Pathways toward sustainable cocoa in Colombia

Nora Huber, 18-110-742

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Toward sustainable cacao: assessing governance strategies and their theories of change

University of Berne

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Acronoms

AFS: Agroforestry System

CAFS: Cocoa Agroforestry System

LSA: Land-scape Approach

PES: Payment for Environmental Services

ToC: Theory of Change

Executive Summary

The aim of this paper is to identify pathways to a more sustainable cocoa sector in Colombia. Using a combination of inside-out and outside-in perspectives, the desired impacts of transformation are identified as follows: strengthening peace, increasing farmers' incomes to reduce poverty, and climate- and biodiversity-friendly production. Since many studies indicate that agroforestry systems (AFS) can contribute to the desired impacts, this paper shows whether and under what conditions this is the case. In addition, this paper identifies different pathways for the expansion of cocoa agroforestry systems (CAFS) in Colombia.

The study is based on a literature review, focusing mainly on primary literature, and a semi-structured interview. The Theory of Change (ToC) approach was used to derive from the case studies which pathways would be most appropriate for Colombia to achieve the desired impact.

The results show that a landscape approach (LSA) is the best way to create all the necessary conditions for successfully scaling up CAFS. Good economic and market conditions need to be created for CAFS to really contribute to peace and reduce poverty. In addition, it is important to conduct more research at the local level with a transdisciplinary approach to take into account individual contexts and identify the best typology and practice of CAFS. These results should also be compulsorily integrated into training, which should be available to all farmers.

The LSA pools resources and involves all relevant actors, leading to greater alignment and coordination of actors' activities in a particular direction. By implementing different LSAs throughout Colombia and ensuring knowledge transfer between these different networks, the aim is to make the cocoa system more sustainable at the national level.

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1 Introduction

The transformation of the current food system remains a main challenge of the 21st century. As the food system is strongly connected to ecological and social challenges just as deforestation, climate change, biodiversity loss, poverty or inequality, there's a huge interest to redesign them and to find pathways towards more sustainability. The Agenda 2030 with the 17 Sustainable Development Goals helps to understand, what goals should be pursued. In general, it's about finding pathways to create a food system that is within planetary boundaries and at the same time meets the basic social needs of all people (cf. Raworth, 2012).

In this paper, the focus is on the transformation of the cocoa sector in Colombia. When talking about transformation, the target area needs to be defined, as there are two different perspectives. One is the "inside-out" perspective, which seeks to minimize negative impacts along the cocoa value chain. Here, it is important to look at the entire value chain and integrate all three dimensions of sustainability holistically. On the other hand, there is the more progressive "outside-in" perspective that looks at global problems and current challenges in general and tries to find solutions, business models, and pathways that contribute to these challenges (Dyllick, 2015). This paper combines the two perspectives, leading to the overarching question of how to minimize negative impacts and target positive impacts in the cocoa sector in Colombia.

First, an overview of the cocoa sector in Colombia is given and the main challenges and perspectives for sustainable development are presented. Based on this, the main goals/desired impacts of the transformation are defined, considering the outside-in and inside-out perspectives. The second chapter deals with the methodological approach and the data basis. In chapter 3, the results of the data analysis are presented, showing possible paths to transformation. Finally, concrete recommendations for action are given.

1.1 Colombia

Colombia is a Country in South America, which is divided into 32 different districts Due to the high diversity of landscapes, Colombia is the second most biodiverse country in the world. But Colombia has also to deal with challenges such as deforestation and climate change, which pose a major threat to biodiversity. The main driver of deforestation are illegal activities such as coca leaf production, illegal timer extraction or also livestock expansion and infrastructure development (Löhr et al., 2021).

These illegal activities also lead to further challenges. In many rural areas paramilitary groups or organized crime have the power and put the population in fear and provoke conflicts. The urgency of this issue is also visible in the Global Peace Index, where Colombia is ranked 143rd out of 164 countries (Löhr et al., 2021). In addition, the country is characterized by staggering inequalities and poverty, primarily affecting rural areas.

Although Colombia produces only about 1% of the world's cocoa, the cocoa sector plays an important role in Colombia (Löhr et al., 2021). The productivity has risen by about 50% in the last 10 years (Swisscontact, 2022) and the average annual harvest in Colombia is about 54,000 metric tons (Abbott et al., 2018). The national strategy lately really focused on increasing productivity but without the expected impact due to lacking incentives for producers (Deans et al., 2017).

Cocoa farming in Colombia is characterized by a smallholder economic system with farms of 3.3. hectares on average, which are distributed in seven production zones. Cocoa production represents the main activity for more than 35,000 families in rural areas, accounting for 75% of their net income Although the main local buyers (Casa Lukar and Compañía Nacional de Chocolates) pay in the average range, the income for smallholder farmers can be improved (Ríos et al., 2017).

What makes Colombia unique, compared with other main cocoa-producing countries, is the focus on domestic demand. So, around 75% of the produced cocoa is bought by the local industry and just 25% is exported to countries such as Belgium, Netherlands, Spain or Mexico (Abbott et al., 2018). Here it should be considered that the local market is also important around 5,8 metric tons of beans a year from other countries such as Ecuador (Ríos et al., 2017). Colombia is one of the most important producers of fine-flavor cocoa, as more than 95% on average is characterized as fine flavor. But only about 1/3 of the produced cocoa is traded as fine flavor cocoa as most production is not commercialized in specialized markets (Ríos et al., 2017).

1.2 Challenges and Potentials

Colombia benefits from the favorable natural conditions which lead to a huge variety of cocoa trees and to a high amount of fine-flavor cocoa (cf. Swisscontact, 2022/ Abbott et al., 2018/ Ríos et al., 2017) Colombia has already entered the export market for specialty cocoa, but as the demand increase especially in Europe, there are great opportunities to expand the export rate of specialty cocoa (Ríos et al., 2017).

Since coca cultivation requires similar conditions for production as cocoa, and coca cultivation leads to violence and conflict in rural areas, cocoa is seen as an alternative to illegal employment in Colombia and as a peace driver (cf. Castro-Nunez et al., 2020/Löhr et al., 2020/Abbott et al., 2017). The low productivity rate in Colombia represents a main challenge of the system, as the potential would be higher. Reasons for the low productivity are diverse, but what stands out are the poor transfer of information and knowledge (lack of coordination between actors, lack of technology transfer, lack of extension services) and the lack of financial resources. The OECD (2015, p. 272) mentions for example that: “The current technical assistance system is costly, unstable, inconsistent, unevenly distributed, and disconnected from research, innovation, and education.” Climate change. deforestation and biodiversity loss pose a threat not only to cocoa production but generally to future life. The illegal activities and conflicts in Colombia are an obstacle to foreign investors or international companies, making it difficult to expand the cacao sector.

Strengths	Weakness
• Favorable natural conditions for cocoa production (climate, humidity) • High amount of fine flavor cocoa • High domestic market	• Labor demanding cultivation -> high costs • Low productivity • Low information flow • Lack of coordination between actors • Lack of technology transfer and extension services • Lack of adoption of technology and understanding cultural practice • Low amount of cooperatives • Low amount of certificated or promoted fine flavor chocolate • Low income
Opportunities	Threat
• Promote fine flavor cocoa • High agroforestry potential • Peace building through cocoa sector	• Climate Change • Biodiversity loss • Conflict • Deforestation

Figure 1: SWOT-Analysis of the cocoa sector in Colombia. (Own representation)

1.3 Target Area and Research Question

Looking at the main challenges and opportunities and trying to combine an inside-out and outside-in approach, the following concrete goals for a transformation of the cocoa system are defined:

1. Increase Peace
   As Peace is seen as basic requirement to achieve other SDGs and cocoa is already seen to have the potential to strengthen it, this should be one of the main impacts of the interventions.
2. Increase small farmers' income to reduce poverty
   Since rural poverty still seems to be a challenge, the income through cocoa should be increased. Further is poverty also a barrier to achieve other SDGs.
3. Increase climate- and biodiversity-friendly cocoa production
   Since many land practices are major contributors to climate change and biodiversity loss, and these are two global challenges, it is important to minimize the negative impacts on it along the value chain.

Recently, many studies have looked at the impact of AFS. The practice of agroforestry appears to be a sustainable alternative to conventional farming practices, which can minimize negative impacts on climate and biodiversity loss (cf. Degar, Tawari, 2017). Further it also promises better income and a higher vulnerability of farmers (cf. FAO, 2005/2019). This leads to the first research question, which focuses on verifying or falsifying the assumption that AFS leads to the desired impacts and main goals.

