Towards sustainable cocoa

DESIGNING A THEORY OF CHANGE FOR SECURED LIVELIHOODS AND CLIMATE CHANGE RESILIENCE IN THE COCOA PRODUCTION IN SAMBIRANO – MADAGASCAR

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List of abbreviations

CNC	Le Conseil National du Cacao
COGBES	Comité de Gestion de Bassin Versant Sambirano
ICCO	International Cocoa Organization
HSC	Haute Stock de Carbone
HCV	High conservation value
JICA	Japan International Cooperation Agency
MNP	Madagascar National Parks
NGOs	Non-governmental organizations
ToC	Theory of change

Executive summary

In this paper, I design a Theory of Change (ToC) promoting the sustainable production of cocoa in the Ambanja region in Madagascar. The area is situated at the north-western part of the country and characterized by the Sambirano River. The majority of the country's cocoa is cultivated in this region. The cocoa bean is the main source of income for over 30'000 smallholder farmers in the area. Over the last 20 years, however, climate change has become increasingly evident in the form of cyclones, long dry spells, and declining rainfall, leading to challenges in agricultural production. Furthermore, the destruction of plantations due to climatic hazards as well as an increase in population accelerates the acquisition of new land and the destruction of biodiversity-rich forests. This development speeds up the degradation of the landscape, which in turn intensifies the effects of climate change. In light of these challenges this study focuses on on how to improve the livelihoods of smallholders cocoa farmers in Sambirano and at the same time safeguard the environment.

The intervention strategies apply a holistic landscape approach, to tackle these developments while leading to a beneficial transformation of this system. The ToC builds on scientific studies from Madagascar and other places in the world and an interview with an expert on the ground, and aims to secure the income of the cocoa producers as well as enhance the climate change resilience of people and nature.

The results indicate that the following levers must be addressed to achieve a positive change in the system: improvement of land governance, participatory development of coordinated land management strategies, promotion of farm level innovations, and strengthening of the collaboration with nongovernmental organizations (NGOs) and the private sector. Together, these actions represent possible pathways for enhancing farmers resilience, decreasing pressure on the landscape, stopping deforestation, and ensuring the sustainability of the landscape and livelihoods in a long-term manner. However, we have to acknowledge certain risks and limitations of the approach. The state structures remain complicated and influenced by corruption. Certain problems such as infrastructure deficiencies, child labor or medical care are not included in the strategies. To truly test the ToC, further direct data from the target area is necessary in order to include local knowledge into the concept and to tailor the interventions to the actual conditions on site.

1   Introduction

## 1.1   Cocoa production in Sambirano – Ambanja District, Madagascar

Figure 1: Regions of cocoa production in Madagascar (JICA 2020).

This paper examines strategies to enhance sustainable cocoa production in Madagascar to improve the life of small holder farmers as well as safeguard the environment and its ecosystem services. I first discuss the challenges of the cocoa industry in Sambirano, from which I finally develop my research question. In the following, I explain my method for the development of the ToC. The complete ToC and its pathways to impact I elaborate in the chapter results. Based on the findings, I conclude with implications for future projects to promote sustainable cocoa production in Sambirano.

Madagascar produces about 0.5% of the global cocoa harvest (Maerker & Bie 2022). 95% of Madagascar's production takes place in the Diana region in the north-western part of the country (figure 1). About 33'000 mainly smallholder cocoa farmers are producing around 10,000-14,000 tons of cocoa beans per year (Maerker & Bie 2022). 80% of the farmers do not own their land, and only 10% of them are organized in groups (JICA 2020). The cocoa of the Ambanja district is fully labeled "fine cocoa" by the International Cocoa Organization (ICCO) (CNC 2018).

The region is shaped by the Sambirano River, which has its source at the higher mountains inside the country (figure 2). The lowland is characterized by wide deltaic plain bordered by hills which are leading to the mountains. The area is surrounded by four protected areas which are biologically rich forest habitats (Maerker & Bie 2022). The climate is exceptional, especially due to the relief of the region, and is favorable for the growth of cocoa shade trees. Other types of crop production include rice, manioc, vanilla, coffee, and marijuana, as well as some fruit trees such as orange, mango, jack fruit, papaya, and papaya trees (Andriamalalanirina 2018). Cocoa is the primary source of income for the local population. Food crop production mainly comprises rice which almost all households grow for self-consumption (Andriamalalanirina 2018).
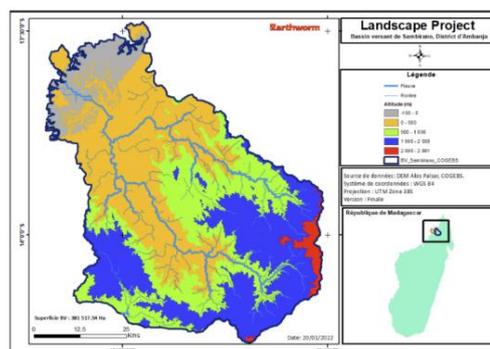
Figure 2: Sambirano watershed, district Ambanja (Maerker & Bie 2022).

