of Communities
Climate Change
+
+
Degradation of Ecosystems
Natural Desaster
+
3

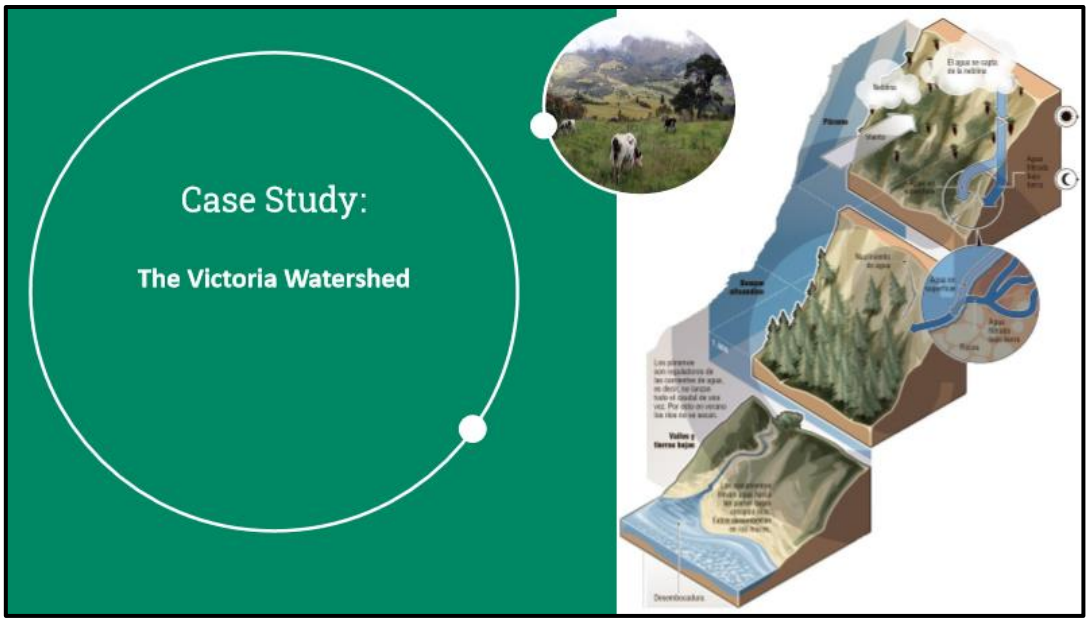

Concepts: Ecosystem Services
Necessary services to obtain the other ecosystem services (e.g. nutrient cycling)
Benefits obtained from regulative characters of ecosystems (e.g. flood protection)
Supporting Services
Regulation Services
Provisioning services
Cultural Services
Products obtained from ecosystems (e.g. water)
No material cultural and social services obtained from ecosystems (e.g. recreation or religious purposes
4

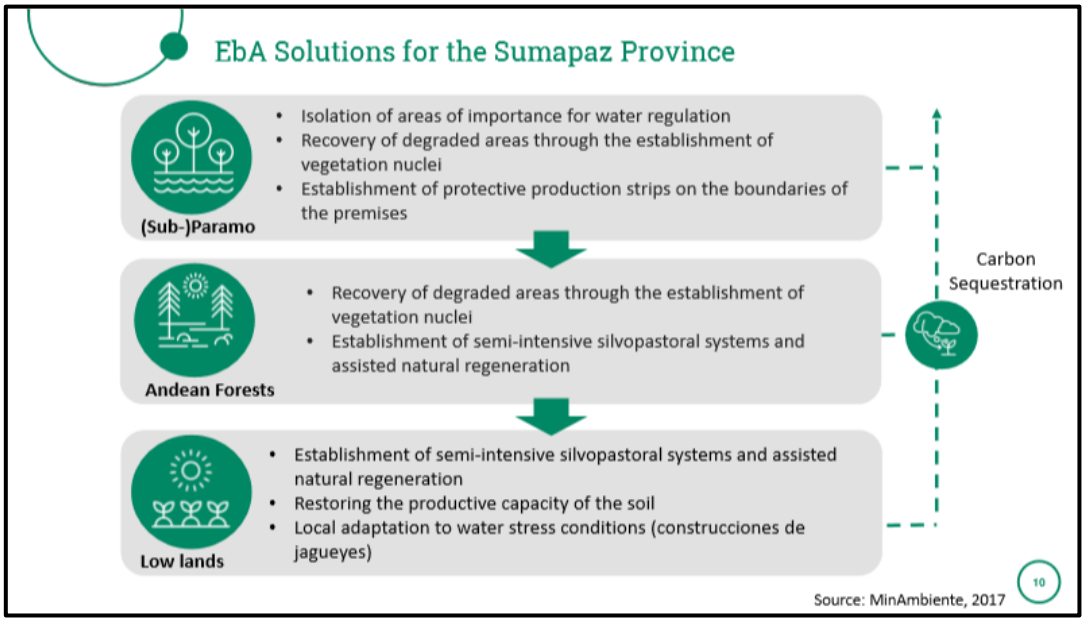

Concept: Ecosystem-based Adaptation to Climate Change
using biodiversity and ecosystem services, as part of a broader adaptation strategy, to help people adapt to the adverse effects of climate change
Reforestation
Agroforestry Systems
River Restauration
Protection against wild fires
Climate Change
EbA
Ecosystems
Natural Desaster
Positive Impacts
Negative Impacts
5