Q1: (How) Do CAFS in Colombia lead to increased peace, less poverty and climate- and biodiversity-friendly production?

CAFS in this study is defined as a controlled, intentional system of growing cocoa along with other trees and plants over a period and space (Sanial, 2020). Here it's also about finding out under what condition CAFS could lead to the desired impact which also offers a lot of hints about needed outputs and activities Further, since it's assumed that CAFS has the desired positive impact, it's about answering the question how pathways toward more agroforestry system could look like. So the second research question is:

Q2: How can CAFS be successfully scaled up in Colombia?

With scaling up, we refer to expanding, adapting, and sustaining agroforestry production of cocoa (cf. Rodriguez et al., 2022). This question will help us to formulate outcome and impact-oriented activities to design a sustainable cocoa sector.

2 Theoretical Background and Methodology

2.1 Theory of change

The approach of Theory of Change (ToC) can help to find pathways to transform complex socio-ecological systems. The theory of change is a method that explains how defined actions or interventions are expected to lead to a specific goal/impact by analyzing and presenting the causal relationships between activities, outcomes, outputs and impacts. In this study the model is used ex-ante to provide a framework and guide for project/ intervention planning. But the method can be useful at any stage of a project. A ToC is not a single theory but a set of theories that describes and explains the multiple steps in a change process. The concept shows that causal processes are often non-linear with multiple interactions and feedback loops, which must be taken into account (Belcher, Claus, 2020). Further, ToC should also include the aspects of unintended or undesirable outcomes and impacts, which are often forgotten (Dhillon, Vace, 2018).

There are different ways to develop a theory of change. In this paper, an impact-oriented approach is used, which aims to find the required interventions by going back step by step from the desired impact to the required outcome - the output of the required interventions and activities.

2.2 Methodological Approach

Step 1+2: First, the main challenges of the cocoa sector in Colombia had to be identified. For this, both primary and secondary studies were used to identify the main strengths, weaknesses, opportunities and threats (SWOT analysis). By analyzing the current state of the cocoa sector and defining the main objectives, it was important to compare the main issues with sustainability issues from a long-term perspective, including an inside-out and outside-in approach. The literature review was complemented by a semi-structured interview with Silvan Ziegler, the project coordinator at swisscontact. As he has been working in Colombia for two years, he was able to provide valuable contextual information.

Step 3: To define outcomes (long-term changes), which lead to the desired goals, initial research showed high potential to achieve the goals by implementing AFS. Thus, the first research question was

established (cf. p.7) Subsequently, a search was conducted for primary studies (comparative studies, meta-analyses, case studies), which explain the impact of agroforestry on the environment and society. For this purpose, databases of geography, sustainability as well as forestry were searched using terms related to the desired goals (e.g "agroforestry peace"). In addition, a snowball system was applied by searching for concrete case studies derived from meta-analyses. These data were analyzed by creating a separate theory of change for each study. Then they were compared with each other, and it was analyzed whether and under what conditions CAFS can lead to the desired impact. Many of these conditions have already indicated important activities and outputs to achieve the goals through CAFS.

Step 4: After that it was about answering the second research question, defining activities and interventions which scale up CAFS, also considering the conditions identified through the first research question. The same databases were used with adapted search terms. First, papers about concretely upscaling AFS and CAFS were searched. Various meta-analyses were found in which key factors for successful upscaling were mentioned, but hardly any concrete interventions and activities. Therefore, concrete interventions (e.g., multistakeholder applications or certification) that could contribute to the results were then searched. In addition, there was an increased search for concrete case studies in which CAFS were upscaled. ToCs' were also prepared and compared for these studies, and the most important activities and results were identified. In doing so, the most important assumptions were always critically questioned. It was also important to consider the context in which the interventions were introduced and compare them with the context in Colombia.

Subsequently, the aim was to bring together the different ToCs' and the two research questions, to identify key recommendations for action and to capture these pathways in a final Theory of Change.

It is important to emphasize that this process is characterized by a high degree of circularity. Thus, several steps forward and backward can be taken again and again until the necessary paths and cause-effect relationships are identified at the end, which is why the research questions were also slightly adjusted in the course of the study.

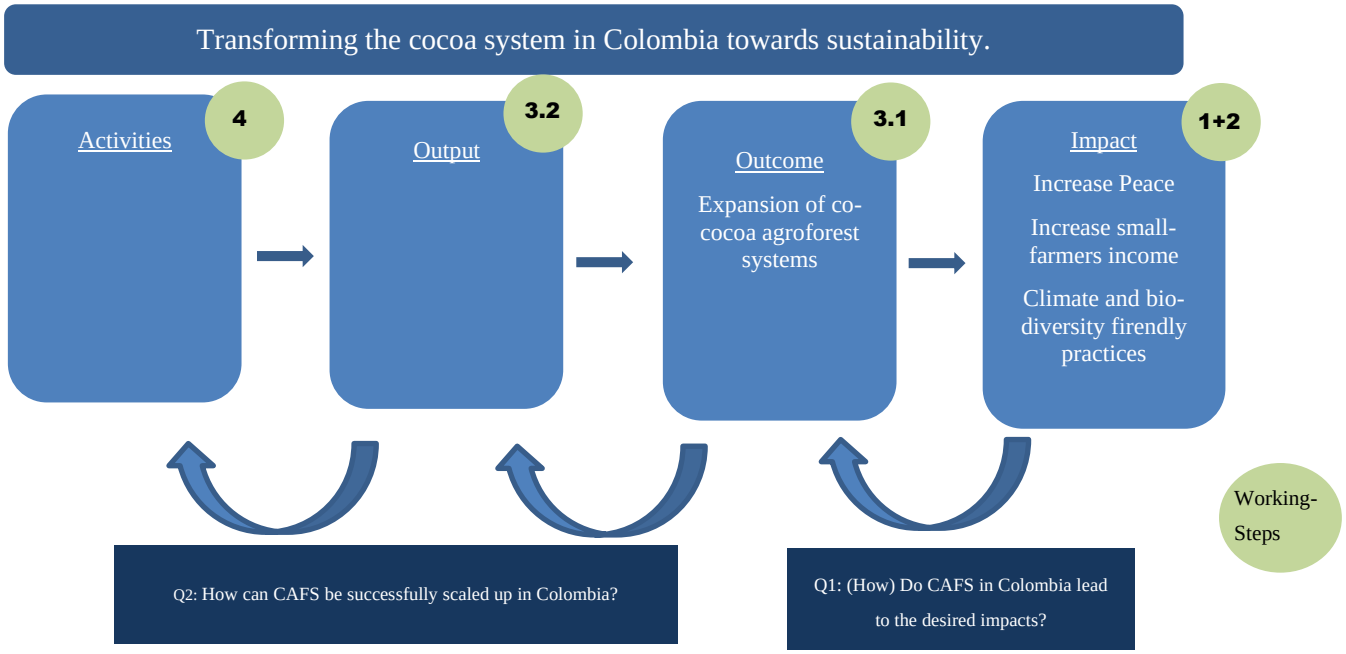

Figure 2: Methodological Approach (Own Representation)

Limitations:

The theory of change is associated with many assumptions that studies try to prove. Nevertheless, effects are always difficult to estimate, as it is almost impossible to consider all influencing factors in such complex systems.

In addition, the amount of data is very small, and since success factors were specifically search, this can lead to a bias in the results and an above-average positive assessment of effects and neglect of negative effects.

As many of the case studies were conducted in other regions of the world, different contexts need to be analyzed and possible changes in impact assessed, which is challenging as it is difficult to compare the exact context of two places through text analysis alone. What further complicates the whole work is the lack of a unified definition of CAFS.

3 Results

3.1 Impact from Agroforestry

Here, the first research question is answered and the potential impacts from cocoa agroforestry systems on peace, income/poverty reduction and climate-and biodiversity-friendly production are presented.

3.1.1 Impact from Agroforestry on Peace

The study of Castro-Nunez et al. (2021) shows that the stakeholder believe that cocoa can foster peace by replacing illegal crops and improving the economic opportunities in rural areas. This is especially important since the illegal economy of illicit crops is a major component in financing armed groups and sustaining the violent conflict in regions (Löhr et al. 2021). Further, other studies show, that cocoa production can be a good alternative to coca, due to the similar natural conditions of cultivation (Löhr et al, 2021). But the stakeholder also mention that peace can only be achieved if the cocoa production becomes a profitable alternative business for farmers and it has to meet at least their basic needs. Because if not, this could reinforce the initial causes of the conflict or lead to further illegal activities (Castro-Nunez et al., 2021).

