Moving problems or two-sided solutions? The impact of forest carbon projects in developing countries to compensate emissions: a case-study of the "CO_2OL Tropical Mix Reforestation" project in Panama

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Date: 7th of August 2017

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Abstract

An increasing number of people, resources and ecologies are becoming part of the global environmental governance system through enrolling these into the operations and modalities of global carbon markets. Among scientists there is doubt about the effectiveness in reducing emissions and the local impacts of projects that are part of this global carbon market. This thesis analyses the influence of the "CO2OL Tropical Mix Reforestation" project on local development and the environment. The project has *fincas* across different provinces in Panama and combines the sequestration of carbon with sustainable timber production and small-scale agroforestry in sustainable cacao. This study focuses on the project influence on the physical, human and financial capital of directly involved people and surrounding communities and defines the role in reducing carbon emissions, conserving forests and improving biodiversity and other ecosystem services. Besides, the specific uncertainties of the forest carbon project in terms of additionality, leakage and permanence have been assessed. For this research, a retrospective evaluation with project employees has been conducted including the use of secondary data and observation techniques.

The main development generated by the project is creating employment opportunities locally. By providing basic education and training about sustainable forms of agriculture and silviculture, and access to infrastructure such as a bicycle, the company contributes to the improvement of human capital and physical capital of employees. However, the major influence of the project is supporting a more secure access to financial capital: by offering permanent jobs with a stable income above the national minimum wage, and providing insurance for all employees. Additionally, feedbacks occur from the achievement of these livelihood outcomes such as that higher income is often reinvested in education; often spent on shelter and water and power supplies; and increases the scope for saving. The results of this research assume that the project is beneficial for the environment by planting eight different tree species, offering space for natural growth of vegetation, serving bridges for animals seeking new habitats, fulfilling important ecosystem functions for protecting water and controlling erosion, and reforesting and conserving the rare dry tropical forests ecosystem. The project reforests only abandoned or pasture land to ensure additionality and covers leakage issues by interviewing former owners or neighbours. The risk of non-permanence has been covered by their ownership of all *fincas* and a large buffer in case of disturbances. In conclusion, this project shows that forest carbon projects could have co-benefits that are useful for local development and sustaining the environment.

Acknowledgements

This research report presents the study on the social and environmental influence of the CO_2OL Tropical Mix reforestation project in Panama. Here, I would like to thank all of those taking their time to contribute to this process.

First of all, I am very grateful to the people behind ForestFinance who made it possible for me to visit different project locations and to all the employees that were willing to participate in the research. Unfortunately, it is not possible to name everyone here, but I would like to thank all the people who gave their time and opinions during the surveys and interviews. In addition, I would like to thank KLM for giving me the opportunity to do this research during my internship. Moreover, I have really appreciated the advice and support from my family and friends during the whole research. Additionally, I would like to give thanks to my supervisor Dr. Femke van Noorloos for her guidance and feedback throughout the process.

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Hoofddorp, The Netherlands

August, 2017

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List of abbreviations

CDM	Clean Development Mechanism
CIFOR	Center for International Forestry Research
CO_2	Carbon dioxide
COP	Conference of the Parties
DFID	Department for International Development (United Kingdom)
EU ETS	European Union Emissions Trading Scheme
FAO	Food and Agriculture Organization of the United Nations
FSC	Forest Stewardship Council
GDP	Gross Domestic Product
ICAO	International Civil Aviation Organization
NGO	Non-governmental organization
REDD+	Reduced Emissions from Deforestation and Forest Degradation
tCO2e	Tonne of carbon dioxide equivalent
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

1.1 Societal background

In 2015, world leaders reached an agreement at the 21st Conference of the Parties (COP 21) in Paris to keep the global average temperature increase to below 2°C and aspire to hold the increase to 1.5°C. The majority of governments around the world (189 countries that represent 96 percent of global greenhouse gas emissions) have promised to reduce their emissions and adapt to the changing climate (World Bank Group, 2016). Besides reducing emissions domestically, there is another market-based method to comply with the regulations. This method is called "carbon offsetting" and implies that governments, companies, and individuals use offsets to address their impact on climate change by compensating for emissions in one area by reductions in another, claim "carbon neutrality" and invest in projects in (primarily) developing countries (Bumpus & Liverman, 2011). The World Bank expects that 2017 will experience the largest ever increase in the share of global emissions covered by carbon pricing initiatives that should mitigate climate change and enhance climate resilience (World Bank Group, 2016). This means that an increasing number of people, resources and ecologies are becoming part of the global environmental governance system. Enrolling these actors and their resources into global markets involves that they are subject to change through the operations and modalities of global carbon markets (Newell & Bumpus, 2012). What are the social and environmental consequences of this development?

The host organization of this study is KLM Royal Dutch Airlines, one of the leaders in the field of sustainability in the aviation sector. As a global sector, the International Civil Aviation Organization (ICAO) affirmed the global goals of sustainable development for aviation by improving annual fuel efficiency and stabilizing the CO_2 emissions by 2020 to address the impacts of it on the global climate (ICAO, 2016). However, improving operational efficiency and the use of sustainable alternative fuels are on the short-term not sufficient to achieve the desired carbon neutral state from 2020 onwards. Therefore, governments and other stakeholders in the aviation sector have developed a global market-based measure scheme for international aviation to gain more on the short term. Aviation operators should purchase appropriate emissions units from acceptable mechanisms, programmes or projects as the UNFCC Clean Development Mechanism (ICAO, 2016).

1.2 Scientific background

The major reason that carbon credits are mainly verified for projects in the developing world is that paying for greenhouse reductions elsewhere is easier, cheaper and faster than reducing emissions domestically. Furthermore, it provides larger benefits to the atmosphere as well as to sustainable

development, in particular when projects are located in developing countries. However, by NGOs, activists and among scientists there is doubt about the effectiveness of some carbon offsets in reducing emissions and their local impacts (Bumpus & Liverman, 2011; Fairhead, Leach & Scoones, 2012; Simon, Bumpus & Mann, 2012). Many analysts have also raised noticeable issues about methodological concerns related to permanence, carbon leakage and rebound effects (Cavanagh & Benjaminsen, 2014; Olsson, Grönkvist, Lind & Yan, 2015). The production of a carbon offset depends on the (often transnational) construction of relationships between those who emit, those who sequester, and the ecosystems and technologies enrolled by both. Carbon offsetting is therefore frequently explained as a North-South divide; a certain allowed amount of carbon dioxide is emitted by industries in the Global North because a precisely equivalent is sequestered by forests or other schemes in various 'frontier' regions of the Global South (Cavanagh & Benjaminsen, 2014). Mainly in literature with a political ecology view, carbon offsetting is perceived as a geographical solution for capitalism's ongoing growth and has been criticized because it puts a price on nature's services (Bumpus & Liverman, 2011). New 'green' markets could result in the reproduction of old inequalities, dispossessions or restrictions of access to natural resources and the generation of new ones. Other concerns are related to environmental justice, which critiques the mitigation of largely Northern-induced processes of global environmental change that harm vulnerable communities in the developing world (Cavanagh & Benjaminsen, 2014). Independent verification of claimed reductions and investigating local effects is important to ensure the environmental and social integrity. Although increasingly literature is written on methodological issues and ethical concerns of carbon offsetting, little (empirical) research is conducted on the local impacts of certain carbon offset projects (Bumpus & Liverman, 2011). Therefore, there is need for in-depth field research focusing on other impacts that those projects have, in addition to the climate impact. This study will define the social and environmental influence of one specific carbon offsetting project: the "CO_2OL Tropical Mix Reforestation" project in Panama. The project aims to reforest formerly degraded pasture land with mainly native tree species and turn it into mixed forests.

1.3 Research questions

The research aim is to contribute to the literature by conducting an exploratory impact study of a carbon offsetting project relating to forestry and to give a comprehensive evaluation of the social and environmental influence of one specific project: the "CO_2OL Tropical Mix Reforestation" project of the company ForestFinance in Panama. There has specifically been chosen for forestry because it involves local people in developing countries, resources and ecologies, which could lead to several positive and negative social and environmental consequences. Therefore, the main research question was:

To what extent has the forest carbon project "CO_2OL Tropical Mix Reforestation" in Panama influence on local development and the environment?

The following sub-questions have been examined:

1. How does the "CO_2OL Tropical Mix Reforestation" project in Panama influences the physical, human and financial capital of directly involved people and surrounding communities?
2. To what extent plays the "CO_2OL Tropical Mix Reforestation" project in Panama a role in reducing carbon emissions, conserving forests and improving biodiversity and other ecosystem services?
3. What are the uncertainties of the "CO_2OL Tropical Mix Reforestation" project in Panama?

1.4 Relevance

Among researchers, there is doubt about the effectiveness of carbon offsets in reducing emissions and their local impacts. Existing carbon offsetting projects should be evaluated consistently and newly developed projects should be monitored from the beginning to assess biophysical and social outcomes at several stages of the project. However, because the main goal of these projects is to reduce emissions, social outcomes are often not assessed throughout all stages (Caplow et al., 2011). Especially for forest carbon projects this is remarkable because by influencing where forests are located, which types of forest exist and who benefits from them, forest carbon projects could have a severe impact on livelihoods (Smith & Scherr, 2003). Although for this research it is not feasible to do a baseline and end line study of a carbon offsetting project, by conducting a retrospective evaluation of such a project will be contributed to the small existing amount of literature in this field. In addition, by assessing the influence on the local development of the forestry carbon project, this study will give insight in the social outcomes as well.

If there is more clarity about the impact of specific carbon offset projects, project developers and certification bodies could consider to retain or dispose certain project types. This research could provide organizations a basis for making a choice for investments in forestry carbon offsetting projects. Besides, a global market-based measure scheme for international aviation is currently being developed, which could presumably increase the demand for appropriate emissions units from acceptable mechanisms in the coming years. Consequently, it is necessary that there is more knowledge on the impact of carbon offsetting projects. The results are not only relevant for the evaluation of forest carbon projects, it does also contribute to the knowledge of social- and environmental impacts of reforestation projects in developing countries in general, since this project has several (agro)forestry activities next to carbon sequestration.

2 Theoretical Framework

2.1 Major theories

2.1.1 Commodifying the environment: A Neoliberal approach

In recent years, new forms of environmental governance include new politics of scale and the emergence of networks that include state and non-state actors playing a variety of roles in the management. Besides, an important transition in the value of nature has been made: nature has become commodified. Carbon offsetting is an illustration of commodifying the atmosphere, developing new governance mechanisms and creating markets between different actors. The governance system of carbon offsetting relies on non-state actors as businesses, NGOs and individuals to achieve climate mitigation. This is considered as the principles of market environmentalism and the neoliberal devolution of governance to supranational, local and private actors. However, until now carbon offsets require state intervention to allocate and secure private property rights and establish and regulate new stable markets. The Clean Development Mechanism is an evident example of a neoliberal approach with intervention of states in the allocation, certification and trade of carbon credits (Bumpus & Liverman, 2008). Carbon markets are advocated by neoliberal ideas of market based solutions and seen as an alternative to direct taxation. As explained by Lohmann (2010), carbon trading means safeguarding climate stability as a measurable commodity. However, large amounts of literature set critiques on this theory that believes that "environmentally destructive enterprises like mining and oil exploration can be mitigated by setting aside other land in compensation for the damage they cause" (Büscher, Sullivan, Neves, Igoe & Brockington, 2012).