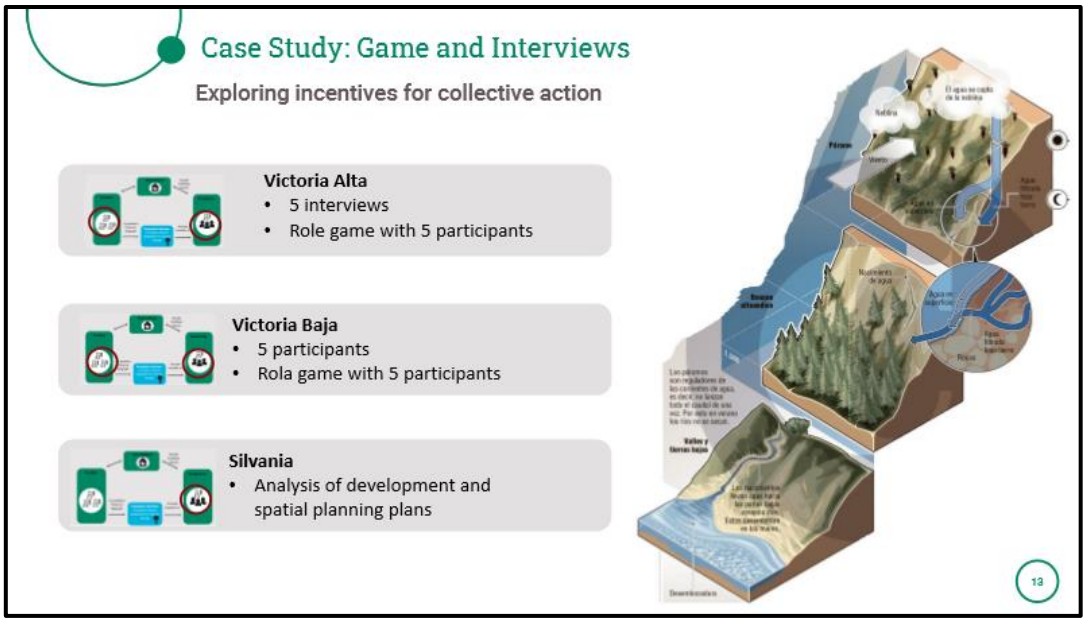

EbA Implementation Dilemma (Trade-Offs)
Agroforestry Systems
vs.
Higher productivity
Mangrove ecosystems
vs.
Tourism
Degraded ecosystems
Protected and reinforced ecosystems
Tragedy of the commons and lack of incentives
Fuente: GIZ, 2017
6

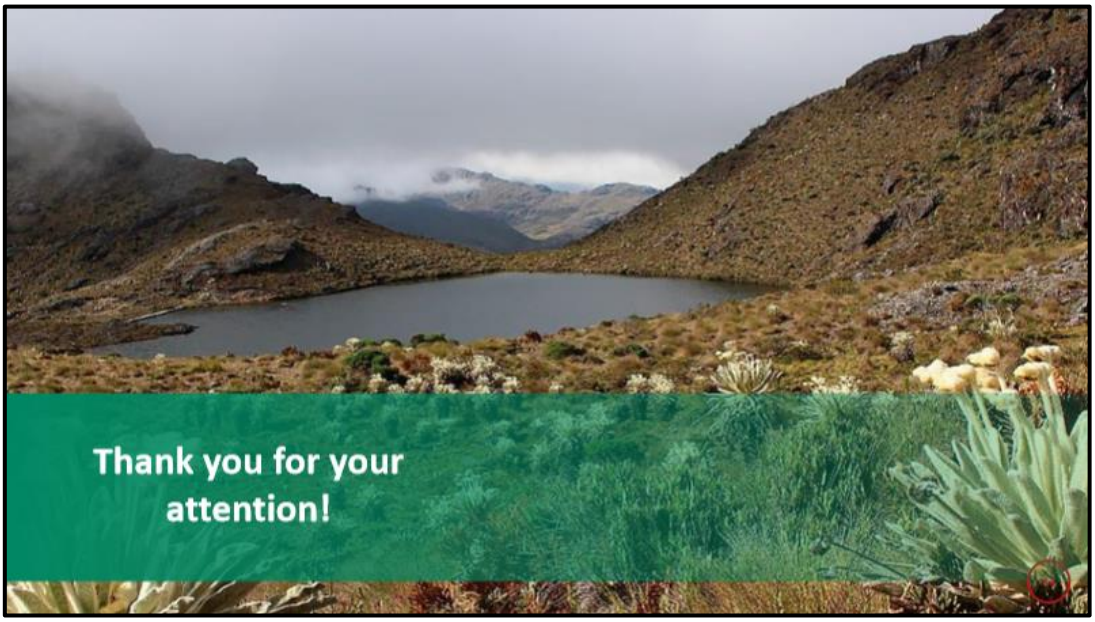

Hypothesis
Policy Instruments from...
State
• Carbon tax, POMCA
Market
• Payment for ecosystem services
Collective Action
• Kunagua
• Collective territories
Cognitive Framing of Social Interdependencis
Capacity to collaborate
Cooperation
Collective Action
Reputation
Trust
Common objective
7


Method
Social Interdependencies in the EbA implementation
Intermediarios
Decide
Facilitate
Inform
Providers
Beneficiaries
Co-produce
Preserve
Degradade
Ecosystem Services:
EbA
Propose
beneficiaries
to
Fuente: Barnaud et al. (2018)
8


Case Study:
The Victoria Watershed


EbA Solutions for the Sumapaz Province
(Sub-)Paramo
Isolation of areas of importance for water regulation
Recovery of degraded areas through the establishment of vegetation nuclei
Establishment of protective production strips on the boundaries of the premises
Andean Forests
Recovery of degraded areas through the establishment of vegetation nuclei
Establishment of semi-intensive silvopastoral systems and assisted natural regeneration
Low lands
Establishment of semi-intensive silvopastoral systems and assisted natural regeneration
Restoring the productive capacity of the soil
Local adaptation to water stress conditions (construcciones de jagueyes)
Carbon Sequestration
Source: MinAmbiente, 2017
10


Case Study: Game and Interviews
Exploring incentives for collective action
Victoria Alta
• 5 interviews
• Role game with 5 participants
Victoria Baja
• 5 participants
• Rola game with 5 participants
Silvania
• Analysis of development and spatial planning plans
13


Thank you for your attention!