Cacao cultivation can not only be a good alternative to coca cultivation but also in terms of other illegal activities. This plays an important role as conflict and illegal activities are among the main drivers of deforestation in Colombia (Landholm et al., 2019), whereas cocoa cultivation and specific AFS are not (Castro-Nunez et al., 2020). This shows that peace is not only strongly related to income generation, but peace can also contribute to the reduction of deforestation and thus to climate protection and biodiversity conservation. In addition, AFS can help maintain healthy ecosystems and ecosystem services, which in the long run is critical in rural areas for a long-term source of income from cocoa, which in turn is critical for peace. This is because the pressure on natural resources often leads to new conflicts.

Supporting farmers to transform their informal and illegal business activities into formal, legal ones is crucial, especially in the first years, as the transition of livelihood is not so easy in the beginning. They need some financial support as the yield won't be high in the first years. In addition, they also need technical support, for example in the form of trainings that provide the necessary know-how and

techniques of cocoa cultivation. In this context, involving local communities in extension services can not only increase knowledge transfer but also social cohesion among farmers, which is central for peace-building (Löhr et al., 2021). Therefore, it is important that these trainings provide sufficient space for interaction and social learning and try to foster a sense of belonging to a new community of practice, as this also increases collaboration and trust. To this end, it is helpful to strengthen cooperatives, as they are often seen as institutionalized forms of social collaboration and support them in providing needed services. In addition, power relations should be considered, and conflict-sensitive approaches should be established in trainings.

To provide these support services, investments are needed. Cooperatives or the state can provide support (Rodriguez et al., 2022/Zingrebe et al., 2020), but external investment, for example by international companies, would also be required. However, many companies are reluctant to invest in a country where there are still so many conflicts (Ziegler, 2023). This underscores the relevance of promoting peace.

3.1.2 Impact from agroforestry on income to reduce poverty

The meta-analysis by Nieter et al. (2020) showed that cocoa yields in agroforestry systems are in most cases about 25% lower than in monocultures, which could lead to the assumption that income is also lower, but it is a bit more complicated and depends on several factors.

Thus, the study concludes that the conversion from a monoculture to an agroforestry system leads to a decrease in production in the short term, but this is compensated for by the longer life of the cocoa trees growing in the shade. Therefore, there needs to be a shift in thinking from short-term goals to long-term ones.

Ballesteros-Possú (2022) also points out that the lower yields of agroforestry systems can be compensated by the higher cocoa prices. Since cocoa from agroforestry systems belongs to specialized cocoa, better prices can be achieved through the right interventions and market relations (cf. chapter 3.2.1).

If the total yield is considered with the inclusion of other agroforestry crops, the study shows, that the total yield of the system is ten times higher. Unfortunately, this is not reflected in higher net incomes or revenues. Possible reasons for this are that cocoa is the most lucrative crop of AFS (Cerda et al. 2014) and many farmers are unable to generate income from intercrops due to the poor accessibility of other crop markets (Castro-Nunez et al., 20021). Cooperatives should be strengthened to facilitate this access as well, as they increase farmers' bargaining power with buyers.

Further, it’s important to consider that, the relationships between socioeconomic indicators and yields of agroforestry products, are determined by the typology of CAFS. The study of Cerda et al. (2014) shows that the probability of positive net income in Central America increases by promoting AFS with moderate size, high woody species density and high yields. A study in Ghana by Ashiagbor et al. (2019) showed that if multipurpose tree species for fuelwood, fodder, soil, reclamation, and fruit production is supplied and incorporated in tree-based intercropping systems, this leads to an increase of the economic assets and income of the farmers. However, it is important to keep in mind that these results are highly context-specific, and the results are difficult to apply to other regions. Therefore, research and development at the local level are needed to determine which typology works best under local conditions.

Moreover, many studies only consider cash flow and net income to make statements about poverty reduction, neglecting other benefits such as the added value from domestic consumption (Ballesteros-Possú, 2022). The study by Cerda et al. (2014) took this into account and showed that although only about 35% of CAFS lead to higher income, due to high material costs and the cost value of family labor, but all CAFS contribute to positive family benefits due to high value of domestic consumption. This further contributes to improved food security and nutrition.

In addition, agroforestry contributes to diversified income (Nieter et al., 2014/ Zingrebe et al. 2020). This is because dependence on a single crop and market fluctuations are reduced through production diversity leading to increased resilience of farmers. Here, however, market access for diverse agroforestry products is a prerequisite. Moreover, this enhanced resilience strengthens peace (Löhr et al., 2021).

3.1.3 Impact from agroforestry to climate-change and biodiversity

Niether et al. (2020) point out that one of the most important functions of trees is ecosystem service to regulate climate. A comparison between monoculture and agroforestry has shown that agroforestry for cocoa contributes to climate change mitigation by storing 2.5 times more carbon than monoculture systems. It should be noted that this depends on various factors such as the tree species or the age of the trees The study Ballesteros-Possu et al. (2022) in Southwest Colombia, for example, compared different agroforestry arrangements of cocoa with melina tree with a traditional agroforest system. This study shows that the differences in carbon stored by traditional cocoa agroforest compared to improved arrangements was around 20%. This once again underscores the urgency of local research and development efforts to improve cultivation and practice methods.

Due to the urgency of the issue, many programs have been developed in recent years to provide incentives for deforestation-free cocoa farming. REDD+ is one example (Catacutan et al. 2012). This is a global program that offers compensation to countries in the Global South for conserving and enhancing forest carbon stocks and managing forests sustainably. The amount of the payments depends on the additional amount of CO2 stored.

As mentioned earlier, despite its wide distribution in Colombia, cacao has not been the main driver of deforestation in the last fifteen years. Thus, promoting cacao agroforestry as an alternative to illegal activities, which are often the main cause of deforestation, also provides an opportunity to mitigate climate change and conserve biodiversity (Castro-Nunez et al., 20202/compare chapter 3.1.1).

In addition, AFS also promotes adaptation to climate change by lowering average temperatures and buffering temperature extremes (Niether et al., 2022). Further, AFS can also help minimize the risks of natural disasters which in turn has a positive impact on the resilience of the entire community. To enhance the positive impact of AFS and CAFS, the packed-based integrated agroforestry approach offers high potential, as the example of Nepal shows. There, the government-implemented program also addressed other aspects such as soil fertility management or water conservation, resulting in a significant improvement of ecosystem services.

The comparative study by Niether et al. (2020) also highlighted that few studies measuring the effects of AFS and CAFS on biodiversity. Nevertheless, their analysis shows that biodiversity is significantly higher in AFS than in monocultures. But like most impacts of AFS, this is highly dependent on the management, diversity, and complexity of a given system.

Commitments to zero deforestation by various cooperatives are an important step. However, they need to be operationalized by considering deforestation issues in the value chain. These value chain interventions, which assume that companies will take ambitious actions to stop deforestation, should be accompanied by public policies to achieve greater impact. Several researchers (cf. Sanial 2020/Deans et al., 2018/Smith-Dumonth et al. 2016) emphasize the importance of stakeholder engagement at multiple levels, i.e., inside and outside the value chain, to achieve goals such as climate change mitigation or biodiversity conservation. In this context, a land-scape approach can be helpful (cf. Chapter 3.2.3)

Since the main goal of the government is to increase the productivity of cocoa production, many monocultures have been established recently (Swisscontact, 2022). Therefore, and because agroforestry systems are much more climate- and biodiversity-friendly, it is important to promote and spread them.