2.1.2 Political ecology

According to the basic vision of political ecology, environmental conservation is essentially a form of environmental control. Carbon offsetting is an example of this: regarded as a form of territorial control and a "spatial fix" for capitalism's ongoing growth. Another critique conforming political ecology is that carbon offsetting is a "technique that extends the financialization of everything" by creating markets for carbon which deepens the role of capitalism in environmental management (Peet, Robbins & Watts, 2011). It is an example of market environmentalism which assumes that the environment could be protected by pricing nature's services, assigning property rights, and trading these services within a global market. With the perspectives of political ecology, carbon offsets could be analysed as "a new commodity that links north and south through a complex set of technologies, institutions and discourses". Political ecology provides a good framework for assessing the effects of carbon offset projects in developing countries because it includes local agency to react to institutional rules and

structures and integrates multi-level environment-development interests (Bumpus & Liverman, 2011). Political ecology has provided a framework for assessing and understanding the local social and environmental implications of (carbon) projects and policies. It includes local agency by giving the possibility to react to institutional rules and structures, considering the nature of carbon reductions and integrating multi-level environment-development interests (Bumpus & Livermann, 2011). Because of this, an analysis of the relationship between (transnational) carbon capital and its effects in specific communities in the global South fits perfectly in political ecology thinking.

2.1.3 Green grabbing

The commodification of nature in the name of 'sustainability' or 'conservation' is increasing. However, with this elaboration, green grabbing is expanding as well. As explained by Vidal (2008), green grabbing is the appropriation of land and resources for environmental intentions and adds a new dimension to the broader discussion of 'land grabbing'. These lands or resources should serve "green" ends through biodiversity conservation, bio-carbon sequestration, the protection of ecosystem services, ecotourism or carbon offsets that are related to all of these. An example can be found in Mozambique, where a British company negotiated with the government about the lease of 15 million hectares (which represents 19 percent of the country's surface) to grow trees that will provide carbon stocks. Appropriation indicates the transfer from the poor to the "powerful" of use rights, control and ownership over (natural) resources that were publicly or privately owned before. It is called green grabbing because appropriation is most frequently related to dispossession and accumulation in which natural resources are released for private capital (Fairhead, Leach & Scoones, 2012). Büscher & Fletcher (2015) link this process of accumulation to contemporary capitalism in which negative environmental contradictions are the starting point for a new 'sustainable' model of accumulation for the future by turning nature into capital that can 'save' the environment. However, the "grabbing" for green ends does not always includes the alienation of land from existing residents. It involves restructuring of rules and authorities over the access, use and management of resources which is related to labour relations or human-ecological relationships that could result in negative effects (Fairhead, Leach & Scoones, 2012).

2.1.4 The sustainable livelihoods approach

To explore and verify the claims from theories of political ecology and green grabbing, the livelihoods perspective can be used to assess impacts on local level. Although various livelihood frameworks were developed in the last decades, the most commonly used is DFID's Sustainable Livelihoods Framework **(Figure 1)**. Many development agencies and NGOs use the livelihoods approach to gain a better understanding of natural resource management systems. By recognizing the seasonal and cyclical complexity of livelihood strategies, the livelihood approach attempts to improve rural development

policy and practice and supports in removing access constraints to assets that complement existing patterns. The approach seeks to strengthen people's own inventive solutions instead of undermining them. The livelihood approach focuses on the links between individual or household assets and institutions or regulations that govern access to these assets and alternative activities (Allison & Ellis, 2001). It can be applied at a variety of scales, from individual to household and from village to region. The assets have been defined in a combination of different livelihood resources, or "capitals", that can change over time according to needs and responses (Scoones, 1998). These capitals have been identified as natural capital, human capital, physical capital, financial capital and social capital. However, some academics integrate other capitals such as political capital and cultural capital (Ellis, 2000; Berkes & Folke, 1994).

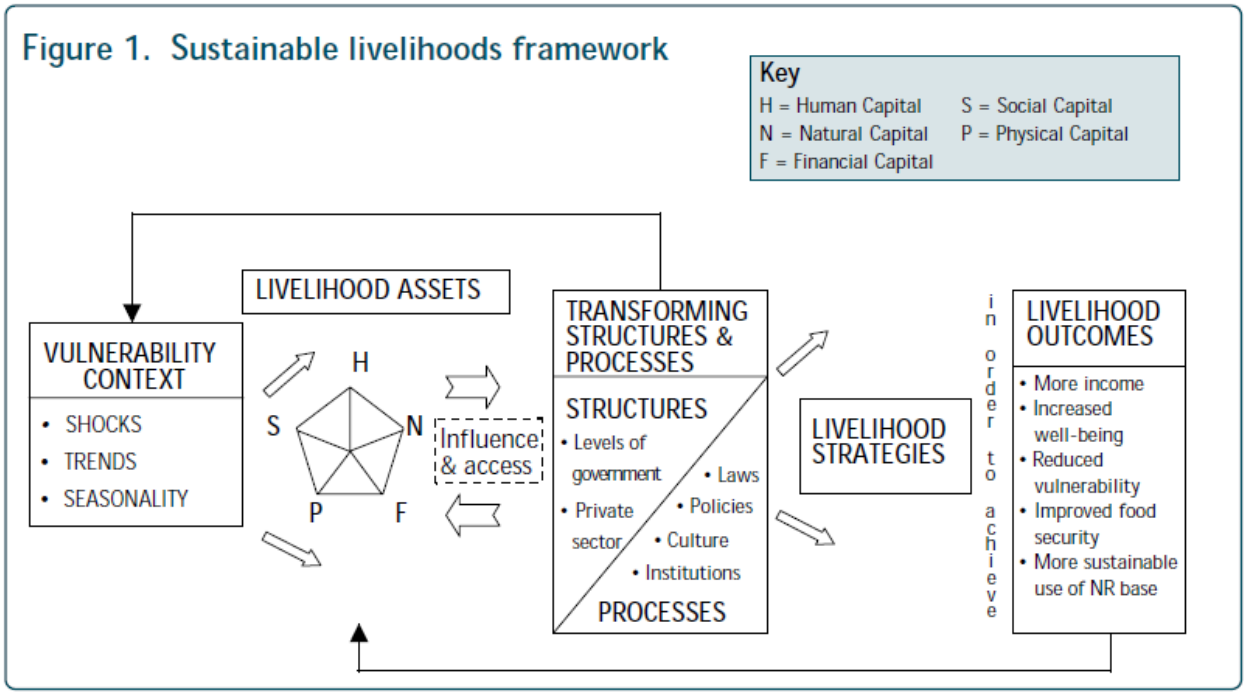

FIGURE 1 SUSTAINABLE LIVELIHOODS FRAMEWORK (SOURCE: DFID, 1999)

Natural capital refers to the natural resource base that includes soil, water, air and environmental services such as water quality. It also includes ecosystems such as forests, that are an important resource for rural communities in the world. Human capital consists of skills, knowledge, health and physical capability that are required to successfully pursue different livelihood strategies (Scoones, 1998). Although labour is an important part of human capital since it is often the first response to crisis, knowledge is also a valuable factor in avoiding vulnerability. Physical capital refers to assets that have been created by an economic production process (Ellis, 2000). This capital is "man-made" and includes producer goods such as roads, dams as well as housing. Financial capital refers to economic assets that are needed to perform livelihood strategies. This includes the money that an individual, household or

village has access to, either in the form of savings or credit. It is not necessary money, livestock to trade can be financial capital as well (Ellis, 2000). Social capital involves the social resources on which people rely in pursuing different livelihood strategies (Scoones, 1998). This can be the social relations and networks that individuals have or the inclusion in a group or society as a whole (Ellis, 2000).

Vulnerability is one of the key concepts of the approach and consists of two aspects; external threats to livelihood security due to risk factors as the climate or markets and the internal capability of coping with these risks by for instance assets and support of the community or government. In addition, resilience and sensitivity are livelihood attributes that refer to the ability of a system such as a community to get over stress or shocks and the magnitude of a system's response to external disturbances (Allison & Ellis, 2001). Most literature on carbon offset projects focused singularly on carbon, while overlooking broader livelihood outcomes. It could result in adverse local livelihood impacts such as destruction of crops, housing and trading centres alongside the start of reforestation activities which is linked to 'land grabbing' (Lyons & Westoby, 2014). Therefore, the livelihood framework could help answer the sub-question to what extent carbon offset projects support local development.

2.2 Concepts

2.2.1 Offsetting schemes

In 1997, the Kyoto Protocol committed industrialized countries to binding greenhouse gas reduction based on their emissions of 1990. In order to more easily comply with exceedances on the total amount of carbon dioxide (CO_2) they are allowed to emit, a market was created that allowed countries to trade emission reductions or purchase emission reductions from projects in Eastern Europe (Joint Implementation) and developing countries (Clean Development Mechanism) instead of domestic projects. Around the same time, a voluntary market was created that allows firms and individuals to compensate for their emissions by purchasing credits from emission reduction projects in developing countries (Bumpus & Liverman, 2011). Those emission reduction credits from the Joint Implementation, the Clean Development Mechanism and the voluntary market became known as "carbon credits".

2.2.2 Creating carbon offsets

When a project has the approval that it reduces or sequesters greenhouse gases, and when those reductions are translated into a measurable and marketable commodity, a carbon offset is created. "Baseline-and-credit" trading systems are used for offsets to create assets in the form of carbon credits, which are measured in tons of carbon dioxide equivalent. Through a conversion based on the global warming potential of different gases, reductions in different types of greenhouse gases (e.g.

carbon dioxide or methane) are made equivalent. Carbon credits should represent reductions compared to baseline situations; the status before the project is implemented. This is called the additionality of a project, which is a fundamental idea of carbon offsetting and should be measured to prove the net reduction in atmospheric CO_2. Carbon offset developers use documents and tests to justify to standard bodies as the CDM Executive Board or Gold Standard that the carbon reductions are verifiable and permanent (Bumpus & Liverman, 2011).

The CDM defined eight different project categories that can be used to create carbon offsets: afforestation and reforestation, renewables (electricity), demand-side energy-efficiency, methane emission reduction and cement and coal mine (such as composting), fuel switch, supply-side energy efficiency, transport and destruction of other primary greenhouse gases. Although the CDM is widely accepted as an imperfect but useful way of engaging non-industrial countries in mitigation work, uncertainties of mitigation benefits of carbon offsets exist (Olsson, Grönkvist, Lind & Yan, 2015). Although different offset technologies are often taken together by advocates and critics, governance, effectiveness and sustainability benefits of offsets vary between different types of technology (Bumpus & Liverman, 2011). Transaction costs of implementing a project as contracting, monitoring, registring, verifying and certifying vary as well between projects. For small projects, transaction costs per tonnes of carbon can be ten times higher than of large projects. Frequently, community development-oriented projects are small scale and target specifically small holders. Therefore those will have the highest transaction costs, which makes them less attractive to investors (Jindal, Swallow & Kerr, 2008).