Appendix 2: Interview Guide

Interview Guide		
#	**Block**	**Questions**
1	**Basic data**	- Could you present yourself? - Since how long do you live in Silvania? - Why did you come to Silvania?
2	**Relationship with the watershed**	- How do you preserve the water situation in La Victoria - Are there any conflicts about the water use and quality? - What behavior pollutes the water? - Do you participate in activities that influence the watershed in a positive or negative way? -
3	**Perceiption of Climate Change**	- Do you know about Climate change and do you believe in it? - Have you seen effects of Climate change in La Victoria and have you been personally affected? - Have you thought about how to adapt to Climate change? If so, in which ways? - What do you think that other community members think about this? Have there been discussions about affects and adaptation strategies? -
4	**Community Dynamics**	- How would you describe the community in La Victoria - Are there any conflicts or ongoing disputes between community members? - How much influence has someone like you to change the life in the community to something better? Do you have an example? - How you participated last year in a joint action for natural resource management? If so, could you tell me more about this?
5	**Reputation**	- What determines whether you engage with another community member or not?

		- Are there any groups within this community? How do they engage with each other? - Are there any prejudices or stereotypes among community members? - Does whether you engage in a natural resource activity depend on the person(s) who organize it?
6	**Trust**	- If you have a problem, would some from the community be able to help you? - If there would be a problem with the watershed, you think that people would try to collectively solve this problem? Do you have an example for this? - Do you think that everyone is contributing to maintain Environmental Health in La Victoria?
7	**Cognitive Framing of Social Interdependencies**	- What does you relate to other people in this community? - What role does La Victoria play in your connection with other community members? - Do you see a necessity to cooperate with other community members in Environmental management or agriculture? Do you have examples?
8	**Trade-offs between Conservation and Economic Development**	- Is there any conflict between Environmental protection and economic profit? - What is the challenge to solve this conflict? - What kind of support would you need to transfer towards a more environmentally friendly behavior?

Appendix 3: List of Quotes

List of Text-supporting Quotes				
Stage	**Theme**	**#**	**Quote**	**Interview**
Reputation	**Identity**	Quote.1	- "The village [Victoria Alta] is practically divided by two groups, there are the natives that have always lived in this village, and then there are the ones who more recently arrived from the city [Bogotá] and decided to start a new life in the countryside"[18].	Pedro
		Quote.2	"All I have, I created it with my proper hands and with the land" […] "all I know is about the land and about my crops that I learned from my father and he learned it from his father."	Manuel
		Quote.3	Us campesinos unifies a common fight. The fight for a land, the fight to bring something on the plate of our family and for a better life of our children.	Maria
		Quote.4	I produce sweet potatoes syrup and kale chips. We do all the production, packaging and selling to organic shops in Bogotá by our self. We also employ campesina women from La Victoria in the production process.	Pedro
	Gossip	Quote.5	Pepe is of the opinion that they "only want to publicly impress" underlying with the example that once one of green businesses of the neo-rurals was on national television and "claiming	Pepe

[18] In Interview 2 and 3, people displaced from a Caribbean coast that came to the village in the late 1990s are described as a third group. Yet, this group is not further mentioned and is only represented in Victoria Alta and therefore not further described here.

			that they improved the lives of 10.000 campesino families, how is this even possible? We are not even so many in the whole municipality?"	
		Quote.6	Sometimes, I can't understand them (neo-rurals). Once, one of the neo-rurals killed three cows besides being vegetarian."	Armado
		Quote.7	"The campesino burn they waste here and there is much toxic air and liquids that get into the water. Sometimes the air is really bad. It would be easy do avoid this but they (campesinos) don't want to change."	Teresa
		Quote.8	the water quality in Victoria Baja is occasionally so bad because the campesino upstream would through their dirt and pesticides in the watershed and would not take into consideration downstream users.	
Trust				
Trust	Water governance arrangements	Quote.9	"I have much trust in the water managers. They work a lot and contribute to our community well-being"	Arturo
	Water governance arrangements	Quote.10	"I think that the water managers are honorably people"	Pepe
	Water governance arrangements	Quote.11	"People really appreciate my work and they reorganize me in the village for the work that I do".	Juliana
	Water governance arrangements	Quote.12	"The agreements that we had before that are not written anywhere that everyone knew do not apply anymore to the new conditions. With more	Jorge

			people you also need to take more care".	
		Quote.13	"I do not know where the money goes that we pay for using the aqueduct, but I do not think it is spent to improve the water quality"	Pedro
	Free Riders	Quote.14	"The pig holders and the mulberry farmers are a bis problem. They damage the water a lot."	Marco
	Free Riders	Quote.15	"It is not about the tourist it's about that they do not give anything back to the community."	Maria
	Free Rider	Quote.16	"These people use a lot of water, often they also have pools. The few time that they spend here, they probably spend more water than we do. And they don't pay any additional fees."	Juliana
	Free Rider	Quote.17	"They bring a lot of garbage that they just leave outside the door."	Marco
Social interdependencies	Social learning	Quote.18	The older still know how to treat the plants in the old way and how to use nature and insect for the land. I think it is crucial to keep this knowledge.	Luisa
	Social learning	Quote.19	"I feel with all the newcomers, that have their university knowledge and have new agriculture technique, the knowledge that has been in my family does not count anymore."	Manuel
		Quote.20	"I am afraid that if we get a plant, the water will become more expensive and we could lose it."	Maria