The main actors in cocoa production in Sambirano are the National Cacao Council (Le Conseil National du Cacao, or CNC), which was founded in 2016. The main responsibilities of this institution are quality control of the cocoa as well as the implementation of agricultural expansion and improvement strategies (Maerker & Bie 2022; JICA 2020; CNC 2018). The Madagascar National Parks (MNP) are responsible for maintenance of the security of the protected areas. The Comité de Gestion de Bassin Versant Sambirano (COGBES) was put into place in July 2021 through a participation process with local stakeholders. The organization is mandated by the region to coordinate actions to ensure harmony between human activities and the sustainable management of natural resources (Helvetas Madagascar 2021). The committee is composed of representatives from the environment, economy and infrastructure, governance and society commission as well as the 15 mayors from the Sambirano watershed (Helvetas Madagascar 2021). Private chocolate producing companies and NGOs are also active in Sambirano by supporting and conducting projects to foster sustainability in the cocoa industry (Helvetas 2022; Maerker & Bie 2022; Lindt Cocoa Foundation 2021). The role of the state is very opaque and characterized by corruption (Rasolofo 2022; Maerker & Bie 2022; Andriamalalanirina 2018).

1.2 Challenges for the cocoa production in the Sambirano watershed

Today, the cocoa production and the environment face many challenges which can be divided into problems accruing through changing climate as well as anthropogenic induced issues. However, we have to acknowledge the interrelation between these two categories.

1.2.1 Climate change

In the past 20 years, a significant change in the climate conditions of Madagascar can be observed. According to the climate risk ranking for the period 2000-2019, Madagascar is among the top 20
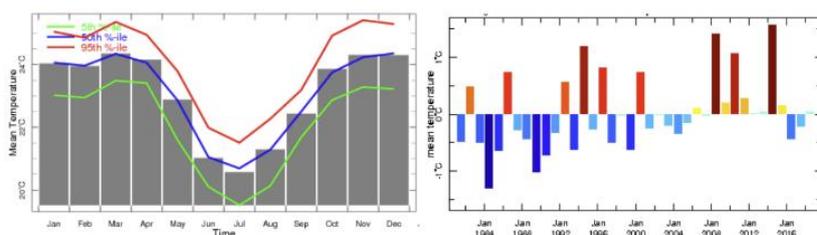

Figure 2. Températures : Moyennes mensuelles et anomalies sur la période 1981-2020 (DGM, 2021)
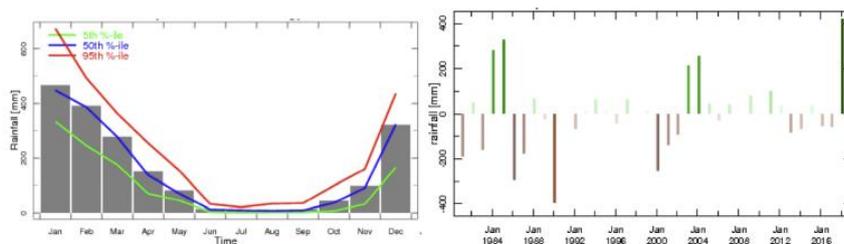
Figure 3. Précipitations : Moyennes mensuelle et anomalies sur la période 1981-2020 (DGM, 2021)

Figure 3: Effects of climate change: Temperature & precipitation 1981-2020 (Maerker & Bie 2022).

countries to be affected by extreme weather events (Maerker & Bie 2022). The main changes comprise the rising temperatures as well as a general decrease in rainfall, coupled with heavy rain events (see figure 3). The region is frequently confronted with cyclonic episodes associated with heavy rains and strong winds. These events lead to flooding and riverbank erosion which are destroying human infrastructure as well as agricultural fields (Helvetas 2022). Alongside the hydro-meteorological hazards, we observe a change in seasonality (Andriamalalanirina 2018). Pests and diseases arise due to climatic changes and impact the plants (Andriamalalanirina 2018).

1.2.2   Anthropogenic challenges

The biggest issue in the Sambirano region is deforestation, mostly induced through slash and burn activities. Deforestation also increases the impacts of climate change (Maerker & Bie 2022; Andriamalalanirina 2018). People appropriate forest mainly for agricultural production such as rice fields, but also for the establishment of cash crops like cocoa and illegal wood exploitation (Maerker & Bie 2022). This process is aggravated by the destruction of fields through climatic hazards, population growth, migration, and unclear land regulations. Furthermore, farmers are faced with a lack of infrastructure, theft of the harvest, price volatility for cocoa beans, and a corrupt state. Maerker and Bie (2022) point out that the opaque land governance system and the lack of law enforcement are two major issues for sustainable land use because they enhance existing challenges and hinder transformation.

1.3   Research question

The effects of climate change – enhanced by deforestation – represent one of the greatest challenges for sustainable cocoa production in Sambirano. Therefore, a holistic strategy needs to consider the interrelation between human and environmental needs and enhance the climate resilience to foster secured livelihoods and sustainable land use. My proposed approach is led by the overarching research question: *How can the livelihoods of small holder cocoa farmers be improved while mitigating the effects of climate change to secure and conserve the ecosystem services in the Sambirano watershed in Madagascar in a sustainable manner.* To achieve this systemic change, the biggest possible levers for transformation such as deforestation, climate mitigation strategies, land governance, and farm level innovations need to be implemented based on participatory and multistakeholder processes.