2.2.3 The uncertainties of carbon offsets

Carbon offsets should be created through a process of monitoring procedures, baseline calculations, guarantees of additionality and by strong offset methodologies (Cavanagh & Benjaminsen, 2014). However, these measures are not always used when producing a carbon offset which causes potential problems. One of the issues is about permanence; this arises mainly in afforestation and reforestation projects from potential threats to carbon sinks from natural disturbances as forest fires or human intervention (for example harvests that are not covered by the project plan). Mitigating the risk of non-permanence is possible by setting up insurances, crediting per year or replanting the carbon-equivalent forest in another place. However, temporary credits are difficult to manage and transfer because of they cause larger financial risks and political and economic circumstances may have a huge effect on future prices of carbon. A second issue is called the rebound effect which can be defined as the lost part of an energy conservation effort. This refers to problems that arise when quantifying emission reductions; emissions may increase on a national scale, outside the project boundary. For example, in the case of demand-side energy efficiency projects, energy efficiency may lead to increased use of the service that will decrease potential energy savings. Most of the countries in which carbon offsetting

projects are implemented do not have national emission reduction targets, and there is no mechanism that takes into account emissions originating from rebound effects (Olsson, Grönkvist, Lind & Yan, 2015). Little attention is given to this issue in the scientific literature and in the tools used for establishing baseline emission scenarios, indirect emissions from the projects are not included. They are not seen as "leakages" because measuring is practically not possible (Olsson et al., 2015). Leakage refers to a situation in which project activities result in increased emissions outside the project boundaries. The chance on leakage is large when projects prevent people from performing an activity that emits carbon which provides income or products, without offering an alternative with a compensatory carbon saving activity (Smith & Scherr, 2003). An example of leakage in a forest carbon project is when through forest conservation activities, deforestation will be displaced outside the project area (Cavanagh & Benjaminsen, 2014). Although the land-use change and forestry sector in carbon offsetting is frequently associated with uncertainties and non-measurability, similar issues are ignored in the energy sector (Olsson, et al., 2015). There are several related problems that arise regarding emission offsetting. First, the lack of (financial) additionality which means that it is difficult to prove that the investment brings the emission reductions as promised because of not assessing the counter-factual. Second, there are no standards for emission calculations to determine the level of CO_2 emissions resulting in a variety of results. Third, emission reduction projects could have unintended negative side effects that harm positive intentions of the project (Spiekermann, 2014).

Increasingly, researchers suggest that carbon offsets are not an appropriate way to mitigate climate change (Gössling et. al, 2007). Structural and behavioural change may still be required (Metz et al., 2007). There is a risk that by promoting carbon-offsetting schemes as the easy way to make a contribution to cope with climate change, the industry may unintentionally remove some of the significant behavioural changes (Mair, 2011).

2.2.4 Forestry projects to offset carbon

Land use practices such as forestry are able to absorb (or sequester) carbon dioxide from the atmosphere (Jindal, Swallow & Kerr, 2008). There are two major categories in forest carbon projects: afforestation and reforestation (AR) and forest conservation. According to the Ecosystem Marketplace (2016), the surface of protected forest by carbon offsetting projects increased from 880.000 hectares in 2008 to 28 million hectares nowadays. By these forest conservation projects, deforestation could be avoided through carbon investments for emission reduction that provides direct economic incentives for countries to take up conservation. One of the mechanisms that intends to facilitate those projects is the Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiative that aims to reverse deforestation by linking forest conservation to carbon markets (Büscher & Fletcher, 2015). Afforestation and reforestation projects include human-induced conversion of non-forest land uses to

forest, by planting trees or promoting natural seed sources. Establishing plantations after cutting down community forests will not be eligible for forest carbon projects, activities should take place on land that did not contain forests for the last decades (Smith & Scherr, 2003). A potential environmental benefit from these projects is that through reforestation locally valued ecosystem services such as higher quality water supplies and control of soil erosion could be generated and biodiversity conserved. However, there are few studies on the social impacts of these specific projects for host countries or project participants (Smith & Scherr, 2003; Jindal, Swallow & Kerr, 2008; Chattre & Agrawal, 2009). That is remarkable, because almost all (tropical) forests have people living in and around them, and forest commons are crucial to the livelihoods of the rural poor in developing countries. More than half a billion poor people obtain livelihood benefits from forests such as a composite of proportions of firewood, green biomass used as fertilizer and timber for domestic use (Chhatre & Agrawal, 2009).

In all carbon offsetting projects, rights of ownership need to be assigned to the tonnes of carbon dioxide that are reduced. Local communities may own the wood grown in a forest for carbon sequestration, and foreign investors may own the reductions of carbon (in the form of credits) that are created through the forest (Bumpus & Liverman, 2008). Forestry offset projects could also bring benefits to local businesses and communities through employment opportunities as planting trees, direct payments for forest carbon services, providing sources of subsistence (food, fuel, construction materials), asset-building (schooling or shelter improvement) or services to farming (erosion control, wind breaks) (Smith & Scherr, 2003). However, there is also a risk for local communities of losing rights to the use of land and water or they are not well informed about their opportunity to demand higher prices for their carbon reductions (Bumpus & Liverman, 2008). Besides, not all projects aim to provide benefits to local communities and whether they receive economic returns depends on the quality of land and the actual land use practice that is followed. Dry lands sequester only 0.05-0.7 tons of carbon per ha/year, while other types of land could take up to 5.9 tons of carbon per ha/year. Because of this, a carbon offsetting project can only be considered profitable for local communities after economic and social benefits are clearly evaluated. However, such projects can have adverse impacts as well. If plantation companies take up sequestration activities in forest areas, local communities could experience a loss of income or do not get a share of carbon revenue from the forestry project. And if only single species are introduced on new plantations or fast growing exotics that are highly effective in storing carbon, local biodiversity, native species and soils can be harmed. Additional studies are needed to assess on an objective way whether or not local people are harmed by commercial carbon offsetting projects, and how more inclusiveness could be integrated in such projects. (Jindal, Swallow & Kerr, 2008).

The measurement of the impact of forestry offsetting projects is more complicated than renewable energy projects. It is difficult to determine precisely the amounts and sequestration of carbon in forests; weather variations and monitoring forms problems in this type of carbon offsetting (Bumpus & Liverman, 2008). One of the concerns about the potential carbon sequestration of forestry projects is the threat of impermanence. At any stage in the project, a forest can be burned or cut which could release most of the sequestered carbon back into the atmosphere (Jindal, Swallow & Kerr, 2008).

3 Contextual Framework

3.1 Panama's socio economic context

The Republic of Panama has a population of 4 million inhabitants of which more than 1 million live in the capital (INEC, 2015). Panama is officially divided into nine provinces and five legally established indigenous territories, which are referred to as *comarcas* (Vergara-Asenjo & Potvin, 2014). Since 2000, Panama's population has expanded from 3 to 4 million and simultaneously the country has experienced enormous economic growth with a GDP that tripled (The World Bank, 2015). The economic boom of Panama started with the transfer of the Panama Canal from the United States to Panama in 1999. The service sector expanded with activities around ports, logistics, trade, communications and financial services which in turn increased the demand for construction. Private non-residential developments such as office buildings and shopping malls, and large public infrastructure projects such as the expansion of the Canal, the new international airport and the City Metro project created a labour-intensive sector requiring non-skilled workers (Hausmann, Espinoza & Santos, 2017). Although Panama's economic growth has led to significant reductions in poverty, from 26% in 2008 to 18% in 2015, Panama has a relatively high inequality rate (GINI is 50.7) (The World Bank, 2015). Especially indigenous people and women experience inequalities and deprivations in economic inclusion, political participation and physical safety. In indigenous territories, poverty is above 70% (UNDP, 2015) **(Figure 2)**.

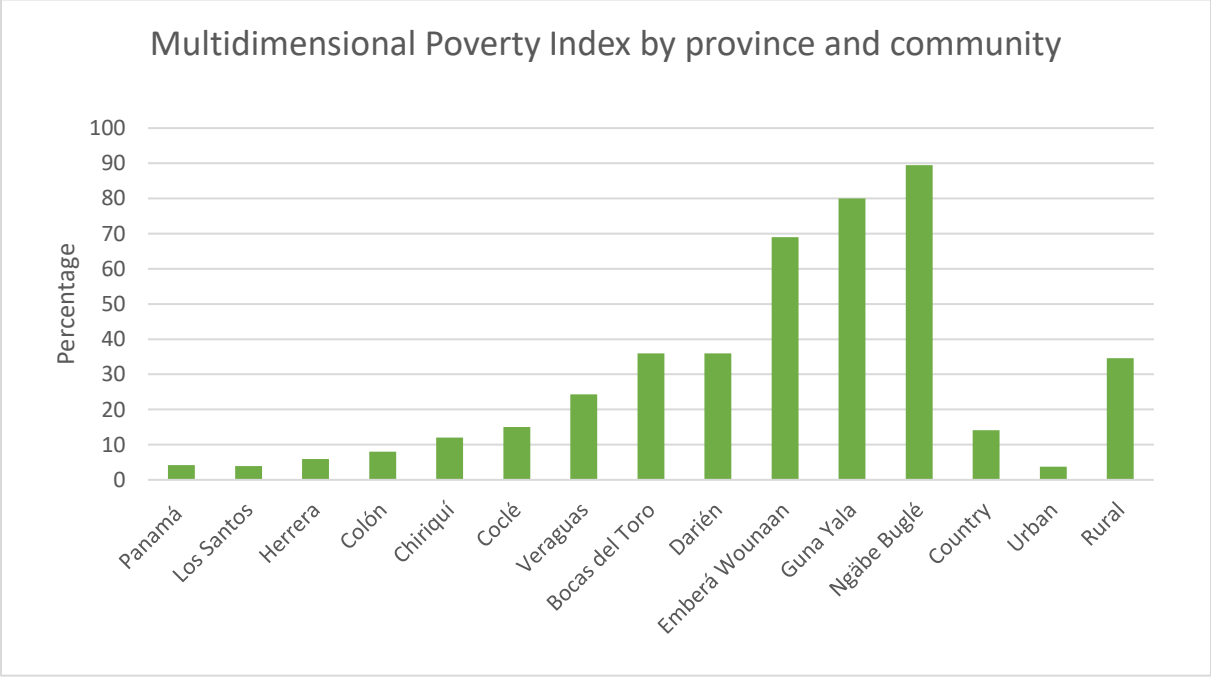

FIGURE 2 MULTIDIMENSIONAL POVERTY INDEX OF PANAMA (SOURCE: UNDP, 2015)

Although Panama's average life expectancy is relatively high (77,6 year), the difference is large between regions. People living in the *comarcas* have a life expectancy of 68, while in the province of Panama City it is 79 (UNDP, 2015). Panama has one of the highest average years of schooling in Latin America (10.7 years), although the quality of education remains a big concern. Especially in rural areas and indigenous regions, children are more frequently low educated. There are three main obstacles: the distance to school, lack of income and child labour (UNDP, 2015).

3.2 Environmental context of Panama

Panama is a relatively small Central American nation that bridges two continents and covers about 74.000 km^2. The country is rich in biodiversity and situated as a biological corridor between Central and South America. The average annual precipitation ranges between 2000 to 3000 mm at high altitude and the annual temperature averages 26℃ in the lowlands and 22℃ in the highlands, with a dry season from December to April (Autoridad Nacional del Ambiente, 2010).

Starting with the creation of Altos de Campana National Park in 1966, the Panamanian government has focused her first forest conservation strategy on protected areas (Vergara-Asenjo & Potvin, 2014). Nowadays, the Panamanian government has a well-established system of national parks and a number of laws and regulations regarding forest management and wood harvesting, processing and trade (Condit, 2015). One of those regulations is the National Forestry Development Plan, initiated in 2008 with a duration of 25 years. The plan is called the Sustainable Forestry Model and aims to restore watersheds, preserve protected areas and promote reforestation. All sectors and stakeholders are encouraged to conserve and sustainably use natural resources. The Sustainable Forestry Model should mitigate the effects of climate change through carbon sequestration and promote the adaptation of the population to the consequences of it, which should lead to better living conditions for all inhabitants of Panama (FAO, 2008). The plan is divided into three practises: an ecosystem restoration program, a forest stewardship programs and a training and research program. The plan promotes agroforestry systems for food production and closer coordination between responsible institutions to prevent the undermining of forest resources.