		Quote.21	"The mining was a big threat to the ecosystem, it affected the water and still does now"	Juliana

Appendix 4: Design of EbA Game

The EbA game follows the irrigation game as seen in Janssen et al. (2012) integrating climate change scenarios and adaptation strategies. The general outline of the EbA game is the following: Five participants take the role of farmers that cultivate land under climate change scenario. Social inequality (as present in the rural Colombia) is reflected in a very narrow way by differentiating between three land tenants and two owners. The consists of four rounds during which three incentives are introduced.[19] Participants do not know the decision of the others and are not able to communicate with each other during the game (except if the incentive creates such a space). Only the aggregated outcomes of the decisions will be presented to the participants by the facilitator. Participants have the positions A, B, C, D or E. Respectively, A has the first choice to harvest water from the watershed, then B has the next turn to take water from the amount that was left by A. This process is repeated until E is able to access the water. The locations of the players are randomly determined before the first round of each stage and will remain the same over the 4 rounds. "The fact that we randomly assign the positions in the experimental irrigation system provides a clean setup that would isolate other confound factors and allows us to measure the effect of the location asymmetry in the study" (Janssen et al. 2012, p. 67).

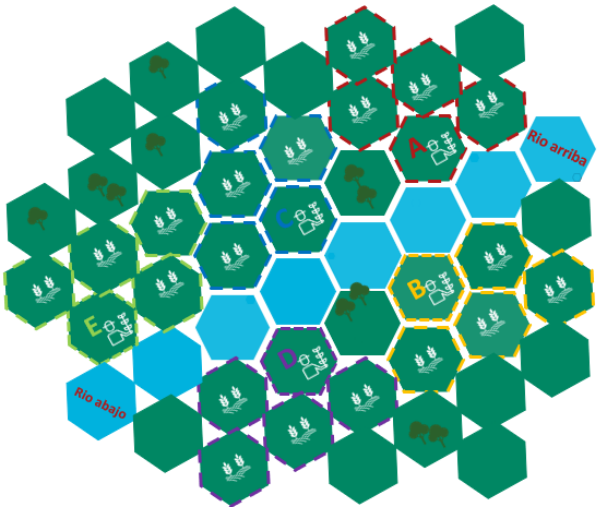


Figure Appendix 4.1.: Game plan with the location of Player A – E located from up- to downstream

The EbA build on this dynamic – as described by Janssen et al. (2012) – and integrates two EbA solutions for smallholder farmers under a climate change scenario. The game follows six steps over the four rounds and in round two to four an incentive is introduced. As followed these six steps are explained and in Appendix 4.1, the three incentives are explained more in detail. Finally Appendix 4.2, explains how reputation, trust, CFSI and more generally collective action is measured.

[19] This is adjusted to a shortened online version. Originally, the game was designed as a workshop format with four stages each compassing ten rounds.

Step 1: Choice of Agriculture

Participants receive an endorsement of 10 tokens (capital) each round that they need to cultivate their field, irrigation, to participate in some of the incentives and to pay the rent for their land. Each player needs to make three main choices at the beginning of each round: First, participant can decide whether to practice conventional agriculture or agroforestry (that qualifies as an EbA strategy) during the game. As in a real-life setting conventional farming, using monocultures and a high degree of pesticides, may be less expensive and more profitable for farmers, but requires significant irrigation and is vulnerable to weather extremes. Agroforestry, in turn, needs less water and is more climate-resilient, but also requires higher upfront investment and tends to be less profitable for famers. Participants need to irrigate their fields to be able to receive the payout at the end of a round. **Table 4.1** reflects the expenses and irrigation needs of the respective agriculture type.

Agriculture Choice					
Agriculture	Costs/time (-X tokens)	Irrigation (-X tokens)	Harvest (+X tokens)	Climatic risk	Symbol
Conventional	1	3	7	High	
Agroforesty	2	1	5	Low	

Table Appendix 4.1. Differences between conventional agriculture and agroforestry as represented in tokens during the game.

The climate resiliency of the yield is important during extreme weather events which are introduced further below. This choice is the only decision in the game that is open to other participants, as similarly in real-life settings community members are aware of the practices of neighboring farmers. This choice will be visible by placing a symbol referring to conventional and EbA-supportive agriculture placed infront of each participant (see **Table 4.1**).

Step 2: Investment in IRBM Fund

In the game, a community-managed integrated watershed management (IRBM) fund is introduced. This fund represents the second EbA strategy in the game. Each participant can participate in the project by contributing tokens that represent time spend into reforestation activities or expenses in trees. The IRBM fund increases the water quantity and quality for irrigation (as needed for the field) and provides other ecosystem services that are both represented in tokens. The tokens available in the IRBM represent the baseline value of water available under normal condition (five tokens) and the amount spend of the participants into the found. The player freely how many tokens they want to invest. *In **Table Appendix 4.2**, this water provision generated is defined as dependent on the total investment of all five participants.*

The investment in the IRBM fund multiplies when a joint effort – or collective action – is happening as can be seen in **Figure Appendix 4.1**. As in a real-life setting, EbA efforts have their highest effect when executed collectively at the landscape level. How much to contribute to the IRBM fund is a secret choice and is only communicated to the facilitator. Once the facilitator received the choice of how much to invest in the EbA fund, he/she communicates to the group how much tokens are available.