2   Method – designing a ToC

Based on the local challenges and selected primary studies, I designed a ToC for sustainable cocoa production in Sambirano (Dhillon & Vaca 2018 & Belcher & Claus 2020). I constantly revised and adapted the intervention strategies through acquiring new knowledge on the target area. Furthermore, I incorporated local knowledge into the analysis by interviewing a local expert (Myrs Rasolofo from Helvetas) working with cocoa farmers in Sambirano. He emphasized, that especially the degradation of the landscape due to climate change and anthropogenic pressure, must be addressed as soon as possible (Rasolofo 2022). Due to the complexity of the challenges in Sambirano's cocoa production, I chose a landscape approach to ensure a holistic strategy which considers the interrelation between human and

environmental needs. The paper of Sayer et al. (2013) provides an overview of the principles of land-scape approaches. These guidelines served as a framework for the proposed intervention strategies, such as farm level interventions and land governance strategies based on multistakeholder and participatory approaches.

The dataset consists of primary studies reflecting the local context of cocoa production in Sambirano. Since the number of scientific studies of Sambirano is relatively low, research from other geographical regions was incorporated into the analysis. Andriamalalanirina (2018) and Maerker and Bie (2022) investigate local challenges and approaches to enhance sustainable cocoa production in Sambirano. Andriamalalanirina (2018) primarily targets the impact of climate change and the perception of local farmers of these challenges; while Maerker and Bie (2022) provide adaption strategies grounded on a spatial and participatory mapping. Howard et al. (2017) examine the possibilities of advanced value chain collaboration in the cocoa production in Ghana, where the private sector is particularly involved in the implementation and financial support of strategies. Vaast et al. (2016) show the benefits of agro-forestry systems in cocoa plantations in a general sense. And finally, van Oosten et al. (2014) look at different landscape governance strategies in the context of forest restoration in Indonesia. Since the two
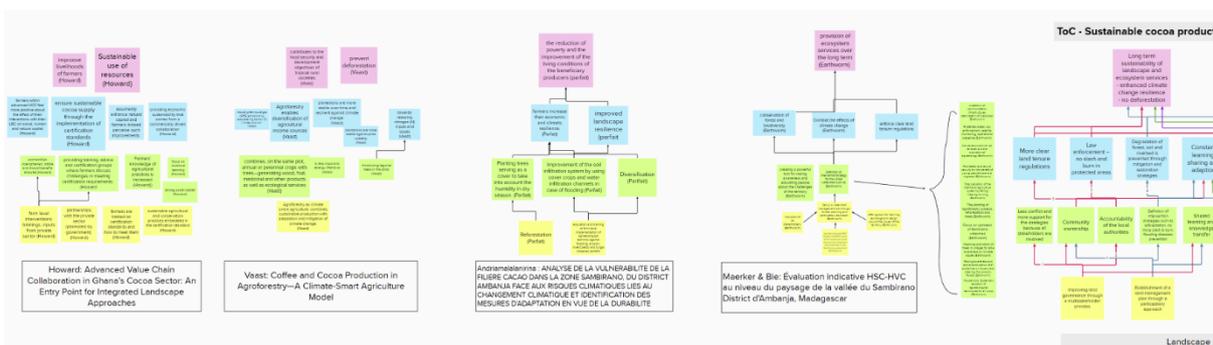
Figure 4: Designing a theory of change: ToC of each paper leads to one synthesized ToC for sustainable cocoa production in Sambirano – Madagascar. (Check figure 6 for the synthesized ToC).

local studies on Madagascar in particular, are of great depth and scope, I incorporated these six studies to design the final approach. First, I developed a ToC for each primary study and finally synthesized them to one comprised concept including four pathways to impact (figure 4 & figure 6).

My proposed ToC is subject to certain limitations. It adapts solutions from other geographical contexts to the specific situation in Sambirano. However, we always must take regional peculiarities into ac-count. The ToC is based on current data of the target area as well as present scientific knowledge. However, these are agile systems and therefore require constant adaptation and revision of the ToC. Furthermore, not all challenges people and the environment are facing in Sambirano are addressed in the approach. Apart from the expert interview, I based the suggested ToC on the results of primary studies instead of knowledge generated directly within the landscape, which limits its validity. Another limitation is that it was designed by one person. Further reflection, triangulation, and a review process could strengthen the results.