Besides the aforementioned model, Panama has a law that aims to conserve and manage forest resources sustainably: The Forestry Act of 1994. One of the actions of this specific forest law was the establishment of the National Fund for Forest Development and Protection (FONDEFOR) which should assist in forest promotion, protection, management, control and research. In 2015, another law was introduced that amplified the Forestry Act by creating a new Ministry of Environment as the governing body of the state in the protection, conservation and restoration of the environment (Forest Legality Initiative, 2016). One of the actions forthcoming from the National Forestry Development Plan was the

collaboration with two REDD+ multilateral readiness programs from the World Bank and the United Nations. The goal was to develop a national strategy that could reverse deforestation, while developing an economic framework (Vergara-Asenjo & Potvin, 2014).

Many of the protected areas in Panama overlap with indigenous territories, which creates a variety of land tenures and overlap zones that are a source of diverse land-use conflicts. The *comarcas* include 12% of the country and around 27% of national forest cover (**Figure 3)**. Currently, around 38,5% of the total land area represents Panama's forests. Therefore, indigenous territories might play a large role with respect to forest conservation in Panama (Vergara-Asenjo & Potvin, 2014).

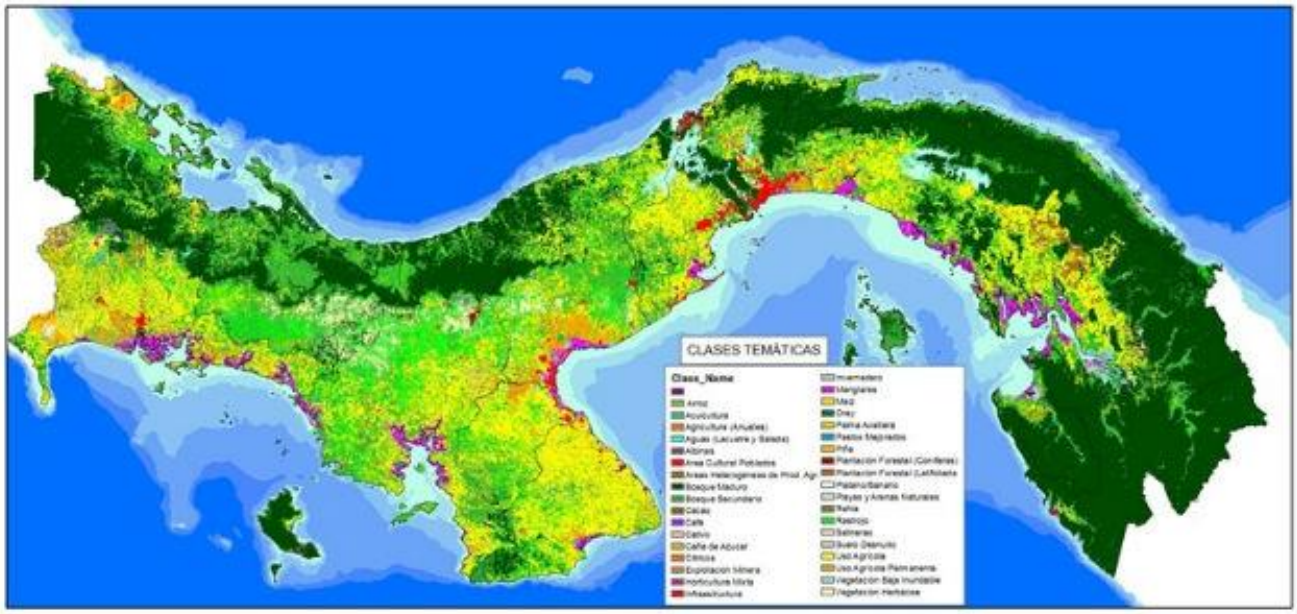

FIGURE 3 FOREST COVER PANAMA (SOURCE: AUTORIDAD NACIONAL DEL AMBIENTE, 2014)

3.3 Forests of Central America

3.3.1 Deforestation in Central America

Throughout Central America, high deforestation rates and forest fragmentation pose significant threats to the remaining biodiversity and to rural livelihoods. Although most of the forest types are threatened by deforestation, particularly tropical dry forests have been vulnerable to these movements (Garen, Saltonstall, Ashton, Slusser, Mathias & Hall, 2010). Before the land was cleared for cattle, much of the Pacific coast of Central America was covered by dry tropical forest (Griscom, Griscom & Ashton, 2009). Around 1.7% of the original expanse has remained due to infertile soils and remote areas, which makes it one of the most threatened tropical ecosystems (Griscom & Ashton, 2010). Tropical dry forests consist of tree species that have always been important for local livelihoods. Parts of the still existing tropical dry forest outside protected areas have been remained primarily because they are valued and conserved by local people (Garen et. al., 2010).

In the fifteenth century, small-scale deforestation started with the arrival of the Spaniards for the construction of ranches for European cattle and extractive logging of timber. This was followed by increased pasture expansion and timber extraction for national and export needs in the early twentieth century. In the 1960s, emerging government and international loans for cattle-raising resulted in a massive increase in deforestation in Central America. Nowadays, the land is again in transformation from pasture land to abandonment because of changing socio-economic incentives and declining productivity or to active reforestation (Griscom & Ashton, 2010). The last transition comes partly from new landowners that are interested in reforesting and protecting land with native trees to create long-term ecological value and increase forest cover and biodiversity (Griscom, Griscom & Ashton, 2009).

Panama has six major causes of deforestation: traditional and mechanized agriculture, extensive cattle ranching, an unsustainable exploitation of forests, poorly planned urban development, inadequate exploitation of mineral resources and low levels of education and environmental culture (Vergara-Asenjo & Potvin, 2014). Although an enormous increase of reforestation started in the 1990s as result of a government tax credit for establishing plantations, the forest cover of Panama has decreased from 36.951 km^2 to 32.433 km^2. However, this "reforestation policy" was only defined as "planting of forest species" which caused that 77% of the plantations were monocultures of teak (Sloan, 2008). This limits plant diversity, promotes soil erosion, and provides only limited services to local landholders. Nowadays, efforts to develop reforestation programs with native species to increase biodiversity and contribute to rural livelihoods are increasing (Garen et. al., 2010).

3.3.2 Natural regeneration

Deforestation and subsequent non-sustainable land use in South- and Central-America has produced vast areas of degraded land. Once the land is left behind, it takes often a lot of time until forests are regenerating naturally. Limitations of seed dispersal, grass competition, fires, droughts and low soil nutrient availability are factors that may hinder tropical forest regeneration. Dispersing seeds through animals is unlikely since they will not enter far into these deforested areas. Although wind-dispersed seeds may reach the abandoned lands easily, it is often limited to small-seeded species because local birds carry small seeds. Deforested sites in Panama are often invaded by non-native grass species that grow densely. The grass species limit tree generation because of competing with tree seedlings for water and nutrients and increase the probability of fires. Seasonal droughts are a barrier for natural regeneration as well (Hooper, Legendre & Condit, 2005). However, topographic position may also influence the success of forest regeneration. Lower slopes are in general more fertile than well-drained upper slopes. Regeneration barriers are equal within wet and dry tropical ecosystems, but limiting resources and land use history may differ. In dry tropical forests, pastures are often grazed for a longer period of time and water tends to be the limiting resource rather than nutrients (Griscom, Griscom &

Ashton, 2009). To overcome obstacles of natural regeneration, low-cost management is an option for restoring native forest cover in Panama that are invaded by grass species. Developing firebreaks, planting shrubs and planting a variety of large-seeded trees to create shade are measurements to eliminate the grass and restore native forest (Hooper, Legendre & Condit, 2005).

3.3.3 Reforestation

Reforestation may be achieved by intensive plantation strategies or relying on the regeneration capacity of the land with some minor measures (Griscom, Griscom & Ashton, 2009). The majority of reforestation projects in Panama are based on fast-growing, non-native timber species, which brings not as much benefits as native species. However, local landholders are more in favour of planting a diversity of native trees. Garen et. al. (2010) have found that many rural landholders have diverse tree planting and protecting practices and use a large number of native trees for different reasons. They leave trees in agricultural field to provide ecosystem services as improving water and soil quality and providing food and shade for cattle, or as a source of wood for construction and furniture. Existing literature highlights the important role of agroforestry and silvopastoral systems, because they could provide a range of ecosystem services and environmental benefits including carbon sequestration and biodiversity conservation (Garen et. al., 2010; Brown, 2002). Besides, reforestation in general has a positive impact on the water balance in the area by regulating water quality and quantity. Forest water consumption and infiltration is higher than that of other vegetation types, and in a forested area the ground is better able to remove or breakdown organic matter, nutrients and polluting compounds (CIFOR, 2010). Furthermore, small-scale rural landholders are not likely to participate in monoculture reforestation initiatives because of insecure land tenure issues, unclear rights regarding tree use and management, short-term economic incentives and complex technologies (Garen et. al., 2010).

3.4 Case-study: The CO_2OL Tropical Mix Reforestation project

The project areas of "CO_2OL Tropical Mix Reforestation" are spread over the country in the provinces Bocas del Toro, Chiriqui, Darien, Veraguas and Panamá, and all divided among several *fincas*, managed by the same forestry plan. Darien and Veraguas are provinces that are less developed in various areas such as income and life expectancy than the Panamá province, which contains the capital (UNDP, 2015). The total project area includes 3.338,2 hectares of which 853 hectares are conservation area. Until now, at least 3 million trees are planted that stored an amount of 135.100 t CO_2e. The project has a Gold Standard verification and aims to reforest formerly degraded pasture land with mostly native tree species and turn it into mixed forests. The project combines planting trees for biodiversity protection and ecosystem restoration with the production of environmentally friendly timber and small-scale production sustainable cacao. The project developer is ForestFinance, an international

company that offers global direct investments in ecological reforestation and sustainable forest products for private and institutional investors. "CO_2OL" is the brand name for carbon sequestration activities within the project. According to the company, the project creates long-term employment for the local population, integrates capacity building and education programmes and provides a sustainable source of income. Besides, it considers ecological values by guaranteeing a high share of native species and creating new habitats for plants and corridors for migrating species, and by controlling erosion and protecting water (ForestFinance, 2016).

Around twenty years ago, ForestFinance started their activities in Las Lajas, a community in Chiriquí close to the Pacific Ocean. The first parcel bought was "La Finca Madera". All parcels owned by ForestFinance were former cattle ranches, characterized by grass species and a few trees. The land has been bought from farmers that left the region to work in another sector or quitted working. The Gold Standard label of the project attempts to guarantee this by requiring evidence that the former owner of the land does not deforest another area. ForestFinance conduct interviews with the owner or with people in the surroundings of the project to prove this. Since two years, the first sustainable timber is harvested and processed in the "Centro de Madera", the small-scale wood processing factory. A small part of the timber is now used to produce furniture for the market in Panama because the factory is not ready to process all the timber to furniture. It is still in a pilot-phase. Therefore, the majority of the yield is now going to India, South-Africa and Germany.

TABLE 1 REGION CHARACTERISTICS (SOURCE: SMITHSONIAN TROPICAL RESEARCH INSTITUTE AND UNDP, 2015)

Municipality	*Climate*	*Type of forest*	*Main economic activities*	*Poverty rate (MPI)*
Chepo (Panamá)	Am	Tropical dry forest	Construction, service sector	24.9%
San Félix (Chiriquí)	Am	Tropical dry forest	Agriculture, livestock, electricity and water services	10.9%
Almirante (Bocas del Toro)	Af	Tropical rain forest	Agriculture, livestock, electricity and water services	50.7%
Soná (Veraguas)	Aw	Tropical dry forest	Agriculture, livestock, fishery	28.2%

Because the project sites are spread all over the country, differences in environmental and socio-economic circumstances exist between locations **(Table 1)**. Chiriquí and Veraguas contain highly fragmented remnants of tropical dry forest and are characterized by small-scale farming activities. Though since tourism increased along the Pacific coastline, more frequently residents work in the tourism related jobs or are construction workers. Similar to other regions throughout Central America, government incentives for agricultural expansion resulted in high deforestation rates throughout

Veraguas and Chiriquí. The Panamá province had the same development in terms of agricultural expansion, but also accommodates the capital and the Panama Canal. In Bocas del Toro, the project areas are characterized by a different climate and forest cover than the other regions. This province has a tropical climate with precipitation in every month and is well known for the large banana plantations **(read more in 4.2)**.