Tabla de cantidad de agua disponible	
Total units invested in the public fund by the 5 players	Available water
0-10	5
11-15	**10**
16-20	**15**
21-25	25
26-30	**35**
31-35	**45**
36-40	**65**
41-45	**85**

Table Appendix 4.2. Tokens available in the IWM fund

Step 3: Extraction of tokens from the IRBM fund

Once the facilitator communicated this final amount, in sequential turns from up to downstream, each participant makes the decision (x.3) on how much water to extract from the water that is available to him/her. This happens under the asymmetric access to water as described above given the upstream-downstream dynamics as described above. Yet, there is no limit to how much a player can extract from the fund and is not proportional with the amount invested. Again, this is a secret choice and player will not directly know how much each player extracted but might get a feeling by the game dynamic if this process was fair or not. Therefore, free riding is possible, for instance, when a player does not invest into the fund but extracts a significant number of tokens.

Step 4: Climate-change scenario

Climate change-related events are integrated into the game which are likely to happen in the Victoria watershed. Originally, two different kinds of events were integrated – droughts and landslides – yet this was limited to droughts to adapt the EbA game to a simplified online setting. During a drought, the harvest will be affected. As conventional agriculture is significantly more vulnerable to drought, it

will be affected by -5 tokens. This means that when harvesting you will only win 2, as you would regularly earn 7 tokens. In turn, as the agroforestry system is more resilient to droughts, it is only affected by -1 token. This means that when harvesting, 4 tokens will be won and not 5 tokens as it would be if there were no drought. Players do not know when a drought occurs, but it is pre-designed that there is a drought round 2 and 4 and is communicated by the facilitator.

Step 5: Field irrigation and harvest

Step five consists in irrigation the field and the harvest. This is only possible if you have the resources to do it, that is, tokens. In the case that you practice conventional agriculture, you must spend 3 tokens to irrigate your field and 1 token in the case of agroforestry.

Step 6: Paying rent

The players who are assigned land tenants (player A, B and D) have to pay a rent of three tokens at the end of each round. This is designed to integrate a scenario of social inequality into the game. Likewise, this aims to take a closer look at what is perceived as fair by the players and how this impacts collective action and the other three variables.

Step 7: Final results

At the end of each round, players calculate their final number of tokens and write this number of their field cultivated during this round. In the online setting, players received an individual GoogleSheet where they simply need to fill in their choices and which does the calculations automatically. On the game play is hence visible: (1) the choice of agriculture; (2) choice of participating in an incentive and (3) whether to be a land tenant or owner and (4) the final amount of tokens after each round. **Figure *Appendix 4.1*** *exemplifies how the game plan (as designed in Mural) looks after one game showing the choice of agriculture, the number of final tokens and an additional symbol for the participation in one incentive*

Figure Appendix 4.1. Final results as of the end of game in the game plan (as designed in Mural).

Appendix 4.1 Incentives Design

The first stage is played without an incentive and in each following stage, a new incentive is presented. These incentives are used to evaluate the behavioral change potential and especially how collective action among participants is affected. Participants have the choice of whether participating in the incentive or not. The incentives are inspired from the payment for ecosystem service literature which have been proofed to have a positive impact on collective action among resource users. In the reviewed literature, no other scholar has compared these three types of incentive in a game or their impact on collective action. Importantly, these incentives do not directly affect the indicators (as described in Appendix 4.2) but aim to push towards collective action.

In relation to these incentives, the game seeks to answers to the following questions: Which incentives creates the outcome closest to the social optimum? How does each of these incentives influence reputation, CFSI and trust? Do these indicators explain a high incentive outcome? How do individual attributes such as age, resource dependence and education may affect the impacts of incentives and their general behavior in the three indicators? The pre-incentive stage serves as a control for measuring the "incentive effect" (Salk et al., 2017) aimed to measuring the effectiveness of the incentives as compared to a no-incentive scenario.

However, as it was not possible to play the games with local stakeholders (as explained in section 3.3), this has only secondary importance. More importantly, were general dynamics around reputation, trust and CFSI as observed during the game.

Overview of Incentives			
Name	**Description**	**Link to collective action**	**Integrated in the EbA Game**
Social Infrastructure	If the farmers practice EbA beneficial agroecology, a fund will be made available to construct a "social infrastructure" (e.g. school, road, farming facilities); under the condition that the community oversees building and managing of this infrastructure. Notably, also participants who do not participate in the incentive profit from the infrastructure (and receive the tokens)	i) Facilitates a space of communication towards a community goal ii) Creates social ties with other community member	(1) Transition to agroforestry (as facilitated with one token); (2) decide collectively which infrastructure would be beneficial for the community; (3) spend 1 token into the infrastructure; (4) gain 3 tokens at the end.
Harvest Cooperative	*If the farmers practice EbA beneficial agroecology, an insurance will be made available to a cooperative which manages this process. In the case of extreme-weather related harvest lost, premiums will be paid out to this cooperative*.	i) aims to create trust into EbA and among other farmers through a cooperative. ii) offers the farmers a safety network for droughts in the transition period towards EbA and iii) offers economic compensation.	For all participants who decide to participate in the agroforestry cooperative: (1) transition to agroforestry (facilitated with two tokens); the harvest is shared and equally distributed among cooperative members; (3) insurance against drought scenario (no lost)

Conditional Landownership	*If the farmers practice EbA beneficial agroecology, the land will be given to a legal institution which promotes collective land tenure ship giving the opportunity to the farmers to self-organize.*	i) Aims to create conditions of fairness ii) Offers improved economic conditions for land tenants to be able to practice EbA iii) Creates a space of communication to find a common strategy.	Players need to find a common climate change adaptation strategy and can openly communicate about this strategy. If all participants (regardless of their status as landowner or tenant) transform to agroforestry, the land tenure ship will be transferred.

Table Appendix 4.1. Incentives for EbA

Appendix 4.2 Measurement of Variables for Collective Action

1) Measurement of Reputation

After each round, the participants need to evaluate all other four players under the question "How much do you think that player X contribute to the community well-being". This evaluation ranges from 0 (nothing) to 6 (a lot).