2.1 Structure of the designed ToC
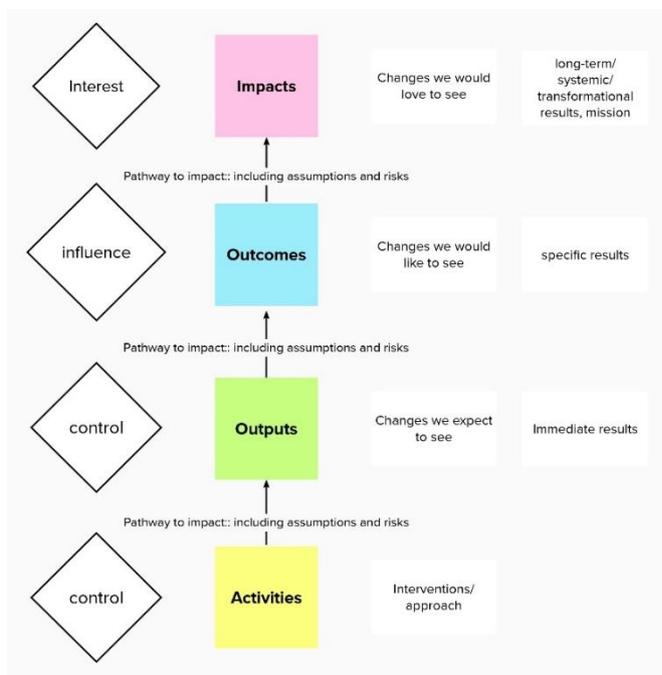
Figure 5: Structure of presented ToC.

In figure 5 I illustrate the structure, the main elements, and the logic of the designed ToC (adapted from: Dhillon & Vaca 2018 & Belcher & Claus 2020). The different steps of *activities*, *outputs*, *outcomes* and *impacts* can be distinguished through different levels of influence. Intervention strategies are determined directly and the first effects – *outputs* – are immediate results which are, based on evidence and experience, *expected to see*. Therefore, a*ctivities* and *outputs* belong into the sphere of *control.* At the *outcome* level, the uncertainty is higher, which is why these are results *we like to see* in a sphere of *influence*. At the highest level are the *impacts we would love to see*. They are comprising the final mission and transformative changes of the system. Due to the lack of control in this sphere, it is called level of *interest*. All steps between *activities*, *outputs*, *outcomes* and *impact,* are connected through interrelations including assumptions and risks. I call these the *pathways to impact* which I will further elaborate on the next pages.

3 Results

3.1 Impact to be achieved

The impact to be achieved is based on the overarching research question that arose from the assessment of human and natural conditions in the Sambirano watershed: *How can the livelihoods of small holder cocoa farmers be improved while mitigating the effects of climate change to secure and conserve the ecosystem services in the Sambirano watershed in Madagascar in a sustainable manner.* The focus lies on the livelihoods while safeguarding the environment. Both aspects are interlinked and therefore cannot be separated. The people in Sambirano rely on functioning ecosystem services to secure their

income; however, the landscape is degraded due to anthropogenic pressure. Hence, I defined the following impact targets:

1) Long-term sustainability of the landscape and ecosystem services
   a. Enhanced climate change resilience
   b. No deforestation
2) Secured livelihoods of small holder farmers

3.2 Intervention strategies – Landscape approach

To improve the livelihoods of the farmers and the sustainability of the landscape, a holistic approach is needed that aims to meet both nature conservation goals and human needs. Therefore, I propose a landscape approach that serves as a framework for the intervention strategies.

Landscape approaches have their roots in conservation theory; however, their further development comes from the recognition of the need to address the priorities of people who live and work within, and ultimately shape, these landscapes. In this systemic and holistic view, issues are recognized as so-called "wicked problems" with no clear final solution (Sayer et al. 2013). This perspective is applicable to the situation in Sambirano because the main conflict of interest lies between the conservation of the nature and the resource dependency of the people who live in this system. Sayer et al. (2013) define 10 principles that must be considered when applying a landscape approach. These include for example the engagement of all stakeholders, a participatory approach, acknowledging the multifunctionality of the landscape, and the establishment of clear rules on resource access. Furthermore, Sayer et al. (2013) state that processes in landscape systems are always dynamic, therefore continual learning and adaptation are also part of the 10 principles.

3.2.1 Activities

Figure 6 displays the diagram of the complete ToC. To ultimately achieve the impact of long-term sustainability of landscape and ecosystem services (enhanced climate change resilience, no deforestation) and secured livelihoods I chose the following four intervention strategies:

1) Improving land governance through a multistakeholder process.
2) Establishment of a land management plan through a participatory approach.
3) Farm level interventions such as agroforestry through learning and training processes.
4) Securing financial support through collaboration with NGOs and private companies.