3.5 Host organization: KLM Royal Dutch Airlines

KLM Royal Dutch Airlines (KLM) was founded in 1919 and has been part of the Air France-KLM group since 2004. Their mission is "to provide innovative products for het customers and a safe, efficient, service-oriented operation with a proactive focus on sustainability" (KLM, 2015). For many years, Air France-KLM has been listed as the world's most sustainable airline by the Dow Jones Sustainability Index. However, as well as other transportation methods, flying on the current fuels as such is not sustainable at all. Strictly speaking, the world should stop or reduce flying to decrease the impact of aviation on the environment and climate. However, this is not realistic since the market for aviation is growing when more countries develop to higher living standards. Besides, KLM is a for profit organization which makes it unlikely that it will reduce their amount of flights for the sake of the environment. Therefore, they try to make their operations more sustainable on an alternative way. Several examples are: fleet replacement for more efficiency, using biofuels and serving certificated coffee on board. In addition to that, KLM purchases emissions units from Gold Standard with the contribution of passengers who choose to compensate the CO_2 emissions of their KLM flight (KLM Takes Care, 2015).

4 Methodology

4.1 Retrospective evaluation

When assessing the impacts of an intervention, there should be considered what would have happened in the absence of the intervention: the counterfactual scenario. A common way to estimate the counterfactual is to measure difference between control and intervention sites or groups. However, interventions could be taken up differentially depending on biophysical and socio-economic characteristics and the political climate. Therefore, the control site or group should be as similar as possible, or randomly assigned to the intervention. The randomization of forest conservation projects is difficult due to for instance specific selection of intervention areas. Another way to compare to counterfactuals is to collect information on potential confounders such as observable socio-economic, economic or institutional factors that influence outcomes (Caplow et al., 2011). Specifically, the voluntary carbon market standards require estimates of the counterfactual to prove that the intervention will result in lower emissions than in the baseline situation. For this research, it is due to time constraints practically not feasible to find a proper control group or conduct a baseline study. Because of that, there is chosen for a retrospective evaluation by creating questions in which respondents should talk about former situations and differences with the current situation. Additionally, secondary data collected by ForestFinance for the verification standard (Gold Standard) is used to compare information that is collected at the project site around two years before this research started.

There is a clear divide between the research processes of studies focusing on measuring carbon and biophysical outcomes and those measuring socio-economic outcomes. But it is hard to form conclusions about trade-offs if only one of the two is included in the analysis. However, impacts on biodiversity and other ecosystem services are rarely measured in project evaluations. Besides, socio-economic indicators are often solely focused on project sites, which neglects general effects that may result from shifting economic activity. Additionally, project impact and success are differently defined by social and physical scientists. Most evaluations reported only social outcomes in terms of employment and income (Caplow et al., 2011). This research has combined social and environmental outcomes, and includes several indicators derived from the DFID Framework (1999) and CIFOR working papers (2005) (*See: Chapter 4.3*).

As recommended by Caplow et al. (2011), one should use mixed methods (such as ethnography and socioeconomic surveys) to understand the process of implementation and causal relationships

between interventions and observed outcomes. Therefore, this study will combine observation techniques, surveys and semi-structured interviews.

4.2 Site description

To provide a valuable reflection of the whole project, the study was located in four of the five different provinces across Panama; Panamá, Veraguas, Chiriquí and Bocas del Toro **(Figure 4)**. Due to the remote location and accessibility and time issues, Darien is the only province with project locations that is excluded from this research. In total, twelve different *fincas* have been visited throughout Panama. While being in the different regions, *fincas* were selected on the spot by presence of workers and accessibility, since not all locations have working activities every day and some locations were hard to reach due to for instance weather conditions. Respondents for the research were through convenience sampling selected while being at location, because there were only a few employees present at the *fincas* and they were difficult to localize in the forest.

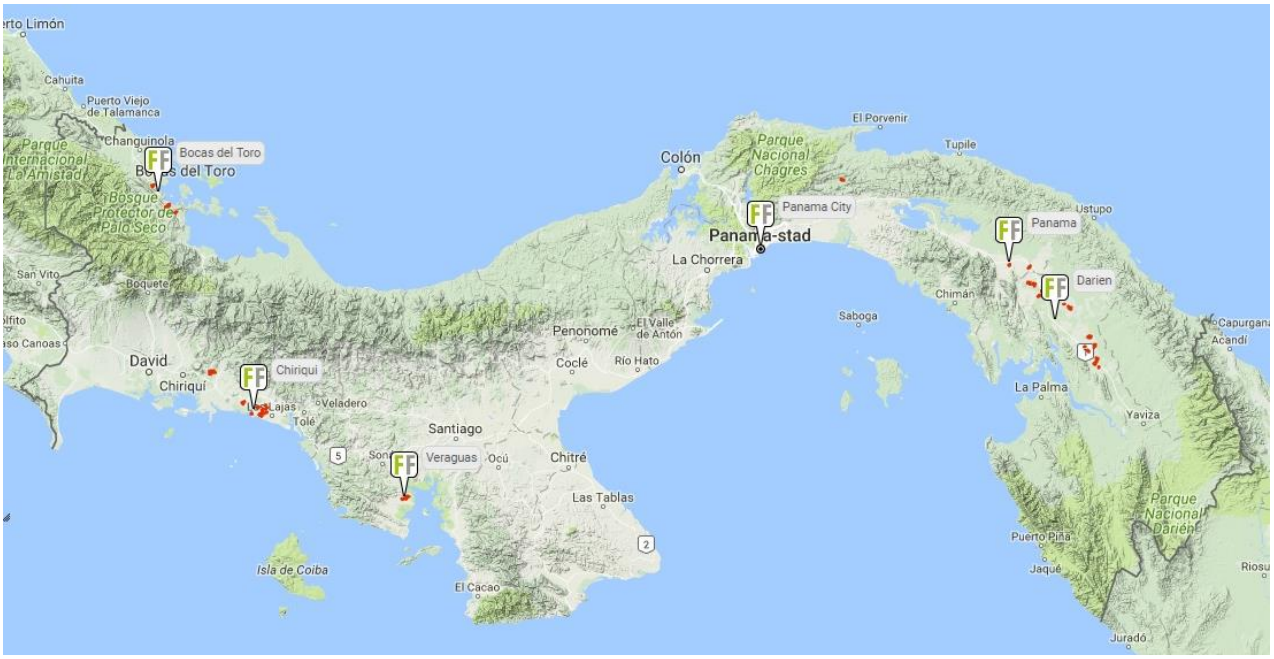

FIGURE 4 PROJECT LOCATIONS (SOURCE: FORESTFINANCE, 2016)

In detail:

- In Panamá, two *fincas* have been visited in a remote mountainous area close to the border of the Guna Yala region, which is an indigenous province. Next to these project sites, there is a small community with mainly indigenous people. One of the sites is already 15 years part of ForestFinance, the other only four years. In total, the project surface is 268,18 hectares in the province of Panamá **(Appendix 4).**
- In Chiriquí, eight *fincas* have been visited in the surroundings of the village Las Lajas. The area is characterized by cattle farms, (subsistence) agriculture and small communities. Besides the

fincas, the tree nursery and the small-scale wood processing factory are located close to Las Lajas. In total, the project surface is 1036,61 hectares in the province of Chiriquí **(Appendix 4).**

- In Bocas del Toro, one *finca* has been visited which is located close to the town Almirante. In this region, the planting of trees is combined with the production of sustainable cocoa. The area consists mountains as well as lowlands for the production of bananas. Many inhabitants work in the excessive banana plantations of Chiquita. In total, the project surface is 315,62 hectares in the province of Bocas del Toro **(Appendix 4).**
- Veraguas, one *finca* has been visited close to the small town Guarumal. The area is similar to Chiriquí and has many cattle farms and small scale rice plantations. In total, the project surface is 245,28 hectares in the province of Veraguas **(Appendix 4).**

4.3 Operationalization of variables

4.3.1 Influence on local development

The co-benefits for local development are defined as socioeconomic and welfare impacts, derived from the sustainable livelihoods framework (DFID, 1999). Whether a carbon offsetting project has an influence on local development, has been assessed by including human capital, physical capital and financial capital. The focus has been on these three capitals because expected was that those ones could be most influenced by the income derived from the project. This is explained by the DFID framework (1999) which indicates that higher income is often reinvested in education and spent on shelter, water and power supplies, and increases the scope for saving. Smith & Scherr (2003) add to this that employment is the main benefit to local communities from particularly large-scale plantations. Improvements in natural and social capital are more frequently seen in community agroforestry projects such as a positive impact on livestock productivity or soil fertility enhancements on community farms. Although natural capital not explicitly has been integrated in this research, there are a few subjects that refer to the assets of this capital (*See: section 5.3.2*).

Table 2 presents the selected capitals including multiple livelihood indicators on individual and household level, derived by the DFID framework (1999) and the CIFOR Working Paper "A method to assess the outcomes of forest product trade on livelihoods and the environment" (2005). The operationalization of the indicators can be found in **Appendix 1 & 2**, where the questions for respondents are outlined.

TABLE 2 INDICATORS FOR LOCAL DEVELOPMENT (SOURCE: DFID (1999) AND CIFOR (2005))

Asset group	*Indicator*
Human	▪ Education and training ▪ (Equitable) access to information ▪ (Equitable) access to technology
Physical	▪ Shelter and household possessions ▪ Ownership/access to means of transportation ▪ Local infrastructure
Financial	▪ Income level ▪ Regularizing income ▪ Household savings ▪ Income diversification ▪ Safety net value

4.3.2 Influence on the environment

Whether the project has an influence on the environment has been assessed by the biophysical outcomes and impacts of the project on different scales. Estimating a project's forest carbon outcomes should be done by measuring the change in forest area and the change in forest biomass in this area. Since it was not feasible for this research to calculate biomass plots, the influence on the environment has been assessed through observation techniques and retrospective interviews questions for project employees related to environmental circumstances. **Table 3** presents the selected environmental indicators on local species and population, regional landscape and global level. The indicators are derived by the CIFOR Working Paper "A method to assess the outcomes of forest product trade on livelihoods and the environment" (2005). The operationalization of the indicators can be found in **Appendix 1 & 2**, where the questions for respondents are outlined.

TABLE 3 ENVIRONMENTAL INDICATORS (SOURCE: CIFOR (2005))

Level	*Indicator*
Local species and population	▪ Changes in population size ▪ Changes in population structure
Regional landscape	▪ Role as a reservoir of forest species ▪ Role as a biodiversity corridor ▪ Role on erosion control and hydrology
Global	▪ Contribution to endangered species conservation ▪ Contribution to conservation of rare ecosystems

4.3.3 Uncertainties

The potential uncertainties of the carbon sequestration activities of the project are defined by three major concepts:

1. Additionality

   With regard to forestry carbon offsetting, additionality means that reforestation would not have happened in absence of the project. Because carbon offsets are not true if the reforestation would have taken place anyway.

2. Leakage

   Leakages refers to the possibility that due to for example forest conservation activities in one geographical area, deforestation or an increase in emissions will be displaced to another location outside the project area.

3. Permanence

   The permanence issue arises by potential threats to carbon sinks from natural disturbances or human intervention. An example of a natural disturbance is an unpredicted forest fire, which results in that the stored carbon will go into the atmosphere again. An example of human intervention is the harvesting of trees that are not covered by the project plan.