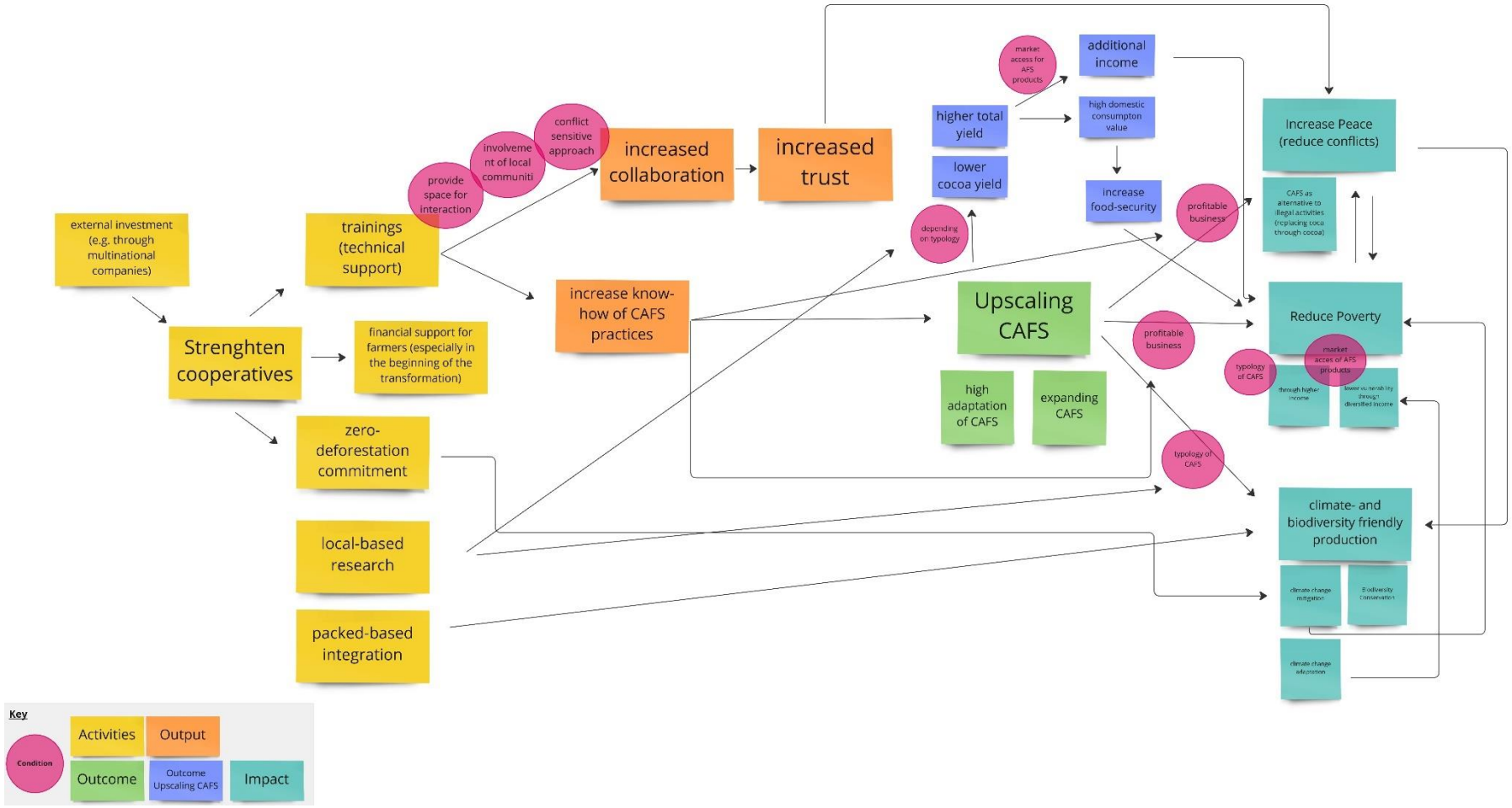

Figure 3: ToC for the first research question. (Own representation)

3.2 Upscaling Agroforestry

This chapter focuses on the interventions and outcomes needed to scale up CAFS. To this end, Cooper and Denning (2010) identified ten key elements: Local capacity building, facilitation, farmer-centered research and extension approaches, knowledge and information sharing, learning from successes and failures, market options, policy options, strategic partnerships, and technology options. We will now take a closer look at some of the key actions needed in Colombia to successfully scale up CAFS.

3.2.1 Better price and market access

To encourage adaptation and conversion to agroforestry, it must be a profitable business. Economic conditions are considered the main obstacle to the expansion of agroforestry in Colombia (Rodriguez et al. 2022). Therefore, it is essential to create favorable economic and market conditions (Rodriguez et al./Coe et al. 2014/Franzel et al., 2004/Buck et al. 2020.). One way to achieve this, would be to strengthen cooperation between producer associations and the private sector, for example, to create marketing platforms.

Certifications are seen as an opportunity to increase prices and allow farmers to access certified markets. Millard's study (2019) shows that certifications can increase ecosystem services if this is part of the norm and standard of certification. In most cases, training and extension services are provided to farmers or their associations on the practices required for certification. On the one hand, this leads to increased interest and capacity to manage their cocoa systems. It has also been shown that farmers who received more training and inputs also had higher yields. In addition, farmers were able to increase their net income, albeit moderately, as costs, particularly labor, also increased. Another study found that about 60% of certified farmers improved their overall economic situation (Millard, 2019). However, over time, this was also the case for non-certified families, which is explained by the fact that they also received some benefits (Millard, 2019). In addition, knowledge spillover occurs as farmers who receive benefits through certification share their knowledge with others. If as many smallholder families as possible are to benefit from the advantages of certification, some barriers need to be considered and addressed. One major issue is access to inputs, financial and business services such as training or extension services. Often, farmers live far away and therefore do not have access or the money needed for these courses. Cooperatives have been formed to establish certification, support farmers and overcome barriers. However, these are often weak, so they need to be strengthened. In addition, there are also some companies working with NGOs and development agencies to develop a more comprehensive investment package (Millard, 2019). Strengthening such linkages are important to remove barriers and allow all farmers to become certified.

Payments for environmental services can also make agroforestry more profitable. There are many different programs that add value to ecosystem services such as carbon sequestration or biodiversity conservation by creating market incentives for farmers. The study by Cole (2010) showed that PES in Costa Rica led to increased tree planting and biodiversity, and farmers were positive about the environmental impact of the program. Income increased as a result of PES and, for some farmers, also higher yields. Most participants indicated that household welfare improved. The main challenges of the projects were

lack of communication and transparency, which also affected trust between farmers and project managers.

Another way to achieve better prices is through direct trade, as the study by Middendorp et al. (2019) shows, by comparing direct cocoa trade with the mainstream cocoa market. New niche markets for specialty cocoa grown in agroforestry systems create more direct relationships between producers and buyers. These direct relationships lead to higher prices for cocoa sales, better access to training and extension services, improve social network, and contribute to more environmentally friendly farming practices compared to traditional markets. It is noticeable that a large proportion of products traded in direct trade are certified, although this is not mandatory. This direct trade is mostly organized through cooperatives, which also contribute significantly to higher prices, underlining its importance.

Closely related to direct trade is the relationship model (cf. Hernandez-Aguilar et al. 2018). This is a business model that supports long-term partnerships between buyers and smallholder farmers. At the heart of this partnership is the quality of the cocoa. The study by Hernandez-Aguilar et al. (2018) shows that this business model not only offers premium prices, but also improves transparency and traceability, and can also lead to improved social networks and social cohesion among farmers through increased farmer engagement. There is also evidence of a significant increase in human capital due to improved access to training. However, the study also showed that this does not necessarily lead to better socio-economic outcomes.