According to the concept of a landscape approach, the strategies incorporate activities on farm as well as landscape level. In alignment with the principles proposed by Sayer et al. (2013) all actors on the ground are included in the strategies.
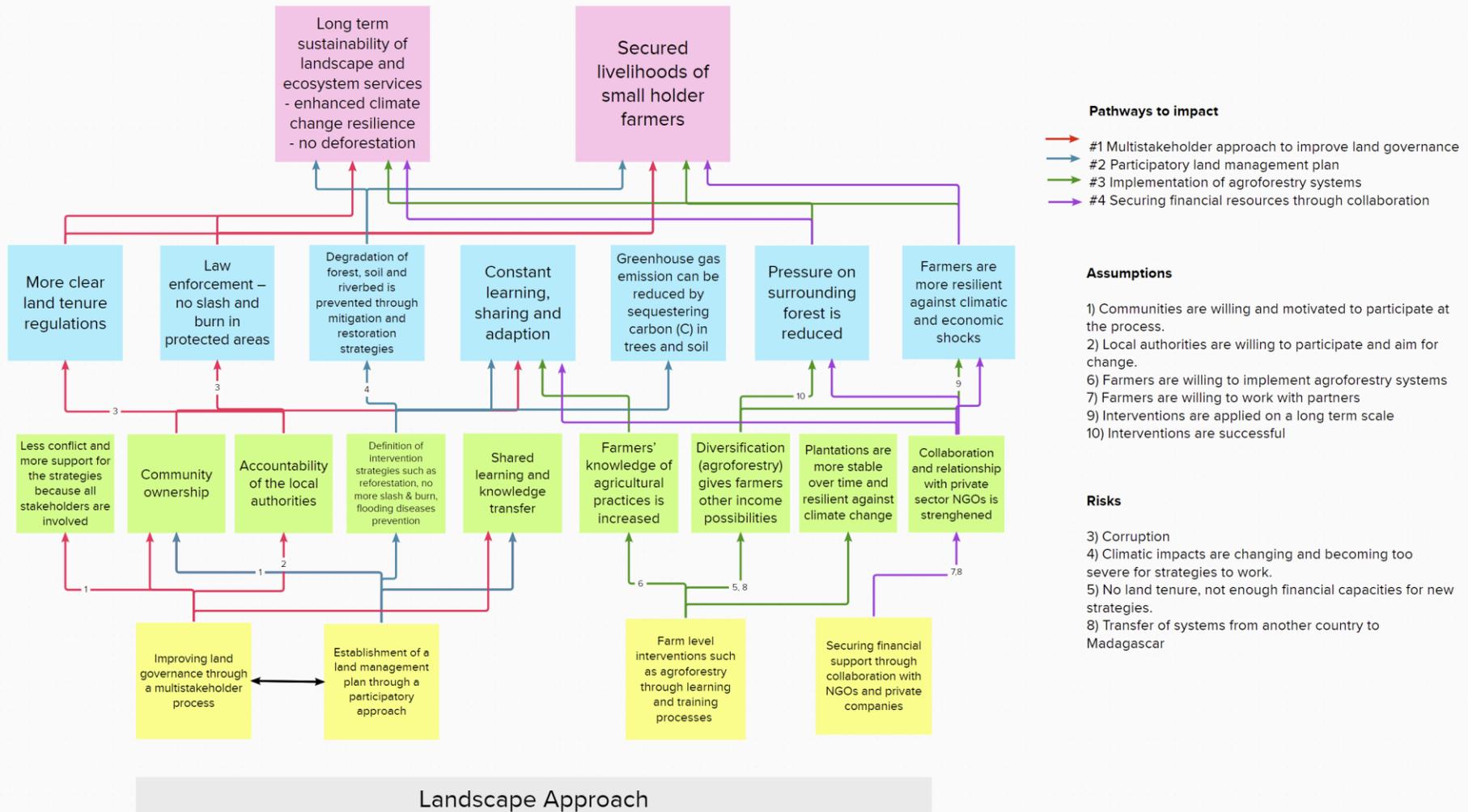
Figure 6: Synthesized ToC for sustainable cocoa production in Sambirano Madagascar. Including pathways to impact, assumptions and risks.

3.3 Pathways to impact

I identified four pathways to impact based on the intervention strategies in the synthesized ToC. These pathways connect the intervention strategies with the final system transformational goals (impacts): 1) Multistakeholder approach to improve land governance, 2) Establishment of a participatory land management plan, 3) Implementation of agroforestry systems, 4) Securing financial resources for innovations through collaboration. These pathways and their connections to outputs, outcomes, and impacts are represented through the colored arrows (Figure 6). Assumption and risk I also considered within these links. It is important to note that results that are not connected through a certain pathway can still be interlinked and influence each other. The arrows shall emphasize certain evident relations and conditions. Ultimately, all activities and effects of the ToC are interrelated and are relevant to the overall vision and transformation and are contributing to the impacts to be achieved (Figure 6). Although they involve different strategies; all four pathways eventually lead to the two overarching impact goals. However, as I explained in chapter 2, the level of direct influence is reduced. In the following sections I explain each pathway in more detail. The concrete activity, outputs, outcomes, and impacts of every pathway are listed in a table at the beginning of each paragraph (Table 1-4).

3.3.1 Pathway #1 – Multistakeholder approach to improve land governance

Impacts	- Secured livelihoods of small holder farmers - Long-term sustainability of the landscape - Enhanced climate change resilience - No deforestation
Outcomes	- Law enforcement – no slash and burn in protected areas - Clear land tenure regulations – farmers know how to "own" land officially
Outputs	- Less conflict and more support for the strategies because all stakeholders are involved - Community ownership - Accountability of the local authorities - Shared learning and knowledge transfer
Activities	Improve land governance through a multistakeholder process

Table 1: Pathway #1.

First, I must stress, that pathway #1 is connected to pathway #2 (Establishment of a participatory land management plan). Both strategies are based on multistakeholder processes. In other words, to define land governance and land use strategies, all concerned actors need to be involved in the process (Sayer et al. 2013). As outlined in the introduction, these mainly include the following players: Small holder farmers, governmental institutions (district and municipality representative, CNC, COGBES, MNP), private companies (collectors, exporters, processors) and NGOs. Pathway #1 focuses on improving land governance systems, whereas pathway #2 elaborates coordinated land management strategies to combat the effect of climate change.

The inclusion of local actors is especially important for conflict prevention, knowledge transfer, and broad-based support for new initiatives. Based on three different case studies on forest restoration in Indonesia van Oosten et al. (2014) demonstrate that without the inclusion of people living in the area,

conflicts arose and locals did not support the initiatives. Through multistakeholder processes farmers became co-managers of the forest, shared responsibilities, and helped implement the restoration plans. This approach also improves relationships between governments, private actors, and a landscape's inhabitants (van Oosten et al. 2014).