4.4 Research instruments

The methodology of this research is mixed method based on qualitative and quantitative analyses. Quantitative analyses have been defined as explaining situations by collecting numerical data that are analysed using mathematically based methods (Aliaga & Gunderson, 2000). Qualitative research has been defined as analysing subjective opinions of social constructions of issues, experiences or usages by collecting non-standardized data (Flick, 2009). However, the first steps of this research are based on literature review of academic peer-reviewed articles and policy reports. The remaining part of data collection is derived from primary data through conducting surveys and interviews on the project locations.

The study was conducted in May 2017 and a total of 21 workers and 4 management employees participated in the research (**Table 4**). All workers that participated were asked to fill in a questionnaire. When respondents lacked reading or writing skills, the survey was conducted as an interview in which the interviewer noted the answers. After the survey, they were invited to answer some semi-structured interview questions, based on their answers in the questionnaire. This was important to understand why they had these opinions and how strong they were. The management employees were asked to answer questions during the project visits. The sample size varied between the project locations due to differences in the total number of workers in each project and the accessibility of them.

TABLE 4 DISTRIBUTION RESPONDENTS

Province	*# management employees*	*# workers part of research*
Panamá	1	3
Chiriquí – Finca	1	4
Chiriquí – Nursery		3
Chiriquí – Wood processing	1	5
Bocas del Toro	1	5
Veraguas		1

The questionnaire for workers consisted of 34 questions covering indicators of human, physical and financial capital and indicators on changes, roles and contributions of the project in relation to the environment **(Annex 1)**. Indicators of change are referring to the time before the respondent started working in the project (in personal related questions) or to the time before the project was present in the region (in environmental related questions). From all the questions, 22 are consisting a five point Likert scale for asking whether and to what extent the respondent agrees with the affirmation. The options are: *No, en absoluto* (Totally disagree, 1) - *Más bien no* (Disagree, 2) - *Ninguno* (Neutral, 3) - *Más bien sí* (Agree, 4) - *Sí, totalmente* (Totally agree, 5). The semi-structured interviews and observation notes are analysed through open coding and will help interpreting and give a better understanding of the survey results. To prevent falsely attributing positive or negative outcomes, the results will be supported by general trends in the region regarding reforestation and socioeconomic and welfare levels.

4.5 Limitations

Although the utmost care has been taken during the research process, some research limitations should be considered that could have consequences for the results. There is a chance that the evaluation of the influence of the project is biased because there was no random assignment of project locations and control areas. Assigning randomly was not feasible because workers were only present at a few *fincas* a day, dependent on the work that should be done at that location. Besides, one of the provinces in which project locations are, Darién, was hard to reach due to the remoteness and therefore not possible to visit. To obtain a valuable sample of the project, respondents in all other provinces have been asked to participate in the research. However, the disadvantage of convenience sampling is that the sample is probably not representative of the entire population which has consequences for the external validity. Furthermore, a limitation of this research is that there were

less employees present at the locations than expected, which resulted in less conducted surveys and interviews with respondents than was aimed beforehand. Although respondents were asked to take part in the research individually and could talk openly, some workers had some difficulties with answering the questions extensively. Although this could raise concerns about the validity, the researcher posed additional questions to obtain a more in depth answer.

The protection of a forest in one place can induce deforestation spill overs to neighbouring forests. Therefore, there is a risk that the environmental project impacts are overestimated. Project impacts may result from the location, rather than the project itself because most protected forests are located on lands that are (on average) less accessible and of lower agricultural productivity (Andam, Ferraro, Pfaff, Sanchez-Azofeifa & Robalino, 2008). In the ideal situation, data should have been collected on randomly selected and non-selected forests and forest users, before, after and during project implementation. By being highly transparent throughout the process and conducting consistent measurements, reliability of the research is considered. Finally, one limitation of this research is that the researcher is not a native Spanish speaker which could mean that from some interviews the researcher would probably have got more information if she was more fluent in the local language.

4.6 Ethics

All types of research that involve people could pose risks to those people. Therefore, this research process ensured the participant's dignity and privacy. Confidentiality is important and has been protected by not identifying participants by name in any part of the report. Participating to this research should not negative implications for the participants. Furthermore, local needs or concerns have been considered and knowledge and traditions of directly involved people have been respected during the research. As far as the researcher knows, none of the respondents experienced negative consequences as result of participating in this research. All participants have received an informed consent to ensure that they were well informed about the study. Furthermore, the findings of this research will be shared with ForestFinance.

5 Findings

5.1 General information

The majority of the workers that participated in the research were men, only three women took part. This is representative for all people working in the project, since most workers are men. When asking management employees why there is such an imbalance, one of the female management employees mention that the work on the field is physically heavy and that women don't want to do these tasks: *"We give women the chance, but many women don't want to work in the field. In Chiriquí, many women are caring for the children at home and prepare food. It is equal and possible to work here for women"* (Management employee). Remarkable is that the vast majority of employees in administrative and management functions are women. However, if there are job opportunities available everyone from the community can apply for the functions.

The average age of respondents was 41 (*M=41*), of which the youngest participant was 25 and the oldest 63. They all mention that they live in villages or communities in the surroundings of the project. For instance, seven out of twelve respondents in Chiriquí live in Santa Cruz, the neighbourhood where the tree nursery and wood processing factory are situated. However, one of the workers with an indigenous background mentions that he lives in Santa Cruz only during the week: *"In the weekends I go to the Comarca, to my family" (*Respondent 4). When asking how long they live in the town they live now, more than halve of the respondents answered that they have lived there all their life. This is important to know since it indicates that people working in the project are the local inhabitants, which could indicate that the project could be beneficial for local development. Only a few respondents work less than one year in the project, the vast majority has started working in the project one to five years ago **(Figure 5)**.

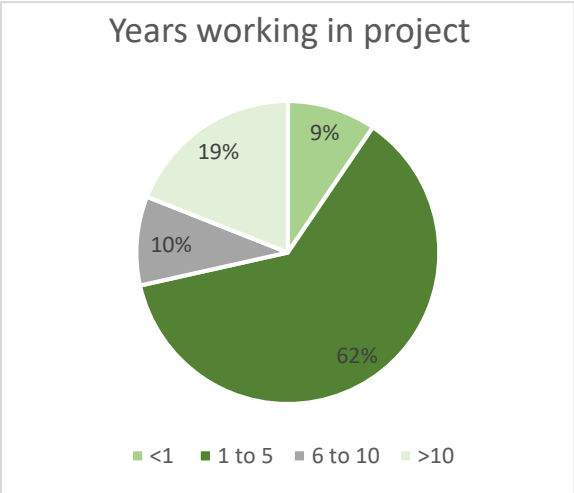

FIGURE 6 NUMBER OF YEARS WORKING IN PROJECT

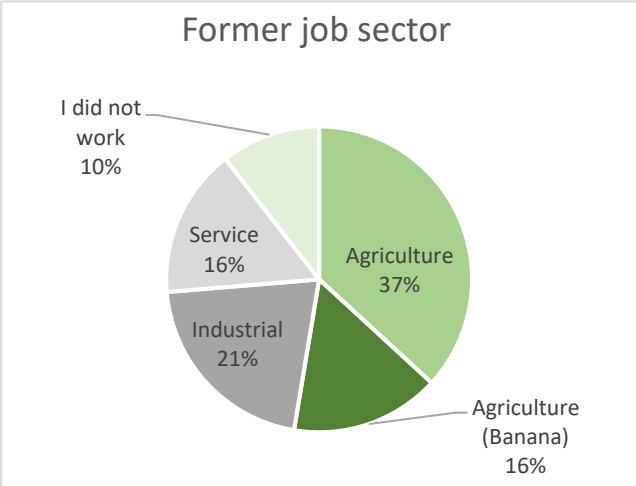

FIGURE 5 FORMER JOB SECTOR

Before the respondents started working in the project, they performed a variety of jobs. The majority worked in the agricultural sector, some workers worked in the industrial sector (construction services) and others in the service sector (supermarket, shop or housekeeper) **(Figure 6).** It is remarkable that three out of five respondents in the Bocas del Toro region worked on the extensive banana plantations of Changuinola. Most of the workers indicate that the work they do now has more quality than the work they did before working in the project (*M=4.5).* However, one of the respondents indicates that: *"…the work I do has more or less the same quality. Before I worked in the construction services"* (Respondent 14).

Until now, the project has created in total around 150 permanent functions in a variety of jobs dependent on the location **(Figure 7).** Employees have the possibility to develop themselves and change functions within the project. One of the workers explained that she first worked in the tree nursery and now is being trained to work in the wood processing centre. A respondent from the tree nursery indicated that the number of people working in the tree nursery varies and depends on the amount of work at that moment. If there is a lot of work in the tree nursery, workers from the field will be trained to work there as well. However, it is unclear how large the chances are on making promotions to higher functions. Remarkable is that respondents have a unanimous opinion about whether they think that the environment is important, the vast majority totally agrees with this statement (*M=4.86*).

Los campos

The work in the field is physically heavy. Workers equipped with machetes and protective clothing clean the paths between the planted trees or chop and collect seeds of trees that will be replanted in the tree nursery. At all *fincas* in every region of the project, this is part of the daily activities. The majority of all employees work in the field.

Los Viveros

On the tree nursery in San Felix (Chiriquí) workers are responsible for different activities in the first stage of the tree planting process. First, someone takes out seeds from the seed pods and select them on quality. After this, seeds are pushed into moist peat. At this moment, most of the growing pots are meant for the *fincas* in Darién. Once the plants are twenty centimeter in height, they will be transferred to the destinations.

El Centro de Madera

In the wood processing center in San Felix (Chiriquí), twelve people are performing different tasks in the production process of timber. Ten employees are educated in the project, and two experienced employees train them. They are currently producing prototypes of furniture, boxes for selling chocolate from the project and special requests from private clients or the local school. Almost all of the equipment and machines in the wood processing center is new and of professional quality.

Las fincas del Cacao

On the cacao *fincas* in Almirante (Bocas del Toro), three species of cacao trees and a mix of other trees in between and around them have been planted. There is a small-scale cacao tree nursery on location. Here, the production process of cacao takes place till the stage of transportation to a chocolate factory. The whole year round, workers harvest ripe cacao pods. After this beans are fermented and spread out to dry. When the beans are dry, they are selected by size and put in large sacks for transportation to the chocholate factory.

FIGURE 7 PROJECT JOBS (SOURCE PICTURES: WRITER'S OWN MATERIAL)

5.2 Indicators for local development

5.2.1 Human capital

To indicate the human capital of workers in the project has been looked at degrees of education and training and whether there is (equitable) access to information and technology between workers. More than half of the respondents has only followed primary education, and only one of the workers has a university grade **(Figure 8)**. One of the management employees explains that some of the indigenous workers can barely read and write: *"Many indigenous people cannot read or write because they do not go to school when they are young, primarily because the school was too far away from the community"* (Management employee). When asking if the project provides education for these people, one of the management employees explains that there is a teacher in the project, especially for them: *"The project has teachers, three in Bocas del Monte and one in Las Lajas. They are here for ten years, but not every day. It is just for the basics"* (Management employee).