This evaluation is completely confidential and has no further impacts on the game.

2) Measurement of Trust

Before the game, trust was measured in pre-questionnaire to identify the initial of level of trust of the participants with regard to natural resource management, collective work and the other participants (see below). In the following rounds, the trustworthiness that the players have in the EbA fund as the level of investment in the fund each round. This is adjusted from Cardenas et al. (2011).

Pre-Questionnaire to determine initial level of Trust	
If I have a problem, someone of this group would help me.	Range from: - **1** (Completely agree)

If a street gets destroyed by extreme weather, my community will collectively solve this problem.	- **2** (agree) - **3** (disagree) - **4** (completely disagree)
I believe that as community we could achieve to improve the water quality of our river.	
I believe that everyone in this group contributes to the well-being of the community.	
Everyone of this groups respects the environment and would not take advantage of the effort of the others.	

Table Appendix 4.2 Prequestionaire to Measure Trust

3) Measurement of CFSI

To invest in IWM fund, the participants need to cognitively understand that a social optimum is only possible if they cooperate. Therefore, it is important to find answers to the question of what determines the level of investment in the IWM fund, and why on the individual level upstream players decide to leave tokens to downstream players and why downstream player keep investing in the fund while receiving unequal payouts.

In addition, it is considered that the general indicator for the degree of **collective action** is the closer the results of a round are to the social optimum. Ideally, among participants there will be a process of "social learning" (Ostrom, 2010a). Hence, that participants learn to adapt their choice of yield, investment in EbA and extraction of water in accordance with the public good. More concretely, this repetition of interactions of the game has several important affects (or structural variables) which need to be considered: (1) the level of information generated about past actions, (2) how individuals are linked and (3) voluntary entry and exit (Ostrom 2010, p 159).

Experimental Game EbA

Game Instructions

Welcome to the EbA Game!

I would like to say thank you for accepting to invitation to participate in the experimental game **"Ecosystem-based adaptation to climate Change (EbA)**. EbA is an entertaining game to recreate a situation during which a farming community in the Colombian Andes needs to take decisions about how to manage their water resources and fields under climate change scenarios such as landslides or droughts. The Game takes approximately **1.5h**.

First of all, I would like to invite you to watch this short video about EbA. The video not only explains the fundaments of the EbA approach but also gives you insights that you can use in your game strategy.

NOTE: Please, take a close look to the digital tool that will be used during the game, at the end of this document.

EbA in practice: Strategies for farmers and communities

During the game, there are two strategies of how to adapt to Climate change, that will be used at the farm and at the landscape level:

Whether to practice agroforestry is an individual choice. The integrated watershed management is a collective fund, which depends on the collective action among participants.

However, you should remember that there are dilemmas in these AbE strategies: While agroforestry systems and integrated watershed management significantly contribute to climate change mitigation, they are also **very time consuming, require significant work effort and knowledge**. In addition, agroforestry systems can be less competitive in local markets

Let's start!

PRICE

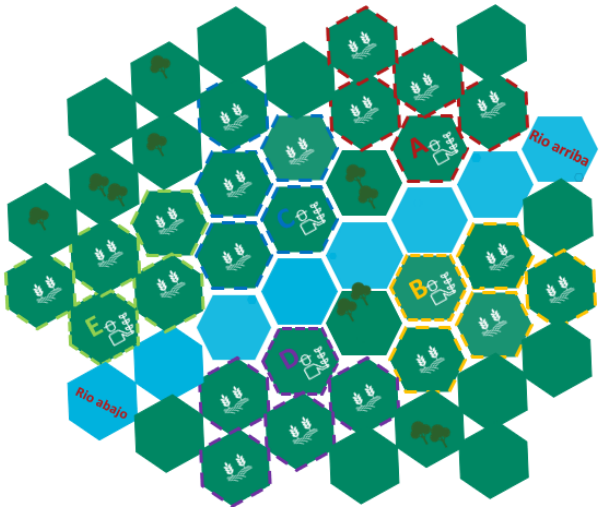
General description

- **The goal of the game is to gain as much tokens as possible**
- **The games consist of 4 round that represent irrigation seasons. In each round you need to cultivate 1 field and you can invest 10 tokens. Tokens are not acumulated for the next round but will be added up for the final score.**
- **The tokens are invested in the fields, your choice of agricultura, the integrated watershed management fund or, if necessary, your rent.**
- **You can gain tokens in 2 ways: i) utilizing water from the river; ii) recollection of your harvest**
- **Some of the decision are private and need to be sent to the facilitator in a private chat**
- **You can only discuss your game strategy with the other player, if the facilitator asks**

Game scenario

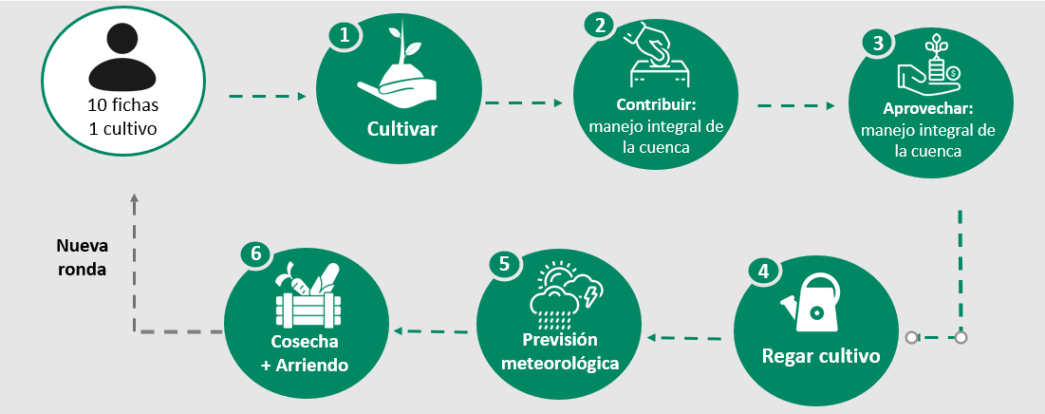
The game takes place in a watershed in the Colombian Andes – called La Victoria – where numerous smallholder farmers and large landowners practice agriculture utilizing local water resources. As in real life, the player (farmers) need to share the water resources and the need to organize that the life in the watershed functions. Increasingly, the watershed is affected by climate change, and therefore, new adaptation strategies are needed.