The main cause of deforestation is the slash and burn practice (Maerker & Bie 2022; Andriamalalanirina 2018). This development is encouraged by land use rights not being clearly regulated or controlled by the state. Many farmers are unaware of the status of their land or how to actually "own" it. Therefore, they are acquiring new plots instead of applying restoration strategies or investing into climate smart agricultural practices. According to customary law, the person who first burns down a certain plot becomes the owner of this land (Maerker & Bie 2022). Maerker and Bie (2022) emphasize that before any other actions are taken, securing land tenure represents the first and best incentive for farmers above any other support. Furthermore, the state must rigorously reinforce official laws to prevent illegal slash and burn activities. Clear rules on resource access are also one of the principles of landscape approaches (Sayer et al. 2013). Maerker and Bie (2022) show that multistakeholder processes foster community ownership and evoke accountability of local authorities. Governmental authorities must acknowledge the severity of the problem with land tenure issues and address the issue accordingly. A multistakeholder process offers a possible entry point to that matter.

However, the premise that governmental involvement in the multistakeholder process leads to clearer land tenure regulations is, of course, an assumption (figure 6). State corruption may hinder changes from happening (Rasolofo 2022). Furthermore, uncertainties considering the willingness of farmers and other stakeholders to participate in this process exist.

3.3.2   Pathway #2 – Establishment of a participatory land management plan

Impacts	▪ Secured livelihoods of small holder farmers ▪ Long-term sustainability of the landscape 　○ Enhanced climate change resilience 　○ No deforestation
Outcomes	▪ Degradation of forest, soil and riverbed is prevented through mitigation and afforestation strategies ▪ Greenhouse gas emission can be reduced by sequestering carbon (C) in trees and soil
Outputs	▪ Definition of intervention strategies for the whole watershed such as reforestation and no more slash and burn activities, measurements against flooding, insects and fungal diseases ▪ Community ownership ▪ Shared learning and knowledge transfer
Activities	▪ Establishment of a land management plan through a participatory approach

Table 2: Pathway #2.

The pathway to impact #2 proposes that participatory planning of land use leads to coordinated and long-term strategies to combat the effects of climate change. The participatory process of land management planning is designed in a framework of a multistakeholder approach, which I introduced in pathway #1.

Andriamalalanirina (2018) demonstrate that it was possible to identify the perception of the influence of climate change in terms of temperature, rainfall, seasonality, and pests through surveys with 60 farmers of the area of the Sambirano watershed. This knowledge can be shared through participatory work and used to draw management strategies for the whole area. According to the results of Andriamalalanirina's work these interventions shall mainly concern the fight against flooding, erosion, insects, and fungal diseases through agro-ecological techniques as well as reforestation (Andriamalalanirina 2018). I further explain agro-ecological approaches in pathway #3.

Maerker and Bie (2022) conducted a similar approach. Through spatial mapping, they first identified forest zones with "haute Stock de Carbone" (HSC) and zones of "High Conservation Value" (HCV) (figure 7). However, landscapes cannot be limited to biodiversity conversation. Their multifunctionality must be acknowledged by including the needs of the local communities (Maerker & Bie 2022; Sayer et al. 2013). Therefore, they revised the map to include historical contexts and the inputs of the local farmers through a participatory approach. It was then possible for them to create a map of the landscape that showed all different types of land use recognized by the communities (figure 8). Furthermore, the participatory mapping is also a powerful tool for community building, raising awareness and educating people about the challenges of the territory (Maerker & Bie 2022; van Oosten et al. 2014). The integrated land use map laid the basis for restoration, mitigation, and adaption strategies. The main issue to address is deforestation. Maerker and Bie 2022 stressed that areas that are sensitive to erosion and landslides must be restored through reforestation.
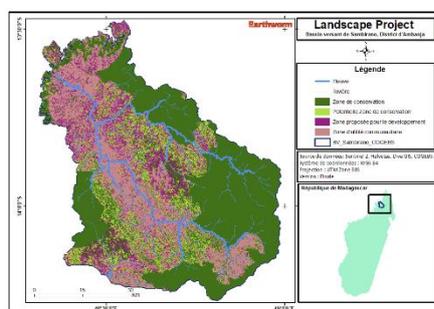
Figure 7: Spatial mapping of Sambirano watershed. Representing possible conservation zones (Maerker & Bie 2022).

Figure 8: Participatory mapping process (Maerker & Bie 2022).

If we look at the outcome level, strategies such as reforestation help to reduce the degradation of forest, soil and riverbed. More forest cover helps to mitigate the effects of climate change (Maerker & Bie 2022; Andriamalalanirina 2018). More carbon can be stored in trees and soil, which again has a positive impact on the climate (Vaast et al. 2016). In the long term the implementation of these measures lead to enhanced climate change resilience, secured livelihoods of small holder farmers, and long-term sustainability of the landscape. (Maerker & Bie 2022; Andriamalalanirina 2018).

Pathway #2 is based on the assumption, that the communities are all willing to participate in such a process and that they adhere to adaptation strategies over the long term (figure 6). As outlined in pathway #1 the main risk is the lack of law enforcement and corruption. Moreover, climatic conditions

might even change to more severe characteristics in the future, which will then ask for new mitigation strategies. Which is why regularly adaption and review of the map and strategies are required.