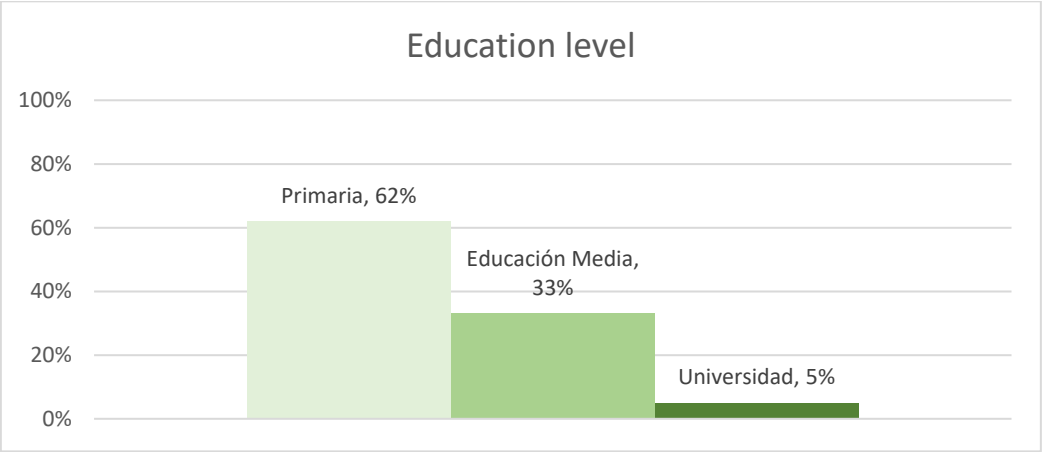

FIGURE 8 EDUCATION LEVEL

Although the larger part of the respondents only followed primary school, for all workers learning is important (*M=4.8*). The majority indicates that the project teaches them about sustainable forms of agriculture and silviculture, though there are also workers that do not feel that they learn about these topics (*M=3.95*). As one of the respondents that work in the wood processing factory explained: *"I don't learn about sustainable agriculture, I only work in the Centro de la Madera. I learn about the machines, wood, and safety is very important as well"* (Respondent 14). The people that indicated that they learn about sustainable agriculture, also pointed out that they nowadays have more knowledge about the topic than before working in the project (*M=4.05*). Besides, the majority of the respondents think that the project teaches them to take leadership (*M=4.33*). When asking what they specifically learn in the project, the answers are very diverse and mostly corresponding with their function and tasks. Planting trees, "cleaning" the paths in the forest, and build a well for water are mentioned by

workers that have a maintenance job in the forests. One of the workers indicates that he learns more than the maintenance tasks: *"I learn to work in a team, several things about managing a plantation, disinfection products and managing and learning about guest visits"* (Respondent 21). Working with machines and techniques for wood processing and constructing furniture has been mentioned by respondents working in the wood centre. Respondents working in the cacao fields in Bocas del Toro mainly refer to learning tasks as harvesting, security and *"everything about cacao"* (Respondent 19).

When asking about whether respondents have access to information they need for working in the project, half of the workers totally agree in having enough access to information (*M=4.32*). Almost all workers explain that there is always someone from ForestFinance available for questions, and others also indicate additional sources of information: *"I am learning from books, how to manage these machines, and there is someone from ForestFinance"* (Respondent 14). However, respondents that are less satisfied indicate that they would like to have more information about their work, but found it hard to explain what exactly. Opinions are more divided when asking about access to technologies (*M=4.0)*. One of the workers indicates that he needs different tools: *"I need better materials for doing a better job"* (Respondent 18). At all project locations, there is a central point where employees could obtain information about the location specific sustainable working methods, safety and the values of Forest Finance **(Figure 9)**. Therefore, at any moment there is information available for employees of the project and visitors.

FIGURE 9 INFORMATION POINT (SOURCE: WRITER'S OWN MATERIAL)

5.2.2 Physical capital

For physical capital is assessed what shelter and household possessions, access to means of transportation and local infrastructure workers have, and to what extent there is equitable access to physical assets among household members. Although more than two-third of the workers mention that they have improved their house because they work in the project, there are also a few that don't agree with that (*M=4.14*). The majority that has improved their house bought new furniture or accessories. However, they all mention that the project does not directly help with improving houses, but that their increased income caused this development: "*The project does not help with my house, the money does*" (Respondent 18). Respondents that were not able to improve their house gave reasons as not sufficient time or enough money. However, one of the workers indicates that even without an enhanced house, he experienced improvements: *"The house remained the same, but I have an improved life quality because I earn a bit more"* (Respondent 12). According to a few respondents, the project did directly contribute to the small school in the community next to the project: *"They provided the oven, cooking utensils and tables for the children's lunch"* (Respondent 3).

When specifying on improved access to drinking water and sanitation facilities, even more respondents totally disagree (*M=3.95*). Some workers explain that the project did not improved their access because it is the responsibility of the state, others have improved access to sanitation facilities themselves because of their higher earnings: "*The project has improved my sanitation by increasing my income*" (Respondent 16). However, one of the respondents mentions that the water quality indirectly could have been improved: "*I do not have problems with water, it is the same as before. But because of the project, the watershed and groundwater levels are perhaps improved"* (Respondent 21) **(See also: section 5.3.2).** On the statement if there is improved access to clean and affordable energy services because of the project, the answers are even more varied (*M=3.77*). Respondents that disagreed with the statement gave the explanation that the state is responsible for these developments as well, which means that improvements have not been made by the project: "*More than ten years ago, electricity came here. But it is something from the government, the project did not contribute to that"* (Respondent 21).

Half of the respondents indicate that they totally have improved means of transportation since they work in the project, while there are also workers that absolutely do not have improved means of transport (*M=4.0*). Workers that have improved means of transportation mention that they first had to walk and now can make use of the business transportation truck. Every employee can make use of business' transportation trucks. Next to one of the project locations in the province Panamá, which is a very remote area, a small (partly indigenous) community can make use of the business transportation car when the management employee drives to the nearby town. Some workers have got a bicycle to

easily move from their house to the project locations or between project locations. In general, many workers live in the surroundings of the project, which results in that the majority goes to work by foot. The answers on whether infrastructure has been improved because of the project do also differ, while half of the respondents totally agree on this, a quarter of the workers totally disagree (*M=3.75*). This is remarkable, because one of the management employees confirms that this is not one of the activities of the project: *"Infrastructure is the responsibility of the government on national level"* (Management employee, date).

5.2.3 Financial capital

Besides income level and household savings, has been assessed whether they have a regularized income, income diversification and a safety net to indicate the financial capital of workers. The vast majority of workers mention that they have a permanent contract, only two workers (both in Bocas del Toro) indicated that they have a temporary job. The organization can offer many permanent jobs because activities as maintenance work and planting cacao has to be done the whole year round. However, mainly in the first years of the project the organization had multiple temporary workers for initially planting a large number of trees. One of the workers in Veraguas mentioned that in his region, many people from the community temporarily worked in the project to plant the first trees: "*Before, there were many people from the town working here, now it is reduced"* (Respondent 21). Workers in the field do their job on all different *fincas* in the region or if extra hands are needed in another province as well. However, employees of the tree nursery and wood processing centre only work on those locations. These jobs require special education and training, which makes it impossible to alternate between functions.

The working hours within the organization are fixed: all respondents said that they work between six and eight hours a day, starting at 07.00 AM and finishing at 03.00 PM or 04.00 PM. Besides, all employees indicate that they have a health insurance (*M=4.81*).

All employees are being paid on a weekly basis and almost all respondents indicate that they earn the same amount of money the whole year round (*M=4.48*). As one of the workers explains: *"The whole year round it is equal, but my income has increased in the past ten years"* (Respondent 21). Workers like to receive income on a weekly basis: "*I do not want to get income per month, per week gives us more advantages. We cannot spend all the money in one time"* (Respondent 11). The workers' income is higher than the minimum wage in Panama, and varies between functions. Several amounts of income have been mentioned, $500 a month on average. Except for one respondent, everyone indicated that because of working in the project their income has changed (*M=4.38*). Most workers stated that their income increased with 50% since they work in the project, and some indicate that it has risen with 25% or 100%. One of the respondents explains why his income remained the same:

"*Before I worked in the construction services, this was an informal job. Now I have a formal job, therefore my income is more or less the same"* (Respondent 15).

When asking if workers can save a certain amount of their income, the answers vary. Some workers totally agree and mention that they always were able to save money, while others indicate that they are not able to save an amount from their income (*M=3.95*). One of the respondents explains that he cannot save money because living expenses In Panama are high: "*We cannot save money. Panama is expensive, food for children is important and we do not have a very large income*" (Respondent 3). According to the workers, increased income also has an impact on other expenses. The vast majority indicates that their children are able to go to higher education because they work in the project (*M=4.42*). One of the workers explains that this expense is one of the reasons that he cannot save money anymore: "*Now I can save less than before, because my daughter studies biology on the university in Santiago"* (Respondent 21). Remarkable is that the respondents' satisfaction about income varies substantially (*M=3.61*) **(Figure 10)**.

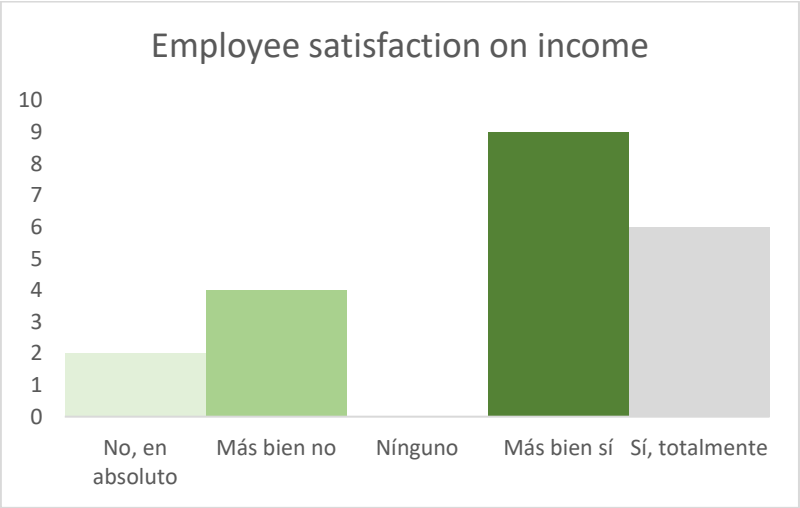

FIGURE 10 EMPLOYEE SATISFACTION ON INCOME

To define the degree of income diversification has been asked if the workers have other sources of income. The larger part only derives income from the project. When asking if other people in their household have a job, most men answer that their wife cares for the children which means that the whole household is dependent on the income from the project. One of the women indicated that she lives with her mother and child, and that she only has additional income in the form of alimentation. Only a few respondents indicated that they have additional income: *"I sell chicken at home"* (Respondent 13) and "*I have my own wood processing machine, which is my additional income"* (Respondent 12).

5.2.4 Differences between project areas

Below, the most noticeable differences in answers between the project regions will be mentioned.

It is remarkable that four of the five respondents from the wood processing centre have followed higher education in relation to the majority of the respondents that only followed primary school. An explanation for this could be that the work in the centre requires a more difficult training than the work in other functions of the project. In the Panamá region, respondents do not think that they learn about sustainable agriculture from the project, while in other regions respondents agree or totally agree in learning about it. This could denote a different impact of awareness on sustainability issues in this area. The Panamá region also differs in opinion about whether children could go to higher education because of the project; they all do not agree on this. This is probably due to the remote location of the visited *fincas* in Panamá. The respondents in Bocas del Toro, Veraguas and of the fields in Chiriquí score higher on whether they have improved their house because of the project than the others. This is in line with the result that respondents from the wood processing centre in Chiriquí score notably lower on whether they have improved access to drinking water and sanitation facilities and clean energy services because of the project. The difference could probably be explained by the result that all the respondents that indicated having an extra source of income are working in the wood processing centre. Therefore, the income derived from the project is not necessarily the means for improving their shelter and household possessions. Respondents from the tree nursery in Chiriquí argue less frequently that they earn the same money the whole year round. This corresponds with the explanation of one of the nursery-workers that on top of their salary, they sometimes earn a variable reward. Respondents of the fields in Chiriquí are relatively more satisfied with their income than respondents working in the other regions and activities, though the majority of the respondents agreed on the statement.