Each player has terrain of 5 hectars that need to be cultivted during the game, 1 hectar each round. In this way, the game board will be filled during the game. The five players are located in the watershed from position A (upstream) to position E (downstream).



Your role has been sent to you in a private message. This role not only determines your position in the watershed, but also whether you have the land tenure ship or not and during which "emotional rationality" you play. This means that you do not completely act rational but that your actions are influenced by previous experience (as described in the private message.)

Each round has 6 steps



As followed each step is described in detail.

Step 1: Cultivation/Crop Choice

At first, you can decide how you would like to grow: you can choose between a) conventional agriculture or b) agroforestry. This has a different implication in terms of how many tokens (resources) you spend cultivating, and vulnerability to extreme weather events. In the table below, you can find a detailed description of these implications.

For example, if you practice conventional agriculture it is cheaper than agroforestry (-1 token compared to -3) but consumes more water (-3 tokens compared to -1). The harvest obtained (7 tokens) is greater than that of agroforestry (5 tokens). However, the conventional is much more at risk of being affected by climate change.

Agriculture Choice					
Agriculture	Costs/time (-X tokens)	Irrigation (-X tokens)	Harvest (+X tokens)	Climatic risk	Symbol
Conventional	1	3	7	High	
Agroforesty	2	1	5	Low	

This decision is open, and you can put the respective symbol of the agriculture option on the game board (in the Mural application explained below). These symbols remain throughout the game and fill each player's field round by round.

Step 2: Contribution to the integrated watershed fund

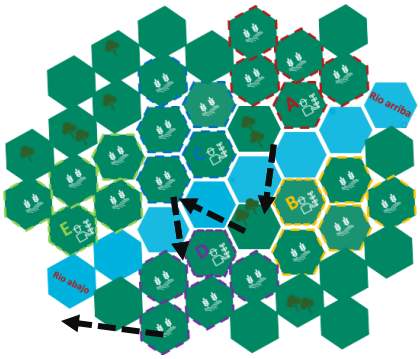
In the second step, you decide how much you want to contribute to the "integrated watershed management fund" that works in your community. As you have seen in the video, this is a way to adapt the watershed to climate change and it has different advantages, such as improving water quality or protecting against landslides. This fund is, therefore, and as previously stated, a way to obtain more tokens. However, this fund depends on the collective effort of all players. The more each player contributes, the more tokens will be available to everyone. The more players are able to dialogue with each other and agree to pass the point where the collective profit grows exponentially, the more everyone wins.

Tabla de cantidad de agua disponible	
Total units invested in the public fund by the 5 players	Available water
0-10	5
11-15	**10**
16-20	**15**
21-25	25
26-30	**35**
31-35	**45**
36-40	**65**
41-45	**85**

For example, if only two players contribute 10 tokens to the pool and the other players decide not to contribute, there will only be 5 tokens in the pool. Conversely, if each player decides to contribute 5 tokens (25 total), there will be 65 tokens available.

Unlike Step 1, this is a blind decision. You can completely decide for yourself how much you would like to contribute, and the other players won't know. Next, you must send your decision of how much you want to contribute to the fund to the game facilitator, through private chat (WhatsApp). Once the facilitator receives all the individual decisions, she shows how many tokens are available in the fund.

Step 3: Take advantage of the "Integrated Watershed Fund"



Then in the third step, you can take advantage of the fund by taking available tokens. This represents, for simplification purposes, taking water from the river and putting it in a tank for various uses on the farm. This is one way to get more tokens. You can use these tokens to water your field.

Player A (located upstream) is the first to decide how much water to drink and will send his decision by **private chat (blind decision)** to the facilitator. The facilitator then sends the number of tokens that are available to player B, who has the second option of taking tokens from the pool. This process continues until Player E has decided.

<u>It is important to always remember that the decisions are absolutely individual, that is, that the numbers that we send by chat will not be shown to the other players.</u>

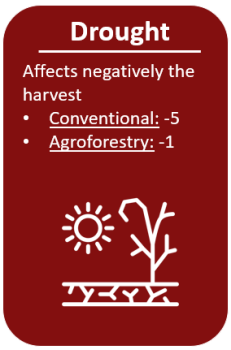
Step 4: Field irrigation

Step 4 is watering your crop so you can harvest it at the end of the round. This is only possible if you have the resources to do it, that is, tokens. In the case that you practice conventional agriculture, you must spend 3 tokens to irrigate your field and 1 token in the case of agroforestry.

In case you do not have enough tokens, you will not be able to harvest.

Step 5: Extreme weather events

As in real life, there is the possibility that there are unpredictable weather events that affect the availability of water and can damage your crop. In the game there is a possibility of drought.

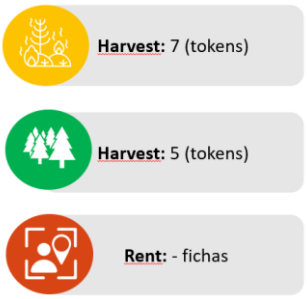


Droughts: During a drought, the harvest will be affected. As conventional agriculture is significantly more vulnerable to drought, it will be affected by -5 tokens. This means that when harvesting you will only win 2, as you would regularly earn 7 tokens. In turn, as the agroforestry system is more resilient to droughts, it is only affected by -1 token. This means that when harvesting, 4 tokens will be won and not 5 tokens as it would be if there were no drought**.**

⇨ Adaptation strategy: transition towards agroforestry.