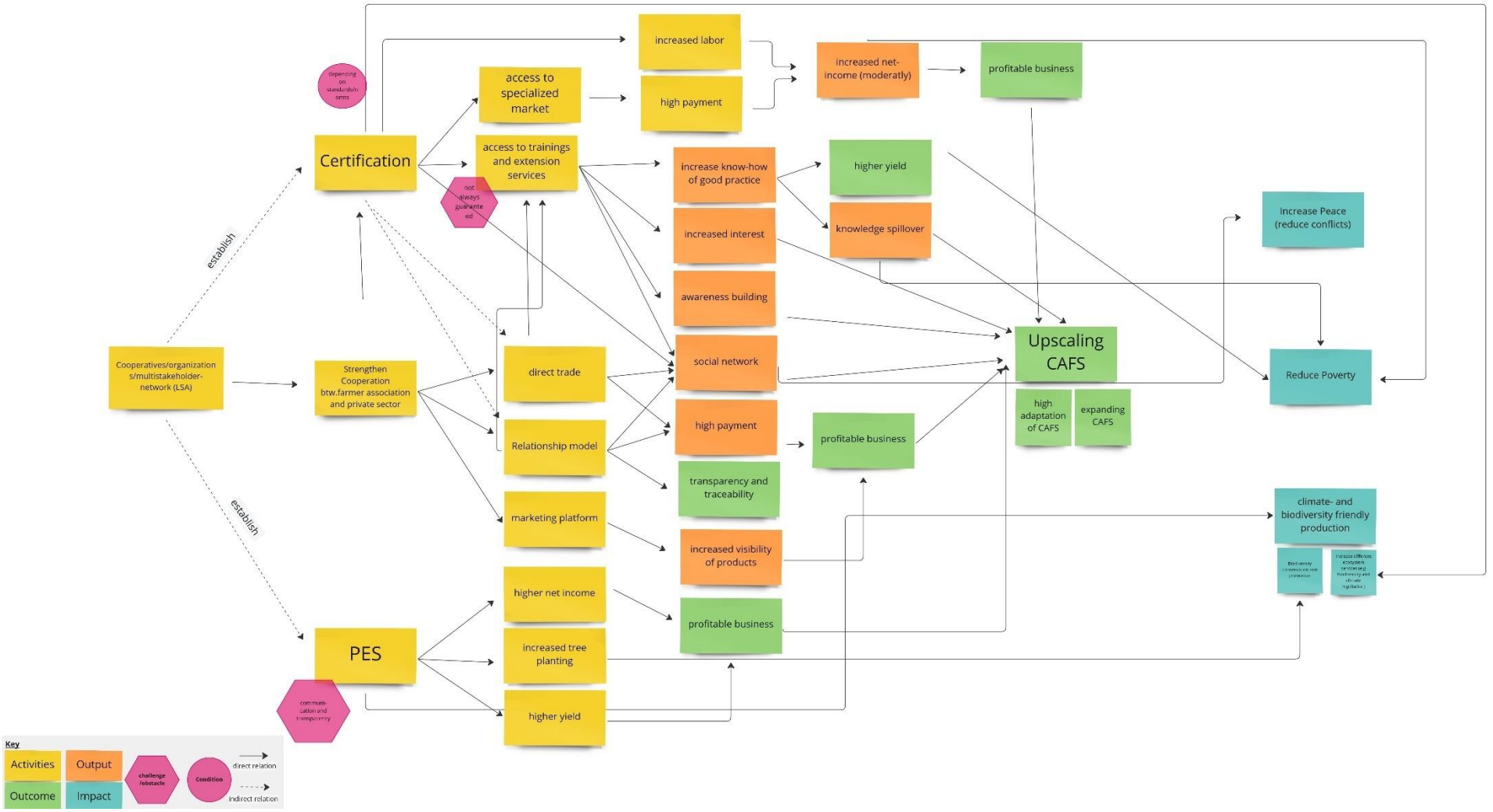

Figure 4: ToC better price and market access. (Own representation)

3.2.2 Research & Development and Trainings & Advisory Services

The relevance of training and advisory services to strengthen the positive effects of agroforestry has already been mentioned several times. Thus, lack of access to information introduces a key barrier to upscaling agroforestry as extension services lead to awareness building, as the case of Ghana shows. To increase the creation of awareness in Ghana, the formation of membership livelihood groups were helpful as they provided support for community member and help through communication. It was also confirmed that anyone who had received some kind of training and material support was more likely to adapt agroforestry practices, compared with the people who haven't received anything (Ashiagbor et al., 2019). The case of Côte d'Ivoire confirms that and shows that despite a great number of tree distribution campaigns, distributed tree survival was less than 2% due to poor management resulting from a lack of training (Sanial, 2019).

It is important to note that these trainings and extension services need to be effective and convey the right things. Upscaling agroforestry is challenging as there is no universally appropriate approach/type. Farmers make their land use decisions at the local level, and there are various context-specific factors that influence these decisions, such as biophysical and socio-ecological conditions or the policy and institutional environment. Therefore, the positive impacts of agroforestry can only be maximized if these local aspects are considered (Coe et al. 2014).

The right combination of local knowledge on the ground and expert knowledge is essential for the development, adoption and adaptation of new practices and CAFS (Sinial et al., 2020). Co-learning needs to be enabled by facilitating collaboration between farmers, extension workers and researchers, for example through demonstration plots (Coe et al. 2014/Rodriguez et al. 2022). This not only helps to incorporate local knowledge but also to identify knowledge gaps and thus improve training programs (cf. Rodriguez et al. 2022). The study by Smith Dumonth et al. (2016) is a good example as it shows how structured stakeholder engagement in the Democratic Republic of Congo led to the development of more diverse and inclusive agroforestry options. First, two participatory scoping studies were conducted to gather local knowledge and better understand the prevailing land use and habitat systems. Subsequently, two multi-stakeholder workshops were conducted to develop different agroforestry options for the different contexts in the provinces. Both public and private stakeholders were represented. A technical manual tailored to the different regions was then produced for use in future trainings, leading to better adaptation of agroforestry (Smith Dumonth et al., 2016).

Further, the active involvement of farmers also helps to upscale AFS, as they support it after observing the benefits (Rodriguez et al, 2022). The case of fodder shrubs in Kenya for example showed that knowledge spillover can be quite effective. In Kenya extension facilitators working with a range of government and NGO partners, assisted 180 farmer-development groups with 3200 farmers across seven districts to establish nurseries. Two years after the implementation, it was shown that each of these farmers had given information and planting materials like seeds to an average of six other farmers (Franzel et al., 2004). But it's not only about the involvement of the farmers. Co-determination also plays a central role, for example shown in the projects in Costa Rica, which were implemented in connection with PES. The success of this projects depended heavily on how much say and freedom of choice the

farmers had, for example in the choice of trees (Cole, 2010). So, offering more diverse and adaptable options will lead to higher adaptation rate and will also generate better benefits (Franzel et al., 2004).

One option is to encourage farmers to experiment with the practice as they wished in research projects. This expansion of technical options acknowledges the diversity and interest of farmers and offers a good opportunity to directly include farmers and support the adaptation of agroforestry. The case in Kenya, where they tried to find the most effective fodder shrubs to improve the quality and quantity of feed resources for dairy farming, confirms this. There, most of the trials were farmer-designed and managed, which lead to improved and innovative practices at both sites, reducing costs and the adoption and scaling up was thereby greatly accelerated. To assure knowledge transfer between farmers and researchers, a monitoring form was developed, which was completed every two years by each farmer (Franzel et al., 2004).

In other research projects, like in Zambia there was a combined approach of researcher-led trials, where farmers chose among different species and management options and farmer-led trials, where they could plant and manage it as they wished. After these trials, demonstrations and farmer-to-farmer visits were set up and different actors were trained. These activities led to an adaptive research and dissemination network with representatives of different stakeholder across the public and private sector like farmer cooperation, NGOs, government extension staff, traditional authorities and researcher. This network serves the exchange of knowledge, information and experience, which is necessary to make further decisions and foster co-evolution in agroforestry design and implementation. This was the key to the success of the project in Zambia as this network was responsible to plan, implement and evaluate on-farm research, dissemination activities and training and met several times a year to plan their concrete activities (Franzel, 2004). The formation of such multi-stakeholder networks and platforms facilitates access to information and the exchange of experiences which enables a joint learning process enormously. In addition, complementary strengths and resources can be used, social cohesion can be built up, commitment can be promoted and thus effectiveness can be increased. High network density with formal and informal links between relevant actors should be aimed for because this is a precondition for the diffusion of innovation and agricultural technology. But such networks are always associated with high time and resource costs and require a responsible person/organization that actively manages them. It should also be noted that strong hierarchies and power constellations can impair the flow of information and cooperation (Schröter et al., 2018).

For such research and upscaling processes, it is also worth promoting cooperation between different research institutions, both at the national and international level. After all, many of the successful research projects mentioned above were the result of such cooperation. In this way, not only knowledge but also funding can be shared (cf. Cole, 2010).