3.3.3   Pathway #3 – Implementation of agroforestry systems

Impacts	- Secured livelihoods of small holder farmers - Long-term sustainability of the landscape - Enhanced climate change resilience - No deforestation
Outcomes	- Pressure on surrounding forest is reduced - Farmers are more resilient against climatic and economic shocks - Constant learning, sharing and adaption
Outputs	- Farmers' knowledge of agricultural practices is increased - Diversification (agroforestry) gives farmers other income possibilities - Plantations are more stable over time and resilient against climate change
Activities	Farm level interventions such as agroforestry through learning and training processes

Table 3: Pathway #3.

Pathway #3 focuses on the implementation of agroforestry systems at farm level. Agroforestry is a land management practice which combines on the same plot cash crops with fruit trees, wood production, and other products (Vaast et al. 2016). Agroforestry is less input and energy-intensive than classical monocultures and more stable and resilient regarding climate change, outbreaks of pest and diseases as well as price volatility for agricultural products. It also provides an opportunity to reduce greenhouse gas emission by sequestering carbon in trees and soil (Vaast et al. 2016). By combining sustainable production with adaption and mitigation of climate change, agroforestry should be considered as a major climate smart agriculture tool (Vaast et al. 2016). Such farm-level interventions can be promoted through learning and training processes organized by the community (Maerker & Bie 2022) or through initiation of private institutions such as cocoa processing companies or NGOs (Howard et al. 2017; Helevetas 2022).

According to the outlined effects, agroforestry is a promising strategy for sustainable cocoa production in Sambirano. The implementation of climate smart agricultural practices and diversification in the production can help to improve the resilience of farmers against price volatility as well as climatic shocks (Rasolofo 2022; Vaast et al. 2016). It reduces the pressure on the surrounding forest and prevents deforestation. According to the expert on the ground, the application of agroforestry measure finds great support within the local farmer community (Rasolofo 2022).

In terms of underlining risks, farmers need to secure land rights to be keen to invest into such strategies – as outlined in the pathway #1. Furthermore, there must be financial support and willingness to induce such learning and training practices. Many players such as Helvetas or Lindt and Sprüngli, are active in Madagascar and could initiate such work (Helvetas 2022; Lindt Cocoa Foundataion 2021). A community organization such as the COGBES can take an important role in sharing the knowledge for farm level intervention strategies.

3.3.4   Pathway #4 – Securing financial resources for innovations through collaboration

Impacts	- Secured livelihoods of small holder farmers - Long-term sustainability of the landscape - Enhanced climate change resilience - No deforestation
Outcomes	- Farmers are more resilient against climatic and economic shocks - Pressure on surrounding forest is reduced. - Constant learning, sharing, adaptation
Outputs	Collaboration and relationship with private sector NGOs is strengthened
Activities	Securing financial support through collaboration with NGOs and private companies

Table 4: Pathway #4.

Since there is only limited financial support from the state, other credit options are required to invest in mitigation and restoration practices such as agroforestry. Pathway #4 focuses on the financial source for restoration, mitigation, and adaption strategies. The private sector and NGOs represent a possible investment source. Investments should go directly to the farmer to bypass state corruption.

Van Oosten et al. (2014) define the private sector as an important actor in terms of financing mitigation and restoration strategies who has taken care of the bulk of investments required for reforestation practices. Howard et al. (2017) show in their analysis of advanced value chain corporation in Ghana that private cocoa processing companies have an interest in investing in climate smart agriculture. Companies engage in partnerships with local farmers, assuming that failing to address societal problems such as food insecurity and unsustainable production will eventually lead to supply failure or productivity losses. Such a development could lead to high costs consequences for the company. Therefore, companies provide inputs such as seeds, credits, and trainings for the farmers (Howard et al. 2017). Such commercially driven collaboration can have mutual benefits for all stakeholders and provide economic sustainability. It can be embedded in the overall framework of a landscape approach (Howard et al. 2017). It must be acknowledged that the situation in Ghana differs of course widely to the one in Madagascar. In Ghana, the sale of cocoa is clearly regulated, while in Madagascar the free market prevails. However, Andriamalalanirina (2018) points out that even though investment cost to address the main risk of cocoa production in Sambirano are quite high, there is also a great potential for donors in Sambirano. Cocoa is an attractive crop to invest in compared to other products from the area and as stated before, there are already motivated players such as Helvetas or Lindt and Sprüngli on the ground (Helvetas 2022; Lindt Cocoa Foundation 2021).

In terms of the outcome level, collaboration with the private sector lead to enhanced resilience of the farmers against climatic and economic shocks, and the pressure on the surrounding forest is reduced which secures livelihoods of small holder farmers and prevents of deforestation.

4   Discussion

Based on the outlined results, in the following section I elaborate implications and suggestions for landscape projects for sustainable cocoa production in Sambirano.

4.1   Working with local communities

The proposed ToC for sustainable cocoa production in Sambirano emphasizes that the inclusion of all local stakeholders, such as the producers, state officials, and the private sector is absolutely crucial to achieve long-term support for intervention strategies such as restoration and mitigation schemes. Such participatory approaches can only be induced while directly working on the ground with the local communities. Such field work provides an understanding of the local realities. Project leaders can adopt general assumptions and solutions of the ToC to the local context. Project initiators and supporters might guide such a processes by helping to set up formats such as workshops and acts as facilitators, however, we have to ensure that the responsibility and motivation to act comes from the local stakeholders. Sharing the responsibility will strengthen community building and ensure accountability among all stakeholders. A common understanding among all participants is needed to design coordinated strategies to move forward.