Step 6: Harvest and Rent

The last step in the game is to harvest your field. Harvesting a conventional crop gives you 7 tokens and an agroforestry crop 5. Keep in mind that if you were not able to irrigate your field you cannot harvest and that if you were affected by a drought your profit decreases as explained in step previous.



Players who do not own their land must pay rent to an owner. In other words, 3 tokens will be subtracted.

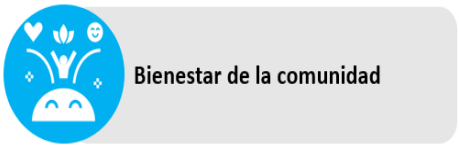
And of the round: Calculate the tokens your earned

During the game, you can calculate all the tokens you spend and earn in a spreadsheet (in GoogleSheets as explained below). At the end of each round you calculate your total tokens for a round and openly mark it on your cultivation arranged on the Mural app dashboard.

Open decision!

Special rule 1: Reputation of the other players

At the end of each round, there is a special rule: You must evaluate how much each player contributed to "community well-being". This decision is entirely yours depending, but mandatory. For example, depending on how much you think a certain player contributed to the watershed integrated management fund, or how fair it was when taking the fund or if it seems that someone earned a lot, this decision is made and they are valued quantitatively in a GoogleSheets table.

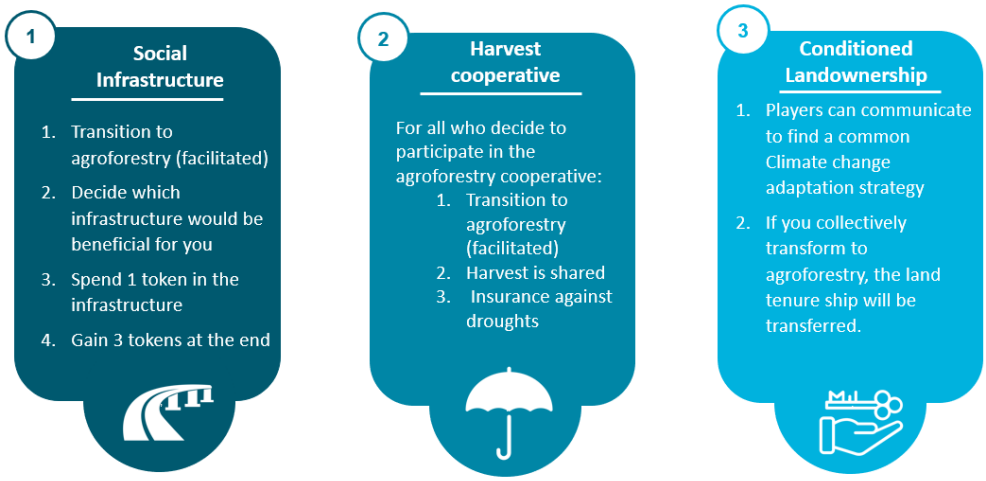


Private decision!

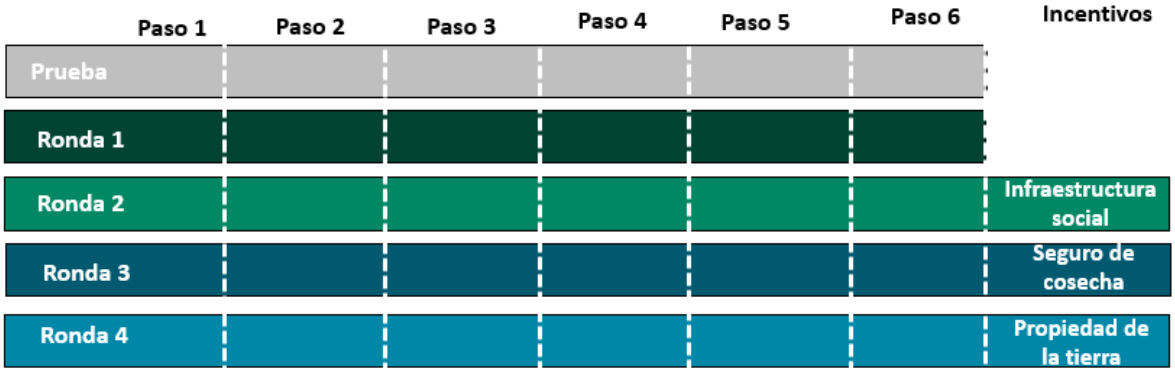
Special rule 2: Public programs for agroforestry

Round 2, 3 and 4 will introduce public programs that promote agroforestry. You can decide if these programs seem appealing or not and if you want to participate. The following briefly introduces what public agroforestry promotion programs consist of. (A more detailed explanation will be given during the game)

After the fourth round, you can vote for the incentive you liked best and state why.



Summary of the game plan



Digital tools

Please note this is online and therefore you will need a computer and a good internet connection. There are three online tools that are used to make this game work: interactively:

zoom

- ***Zoom:*** *it is a communication platform that works similarly to Skype. We will be connected throughout the game in ZOOM, to be able to talk to each other and see each other. You can join the ZOOM call through this link:*

Mural: *digital workspaces for visual collaboration. We will use Mural as a game board where you can actively participate, changing the tiles and cultivating your field. You will also be able to see the actions of the other players in the watershed.*

GoogleSheets: *In an online spreadsheet that you will use to calculate your tokens during the game. Most of the calculations are done automatically, you just need to mark your respective choices at each step.*