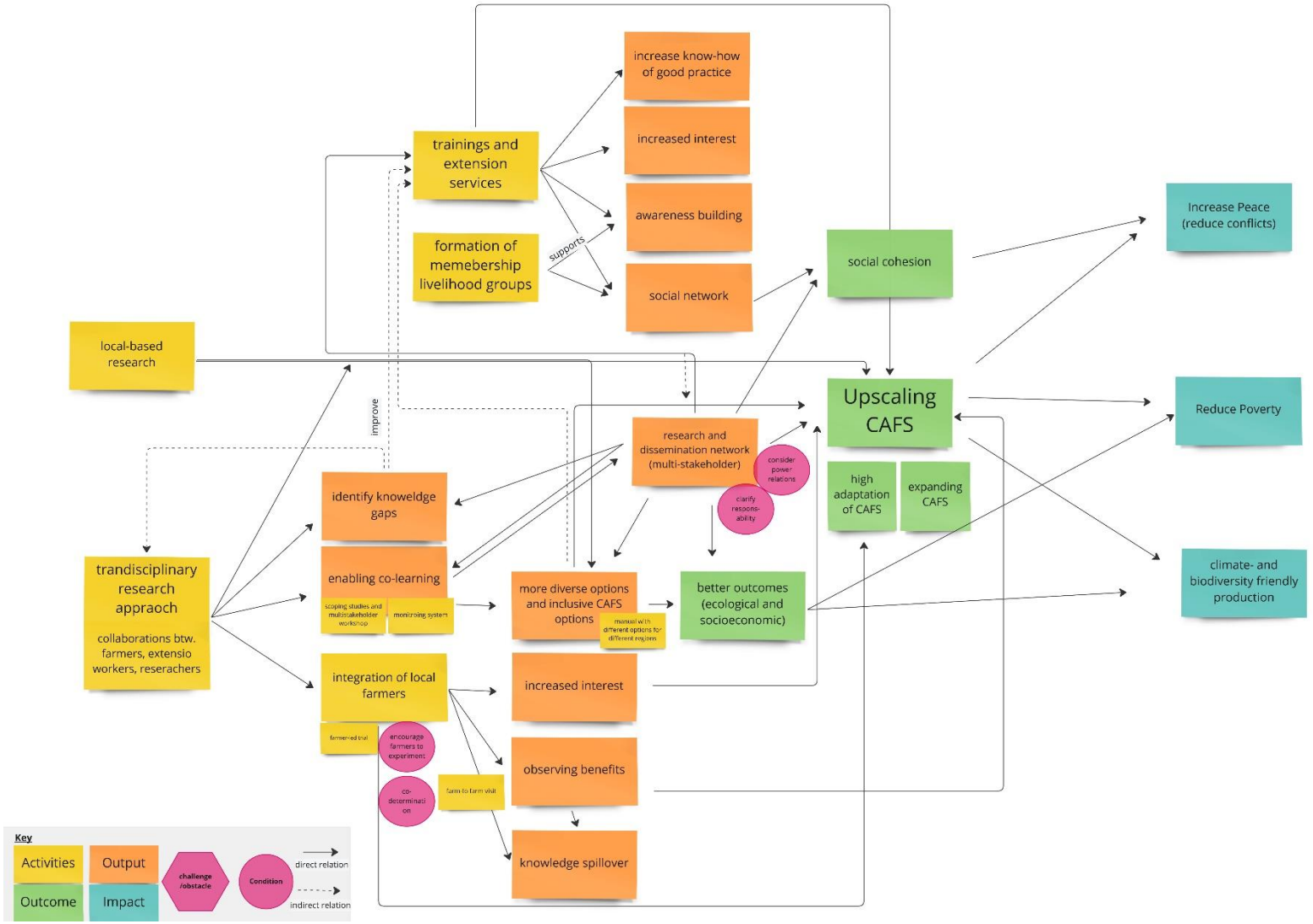

Figure 5: ToC Research & Development and Trainings & Advisory Services. (Own Representation)

3.2.3 Land-scape Approach

Strengthening Cooperations, Networks and the engagement of stakeholder seems to be important to successfully upscale agroforestry, as these can facilitate many of the prerequisites mentioned. Considering the complexity of AFS implementation and management, it's important to pool resources and bring all stakeholders together to develop agroforestry approaches locally on a landscape level.

For example, the measures mentioned, such as certification procedures or research at the local level, should also be supported by political and institutional frameworks in order to increase the impact and the desired effect. Here, ordinances could be an effective way, as the study by Ajayia (2016) et al. showed. There, they were developed and implemented with the involvement of local traditional authorities,

Reed et al (2020). define landscape approaches as "frameworks for integrating policy and practice for multiple competing land uses through the implementation of adaptive and integrated management systems". The involvement of multiple stakeholders within a landscape plays a key role in identifying trade-offs and synergies. This addresses complexity, conflicts should be reduced, and resources should be pooled.

There is no single definition of LSA or approach, but the following key elements should be considered. First, it is important to identify the key stakeholders in the defined landscape. Then, a common goal/concern/approach should be identified, which forms the basis for the joint development of strategies. Third, a framework for regular stakeholder exchange (e.g., platform, forum) needs to be established, and a framework for monitoring and evaluation should also be put in place (Reed et al., 2020). In addition, good governance and coordination are needed to avoid accountability gaps (Sarkki et al., 2016).

The study by Buck et al. (2020) showed how a landscape approach can be used to address the barriers of upscaling AFS in two landscapes in Ecuador. The study showed that the constrained can be overcome as LSA are efficient in getting relevant knowledge and enables co-learning (compare chapter 3.2.2). Further are LSA a cost-sharing approach through which financial resources can be mobilized across diverse actors. LSA are also a power-sharing approach, which means that all stakeholder influence together decision-making and investments through organizational alignment around market and policy priorities toward the defined goals. The activities of the stakeholders have been coordinated to achieve the common goal of creating suitable framework conditions for AFS. For example, financial and technical resources were used to directly support farmers, access to land was facilitated through legal reforms, and market fundamentals were created through the promotion of certification and PES. By addressing the various benefits of agroforestry systems, in the case of Ecuador, stakeholders who were not previously focused on agroforestry were also reached.

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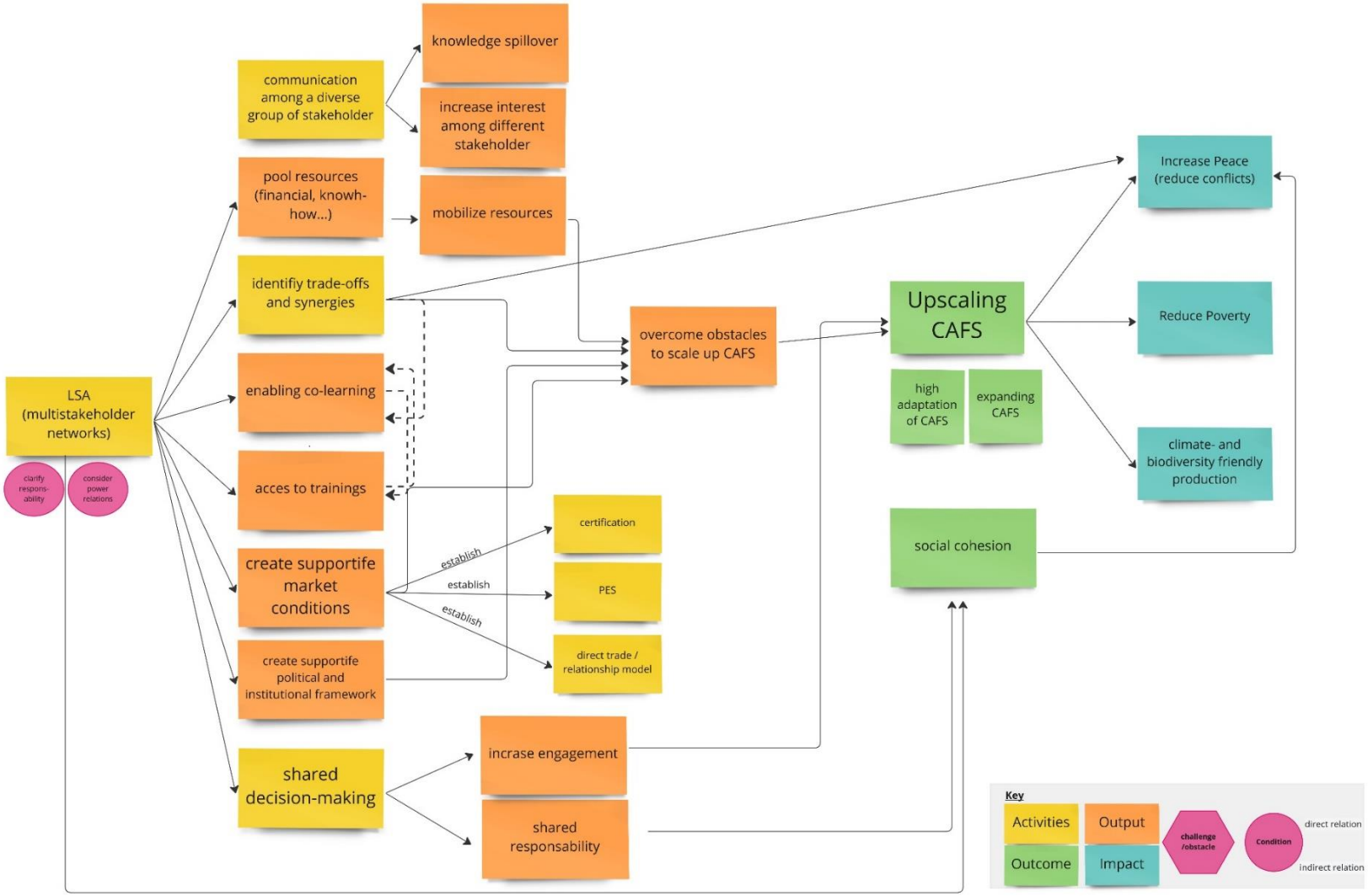

Figure 6: ToC Land-scape Approach. (Own representation)

4 Discussion

4.1 Pathways to sustainability

The two research questions are closely linked. As the results of the first question show, under the right conditions, agroforestry can lead to climate protection and biodiversity conservation, as well as to a reduction in poverty among small farmers and to more peace. An important prerequisite for CAFS to have the desired impact is that it is a lucrative business that is an alternative to illegal business and satisfies people's basic needs, thus contributing to more peace and less poverty. It is therefore essential to create suitable economic and market conditions. This also plays a central role when it comes to the expansion of CAFS, especially the adaptation of CAFS by various stakeholders. Furthermore, in answering the first research question, it was shown that the composition of CAFS as well as the practices applied have a major impact. However, as the appropriate practices and composition are highly context-dependent and therefore vary greatly at the local level, scaling up remains a challenge. In addition, the decision of stakeholders to pursue CAFS or not is also influenced by many other context-specific aspects, which adds to the complexity. Given this complexity, an LSA that brings together a wide range of stakeholders, both within and outside the cocoa sector, to jointly promote CAFS is appropriate.