Participation to multistakeholder events must be ensured when designing formats for i.e. participatory mapping. Conditions of the roads, time management and personal resources of the participants must be considered. The same applies for the accessibility of information. Knowledge must be shared through appropriate and accessible channels and different levels of education and know-how must be taken in account. Tools such as maps have to be visualized in a way, that they are comprehensible for everyone (Maerker & Bie 2022). For the system to remain agile and adapt to new circumstances, constant knowledge transfer and adaptation must be ensured.

4.2   Land tenure regulations

Land tenure regulations represent one key aspect that hinder transformation and accelerate deforestation practices in Sambirano. However, as Sayer et al. (2013) outline, clear land tenure regulations are key for the implementation of successful landscape approaches. Van Oosten et al. (2014) also emphasize that governments must be the leading actor when it comes to landscape restoration. When working on a project for sustainable cocoa in the landscape of Sambirano project initiators must therefore consider land tenure in the design of implementation strategies Pathway #1 represents a possible entry point to tackle the land tenure issue by including state authorities into the multistakeholder process and thus raising awareness and accountability. However, limitations in terms of influence on the state, especially given the widespread corruption, must be recognized and can represent a potential risk.

If financial support from the state for restoration and mitigation strategies is failing, private companies or NGOs could be a potential source. In these cases, it is essential, that investment goes to people directly affected to bypass corruption (Rasolofo 2022).

4.3   Biggest levers for transformation

Climate change represents one of the greatest challenges for farmers to produce cocoa sustainably while securing the necessary ecosystem services. To address this problem as quickly as possible, but also as sustainably as necessary, initiatives must address the biggest levers for change. In the proposed ToC I identified deforestation and farm level interventions as such levers. Therefore, the goal must be to design concrete restoration and mitigation strategies to tackle these issues through participatory processes. These strategies also involve measurements against strong climatic hazards such as drought, floods, diseases as well as adaption to new seasonality (Andriamalalanirina 2018). However, as Maerker and Bie (2022) point out, investments must also be done cautiously and implemented at places where the biggest effects can be achieved. It is ineffective to implement flood erosion practices in places that are frequently flooded anyway (lowlands) because the anthropogenic structures would not sustain the next hazard (Maerker & Bie 2022). Therefore, it is important to evaluate where efforts have the greatest impact.

When proposing strategies for farm-level interventions, the producer's possibilities must be considered according to his time, personal resources, and assets. Approaches have to be tailored to the local circumstances. Otherwise a long-term implementation cannot be expected. Furthermore, it must be acknowledged that the environment is not a stable system, and therefore constant updates of the evaluation of the situation are needed to adapt to current trends and circumstances.

4.4   Other entry points

Even though a systemic approach was used, not all the challenges or underlying issues for sustainable cocoa production could be addressed in the suggested ToC. The intervention strategies are mainly focusing on landscape solutions such as mitigation against climate hazards, prevention of deforestation as well as farm level improvements. For future landscape projects, other possible entry points could be considered. Such entry points are the strengthening of the farmer's position in the value chain (Abdirassoul & Ravelomanana 2022) by supporting farmers to organize themselves in cooperatives or move into contract farming (Callahan 2019). Nature-based solutions, such as carbon credits represent further possibilities for improvement. However, it must be ensured that the money reaches the right people (Rasolofo 2022). Furthermore, future projects could address issues such as health, infrastructure, education, and child labor. It is important that such assessments are accompanied by work on the ground to collect the required scientific data to address these problems.

5   Conclusion

The analysis of the cocoa sector in Sambirano Madagascar revealed that the producers are confronted with multiple anthropogenic and environmental challenges. The biodiversity rich nature of the region is suffering from human-induced pressure on the landscape, which is mainly displayed in deforestation that leads to a degraded landscape. In the last 20 years meteorological changes, such as a decrease in annual rainfall, long drought periods and strong cyclones, have become evident and are visibly aggravating the situation. Madagascar is one of the worldwide most affected countries by climate change. The pressure on the landscape is increased due to population growth as well as destruction of agricultural land through climatic hazards.

Recognizing the local realities and finding solutions which are mutual beneficial for nature and people are crucial to enhance the sustainable production of cocoa. Local communities must be included in participatory approaches to create a common understanding of the problem and ensure long-term support for restoration and mitigation strategies. Information must be accessible to all stakeholders, and knowledge-sharing and learning are the foundation for constant adaption and improvement of the current situation. Although difficult, land governance needs to be addressed and local government awareness and responsibility in this matter needs to be raised. At farm level, farmers can be sensibilized to implement agroforestry systems to enhance their resilience against climate change and economic shocks. The financing of such approaches is one of the major obstacles that future initiative have to address. Collaboration with private sector, as well as NGOs, could represent a possible entry point. Eventually, all of these strategies will reduce the pressure on the landscape, prevent deforestation, and improve the livelihoods of the cocoa producers in Sambirano.

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