Economic and market conditions to enable profitability of CAFS

As mentioned above, good economic and market conditions for cocoa produced in CAFS are crucial for achieving peace and reducing poverty. In addition, the lack of stable and differentiated markets that could absorb products from CAFS is considered the main obstacle to the expansion of CAFS in Colombia (Rodriguez et al., 2022). In the market for specialty cocoa, farmers are paid higher prices. As the cocoa produced in CAFS is also part of specialty cocoa because it is seen as an ecological alternative to other cocoa production methods, it offers farmers a high potential for income increases and is therefore a good alternative to illegal cultivation. Colombia has already successfully entered the export market for specialty cocoa, but as the market for specialty cocoa grows, there is huge potential. However, it should also be kept in mind that it is still a niche market in Colombia and worldwide. Since most farmers sell their cocoa to one of the two big companies (Casa Lukar and Compañía Nacional de Chocolates) it is important to work with them to expand the market for specialty cocoa.

In addition, certifications offer great potential as they not only provide access to specialized markets and increase the net income of farmers, but also provide access to training and extension services that guarantee the quality of cocoa production. As there are many different certifications, it is important to first analyze which of the certifications best fits the local circumstances and has the best socio-economic and environmental impact. This can have an additional positive impact on sustainable development. In Colombia, there are already some certifications, but they are not widespread. Furthermore, access to support services such as training is currently not guaranteed for all farmers. The demand for certified cocoa is increasing, especially in the European market, which offers great potential. One also must consider that most cocoa is sold to the two big companies for national use, which do not put much emphasis on the quality of the cocoa. So, the farmers also have to change their middleman and buyer. Therefore, cooperatives and farmers' associations can play an important role. In most cases, cooperatives and organizations are set up to support the project of certification. In addition, cooperatives can strengthen

cooperation between their members and the private sector to promote direct trade and long-term relationships. These business models also lead to higher payments compared to the normal cocoa market and thus also increase transparency and traceability, which plays an important role in terms of sustainability. Moreover, there is still a lot of potential, as according to the study by Löhr et al. (2019), only about 6% of all producers in Colombia belong to a cooperative.

Another possibility that could also be initiated by cooperatives is PES. In view of the increasing climate and biodiversity crisis, it is important to create more incentives for ecological farming methods. There are various ways in which such projects can be implemented. Cooperation between farmers and other stakeholders is recommended, as they can provide support (e.g., financial and institutional support). Trust and good communication are basic requirements for successful projects. As PES are not linked to a specific crop and the overall objective is to protect the environment, it is also worthwhile to implement them through LSAs.

Another argument in favor of LSA is that not only market access for cocoa from CAFS, but also that for other AFS crops needs to be secured. The lack of stable and differentiated markets to absorb AFS products still seems to be the biggest challenge in Colombia. By engaging different actors within and outside the cocoa sector, this challenge can also be addressed.

Local and transdisciplinary research to upscale CAFS and maximize the positive impacts of CAFS

The composition and practices of CAFS have a great influence on the impacts of CAFS. There are already some studies that have examined different compositions of CAFS and their influence on environmental and socioeconomic aspects. However, since these are context-dependent, it is difficult to transfer the results from field studies to other regions and areas. Few papers could be found on recommendations for agroforestry systems in Colombia. One paper described that a large proportion of current CAFS consists of timber trees, banana trees, cacao trees, and other fruit trees. This highlights the importance of locally focused research that identifies appropriate practices and contexts of CAFS in different region.

These studies should not only be conducted at the local level, but also with a transdisciplinary approach. Therefore, it is important that local farmers are involved and have a say in the planning and implementation of the research. By involving local farmers, not only can their knowledge and years of practical experience be incorporated, but knowledge gaps can also be identified. In addition, there may be knowledge spillover among participating farmers, which will help spread CAFS. It may also promote the commitment and motivation of the farmers involved. Various models are therefore conceivable. For example, the collaboration between national and international research institutes (cf. Franzel et al., 2004) to test different methods and establish monitoring together with local farmers seems promising. Farm visits have also proven effective. A combination of a study to understand the local context and subsequent workshops would also be conceivable. As conflicts are still prevalent in many areas of Colombia and are strongly characterized by illegal activities, it is important to adopt a conflict-sensitive approach, pay attention to power relations and leave room for interaction. In addition, it is very important that the results of this study are shared and communicated with other stakeholders and used in trainings. In Colombia, most of the services offered to support farmers are disconnected from research and development and focus only on increasing productivity without direct reference to good and locally adapted

agroforestry practices. One challenge is to provide access to these trainings or even research to all farmers, as accessibility is very poor. As the importance of training and extension services is shown in this study, this challenge should be addressed and more organizations should be involved at the local level, and in turn, the formation of cooperatives should also be supported as these can also facilitate access. In addition, new opportunities arising from increasing digitalization should also be explored.

There is also a lack of coordination among the various counseling and support services in Columbia. That is another argument for the LSA. All relevant stakeholders that provide some kind of services should be represented there and then pool resources to make it more cost effective and stable as well.

The only way to upscale on a large scale is to foster many different knowledge networks at the local/regional level between research institutions, farmers, as well as other stakeholders to actively communicate research results and integrate them into extension services and training - always locally adapted. Furthermore, the exchange of knowledge and experience between these local networks must be ensured in an appropriate framework (e.g. platform, annual meetings, etc.) in order to pool possible resources.

Landscape approach to trigger successful upscaling CAFS

The results show that many different activities and measures required for a successful expansion of the CAFS, and the achievement of the desired impact can be initiated by LSAs. Most of the measures and activities mentioned do not consider the current policy framework, as this would have been beyond the scope of this paper. However, all the measures mentioned should be accompanied by supportive public policies to increase the scale and effectiveness, e.g., through regulations or other provisions. Therefore, the LSA is very suitable, as political actors should also be represented there. Furthermore, the study by Rodriguez et al. (2022) shows that local governments in Colombia lack institutional capacity, while organizations supporting (C)AFS often lack strategies. With which an LSA becomes more and more imposing, possibly also with the involvement of some actors at a different level.

Farmers play a crucial role in LSA, and it is important to ensure that they have the same rights as other actors. To this end, cooperatives must also be strengthened, as they pool farmers' power and represent them, and many farmers are not yet in cooperatives. This is because it would be difficult to find a farmer representative if they are not already organized in cooperatives or similar organizations.

In general, it is important to always question which stakeholders are involved in such LSAs and by whom they are represented. Especially in areas with high conflict potential, it is important to pay attention to this and to involve particularly vulnerable groups. Furthermore, social cohesion should also be actively promoted, as this plays a central role in peacebuilding. Therefore, the same applies to this approach as to the trainings: there should be enough space for social interaction and a sense of connectedness and togetherness should be strengthened.

In order to disseminate CAFS effectively at national level, different actors at different levels are also needed. Therefore, many different LSAs are needed that also learn from each other. The exchange of experience and knowledge between these networks should also contribute to an overarching common learning. In order to test whether the LSAs really contribute to the desired results and impacts, it would be advisable to start with some pilot regions. The following regions would be suitable for this: Maceo and Bajo Cauca, Antioquia or Arauca. In Maceo, there is a high proportion of monocultures, which leads to high productivity but as shown, has many negative ecological impacts. By scaling up CAFS instead

of monoculture, this negative impacts could be reduced and positives could be brought. The other regions are known for high coca cultivation and conflicts. In these regions, the goal to achieve peace is in the center.

Many challenges of the current cocoa sector are related to the lack of coordination between the different actors. Therefore, LSAs that bring together all key stakeholders to pool resources offer enormous potential to overcome these problems. Moreover, since CAFS can also have such a wide range of positive environmental, social and economic impacts, it should be easy to bring together a wide range of stakeholders and show them how CAFS can add value to their individual interests as well.

4.2 Critical reflection

There are a lot of different things influencing the decision of stakeholder to adopt a practice or not. It's hard to change behavior without really understanding the reasons why current practices are different. Cultural aspects as well as a multilevel perspective could help to better understand the given context, therefore interdisciplinary research including multiple factors and a system perspective is needed. Moreover, it's difficult to define interventions for changing a system without really knowing the context, just by a literature review. In addition, it must also be taken into account that no specific region was selected for the work, but the goals were looked at on a national level. This makes it difficult to get an overview of the context and leads to an additional simplification of reality.

The regarded economic and market conditions in the study, such as certification, PES or direct trade mainly focus on the export market. Further research is needed, to better understand the chances for agroforestry products on the domestic market, since a large part of the cocoa produced in Colombia is for domestic consumption. It is not clear to what extent a market for specialty cocoa exists in the country or will develop in the future.

What has hardly been considered in the work is land rights. Some studies have pointed out that land rights are a decisive factor in the decision for or against agroforestry. It has been shown that when land rights are secured, they also contribute to more sustainable land management, which would encourage adaptation to CAFS. Especially in areas governed by paramilitary groups or drug cartels, for example, the question arises to what extent local farmers have the power to decide what to do with their land.

In addition, both international and national regulations could favor the promotion of agroforestry. It should be noted that the current trend is increasingly toward neo-ecology, and the regulatory framework and private sector interest in doing something about sustainability are expected to grow steadily. It is therefore worth investing now in the transformation to greater sustainability and anticipating trends early to have a market advantage. Here, future research should look more closely at the impact of these regulations on the cocoa industry and identify opportunities as well as risks.

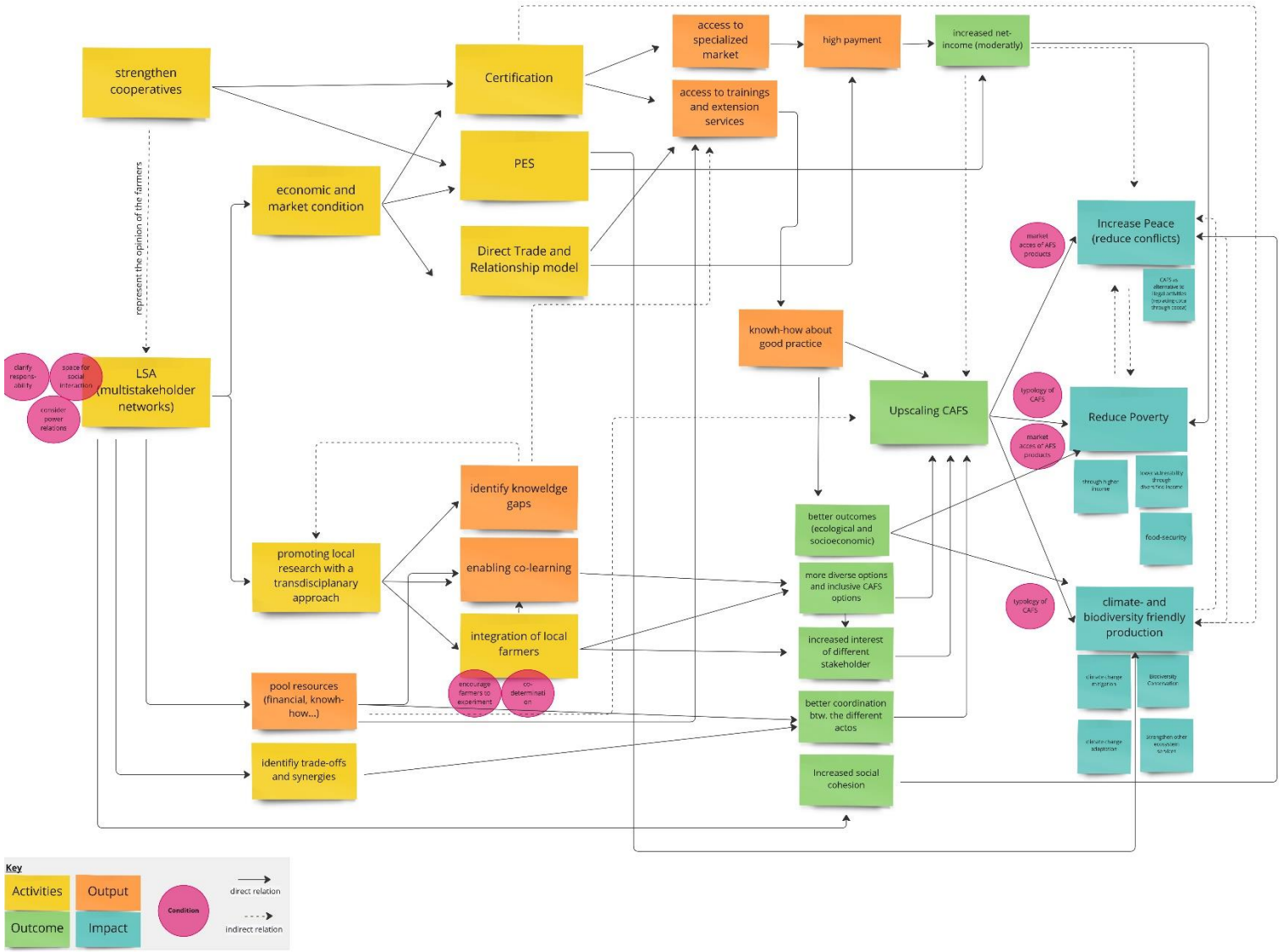

Figure 7: ToC for transforming the cocoa sector in Colombia (Own representation)

Conclusion

There are several pathways to initiate the transformation of the cocoa sector towards more sustainability in Colombia. The aim is to reduce the current negative environmental, social and economic impacts of the cocoa sector and to contribute positively to the achievement of the SDGs. In this context, the results have shown that CAFS can contribute to peace and poverty alleviation and is an ecological alternative to other cocoa productions, as CAFS makes a positive contribution to climate protection, promotes biodiversity and also provides other ecosystem services. These desired impacts/goals play a central role in the transformation, as they are closely linked to the achievement of other SDGs. For CAFS to achieve all these impacts, the composition and practice must be adapted to local conditions and be lucrative.

Therefore, economic and market conditions must be created that contribute to better prices and higher net incomes in order to reduce poverty and provide an alternative to illicit cultivation that also promotes peace. Various options are available for this. Results have shown that certificates offer a higher price and access to niche markets, that PES improves farmers' incomes, and that direct trade or long-term relationships also contribute to higher incomes. However, the benefits of CAFS go beyond financial income. If market access is also ensured for other agroforestry products, CAFS not only lead to higher incomes, but also reduce farmers' vulnerability as they are no longer so dependent on the market fluctuations of a single product. In addition, CAFS provide high value for home consumption, which contributes to food security.

To achieve the maximum impact of CAFS, they need to be adapted to local conditions. This requires local research and a transdisciplinary approach. A mix of local and expert knowledge not only helps to identify knowledge gaps and enable shared learning, but also increases the motivation and commitment of local farmers, provided they have a say. This enables upscaling. It is important to build networks at the local/regional level, analyse different options and incorporate research findings into training.

Furthermore, effectiveness can be further increased if not only researchers and farmers are represented in these networks, but also other stakeholders. As the management of CAFS is very complex and there are different aspects that influence the impact and the decision of farmers for or against CAFS, private and public actors within and outside the cocoa sector need to be integrated, which then corresponds to an LSA.

Since CAFS can provide environmental as well as social and economic added value, it will be easy to engage a wide range of stakeholder to this overarching goal if implemented properly. Moreover, such multi-stakeholder networks serve as a catalyst for various activities that contribute to the overall goal. This is crucial given the complexity of the issue. In addition, the coordination of different actors and their services is a key challenge in Colombia that could also be addressed through an LSA. In order to disseminate CAFS nationwide, LSAs are needed in different regions. Exchanges between them should also be ensured so that experiences can be shared, and a learning process takes place. Thus, our findings show that both multi-stakeholder and multi-level cooperation are crucial and should be encouraged and managed.

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