5.2.5 Contribution to surrounding communities

Besides the effects on individual and household level, the project has also a direct or indirect influence on the surrounding communities. Directly because almost all employees of the different project locations live in the neighbourhood of the project, which indicates that the majority is part of the surrounding community. Besides, the project gives in some locations extra support to the community by providing transportation (Panamá) or contribute to the local school through supplying for example furniture.

Respondents have been asked to give their opinion about the project in general. All the respondents indicated that they like the project or believe that it is good to have it in their community. Often, workers gave a positive answer related to better education or higher income. As one of the respondents indicated: *"I like it really much, many young men work in the project and get education.*

Without they would not have income, it brings opportunity." (Respondent 11). Others mention the benefits of the project for the community at first: "*It is a good project, it helps the community as well: for instance the school with furniture made from our timber"* (Respondent 12). One of the respondents links the employment opportunities with the development of the community: "*The project contributes to the community because mainly local people work here. It helps to give our people another job"* (Respondent 15). Although the most people are contented with the project in the surroundings of their community, one of the respondents mentioned that there are people in his community that are less satisfied: "*There are some people that prefer not to have the project here, but they are old people that prefer to see the livestock here instead of forestry"* (Respondent 21). He explains that these are only a few people that want to keep the landscape as it was in the last decades.

Through the agroforestry and sustainable timber harvesting activities in the project, Forest Finance also indirectly creates work somewhere else in the supply chain of timber and cacao. At this moment, the cacao is being produced to chocolate at one factory in Panamá. Because the production of furniture in the wood processing centre of the project is in a pilot-phase, the majority of the timber yield is now being sold to different (international) customers in the manufacturing industry. However, one of the management employees aims that in the future, the larger part will remain in Panama resulting in a larger effect on local development in the supply chain.

5.2.6 Local consultation activities of the project

In 2014, the project has carried out three "local stakeholder consultations" as part of their application of new project locations in Veraguas, Chiriquí and Darién for the Gold Standard label. This is an example of how the project involves the local community in the project development. The stakeholder consultations consisted of assessing twelve indicators regarding environment, social development, and economic and technical development; a reflection session on the answers in order to enquire how these potential negative impacts can be mitigated, and a closure with evaluation forms for giving comments on to what extent and why they like the project. A variety of regional, national and international stakeholders have been invited to join the different consultations. Local inhabitants, former land owners, representatives of the municipality and experts from universities joined the stakeholder consultation.

For the indicator assessment, local stakeholders were asked to mark whether they perceive the project scores negative (-1), neutral (0) or positive (+1) on this topic. Neutral implies that the project does neither improve or hinder the sustainable development. However, these topics are quite broad and hard to assess without sufficient knowledge on the subject: 1) air quality, 2) water quality and quantity, 3) soil condition, 4) other pollutants, 5) biodiversity, 6) quality of employment, 7) livelihood of the poor, 8) access to affordable and clean energy services, 9) human and institutional capacity, 10)

quantitative employment and income generation, 11) access to investment, and 12) technology transfer and technological self-reliance. The questions on the evaluation form "What do you like about the project?" and "What would you like to see that the project does for the community?" give more space for providing individual opinions.

The first consultation was in Veraguas, in which four local stakeholders participated. They have given a positive score to almost all indicators, except for one of them who gave a negative score to the economic and technical development indicators (10, 11 and 12). Another exception is the indicator on pollutants (4), which is indicated on neutral by two of the stakeholders. On the first evaluation question, the neighbours of the project in Veraguas have answered "*reforestation*" or "*planting trees*". On the second question, the answers are more varied: "*The conservation of endangered species*", "*a donation for the school, for the community"*, "*managing and maintenance of the roads*" and "*that they support the school".* The second stakeholder consultation was in Chiriquí, in which eight stakeholders participated. The majority has given a positive score to all indicators, except for "other pollutants" and "access to affordable and clean energy services" which were indicated as neutral. In the reflection session, the mitigation measure brought up for pollutants was the use of organic fertilizers, and the measure for clean energy services was the maintenance of roads for easy access to governmental energy installations. The stakeholders mentioned four topics that according to them are important subjects to act on by the project: the protection of endangered species, mitigation to climate change, sustainable wood and safe employment. In Darién, the third stakeholder consultation took place with four local stakeholders. They majority has given a positive score to air quality, water quality and quantity and quality of employment. On livelihood of the poor and access to investment, the most frequently chosen score was neutral. The score of the remaining indicators varied between the three options and therefore do not give an unambiguous answer. On the first evaluation question, the stakeholders have indicated positive effects on the employees and the environment: "*That you improve quality of life from employees*", "*Contribution to the environment*", "*That you offer openly work to the community" and "The possibility for more people, the whole community, the responsibility and delivery. The project is important and recognizes the added value of the plantations."* On the second question, the answers are focused on more engaging and supporting the community: "*more coaching about the projects and benefits you give for the population*", "*more direct communication with the community", "that you will give more support to the community and more benefits to your employees"* and *"The development of extension programs, as close as possible for the environment, about the natural resources, together with the schools, the development of research with universities."*

Comparing the results of the local stakeholder consultation with the primary results of this research, the environmental indicators are still perceived as very positive. However, the results of the local

stakeholder consultation show that stakeholders would like to see more engagement and support to the local community. The results of this research indicate that the employees that are part of the local communities are satisfied with the contribution of the project to the community.

5.3 Environmental indicators

5.3.1 Local species and population

To assess the local species and population level, there has been evaluated to what extent there were changes in population size and population structure. Except for one respondent, all workers indicated that the number of trees in the region increased since the project is there (*M=4.71*). Not all parcels of the project are used for sustainable timber production, some parcels are solely for nature conservation or carbon sequestration purposes. Even on those parcels used for timber production, not all trees are for harvesting. To make clear which trees are for timber, the selected ones are marked by a red circle or number. In the nature conservation and carbon sequestration areas, you will not find exotic species such as teak that are especially valuable for timber. Only native tree species has been and will be planted: Amarillo (*Terminalia amazonia*), Cedro espino (*Bombacopsis quinata*), Almendro (*Dipteryx oleifera*), Caoba (*Swietenia macrophylla*), Cocobolo (*Dalbergia retusa*), Zorro (*Astronium graveolens*) y Zapatero (*Hyeronima alchorneoides*). However, since teak is a popular specie for timber, it contains 38-40% of the total surface for sustainable timber production (ForestFinance, 2016). The management system differs not only on tree species, the maintenance process is also different. The conditions should be optimal for carbon sequestration which means that trees should be able to create as much biomass as possible. Large leaves and a wide crown result in high carbon sequestration potential. In the areas that are solely for nature conservation and carbon sequestration, there is especially space for natural growth of vegetation. However, this also takes place in parcels in which timber is harvested. One of the management employees explained that natural regeneration exists because seedlings disperse by wind and animals: "*One important aspect is the natural regrowth of new trees. Trees that we planted lose and spread their seeds that grow somewhere else up to new trees. Because of the climate, some tree species grow really fast. In only two years there is something new that you can call a tree!"* (Management employee).

Several *fincas* of ForestFinance also have to deal with dominant grass species that have been planted for cattle. Even after 15 years it is still present between the trees, as explained during a field visit at *Finca Rio 3*: *"These grass species do not belong in the jungle, they are hard to control and remain present because it is a strong specie"* (Management employee).

One of the daily tasks of workers on the *fincas* is cleaning the paths between the planted trees to create room for the trees. One of the management employees indicates that this is of importance for

both carbon sequestration activities and timber production; trees grow better with space and without an abundance of shadow. Although these measures do not seem to be beneficial for natural regeneration and biodiversity, the business model of ForestFinance requires timber yields and measurable trees for carbon credits. Because of the high demand and the relatively fast growing process, teak is the most harvested tree species. Native species as Cedra Espina or Cocobolo are less suitable because those species take thirty or forty years to reach maturity.

On the cacao fields in Bocas del Toro, the landscape is characterized by hills surrounded by cacao trees, plantain trees and native tree species that provide shadow. Shade trees are able to lower air temperatures around the plant and protect the soil against erosion from heavy rainfalls. To prevent risks of monoculture, three types of cacao have been planted next to each other. Some cacao trees thrive better in sunny circumstances while others give more fruits on shady positions. One of the management employees explains to me that location of the cacao tree sometimes requires different management: "*In general, more light means more production and less light means more caring*" (Management employee). The three types of cacao differ in colour and taste, but will be mixed in the fermentation process. Because of its sustainable management method characterized by for example planting shade trees and multiple cacao species, the cacao from this project has obtained an UTZ certified standard.

5.3.2 Regional landscape

By assessing the role of the project as a reservoir of forest species, as biodiversity corridor and on erosion control and hydrology, the effect on the regional landscape has been estimated. The project aims to plant a variety of tree species to create a mixed forest (*see chapter: 5.3.1*). Observations on many different *fincas* have proven that on most parcels different tree species have been planted next to each other. However, there is not one large reforested area in all situations. Mainly in Chiriquí, the *fincas* are scattered over the region **(Figure 11)**. Although some parcels are bordered, the newly planted forests are all still surrounded by cattle land. There is a clear diversion between the cattle land and forests, because every parcel has a fence around it. One of the management employees explains that there is a fence to prevent that escaped cattle enters the forests: *"Quite frequently cattle escapes here, the fence keeps the cows and undesired guests outside"* (Management employee).

FIGURE 11 PROJECT LOCATIONS IN CHIRIQUI (SOURCE: FORESTFINANCE, 2016).

The reforested *fincas* do not only absorb carbon dioxide from the atmosphere, they also serve as bridges for animals seeking new habitats. When asking if animals return in the area as result of the project, all respondents indicate that bird and wildlife species return (*M=4.66).* Workers mention that they frequently see monkeys and many different bird species, and one of them even observed an ocelot once. When asking if the returning animals have negative effects for neighbouring farmers or communities, one of the management employees said that she does not know incidents with cattle, but confirms that the return of predators is an indirect effect of reforestation. Only once, a worker in Veraguas mentioned that he does not frequently observes animals. However, that location is unique in its management system, because multiple parcels are used only for producing timber. It looks more like a plantation than a forest: four different tree species have been planted in blocks on one parcel. The returning animals show that the project locations are used as a biodiversity corridor. However, in most cases the *fincas* are not contiguous and therefore animals still have to pass over cattle land which is in between **(Figure 12)**. When asking why some of those in between parcels are not bought by the project, one of the management employees explains that this is the choice of the owner: "*The land owner does not want to sell the land. No land is no property and no food"* (Management employee). She indicates that at this moment the cattle have more value than selling the land.

Additionally, reforestation fulfils important ecosystem functions for protecting water and controlling erosion. These functions are not only beneficial for the environment, they also contribute to the natural capital of local communities and individuals. Most of the respondents indicate that the quality of the soil has improved because of the project (*M=4.*33). The project deals with the limitation of low soil nutrient availability by initially planting one species that thrives well in these circumstances and improves the soil quality. After ten years when the circumstances are better, they start planting other species to create a mixed forest. One of the management employees mentioned that the recovery of the watershed functions is one of the other additional advantages of the project: *"It is an indirect advantage for surrounding farms and communities. On the long term, they could experience benefits of more and better water from the wells"* (Management employee). This is confirmed by one of the workers in Veraguas: "*I have no problems with water, but I think that through the project the watershed and well have been improved*" (Respondent 21). In the tree nursery, watering the young plants only occurs in the dry season. However, according to one of the management employees, it does not compete with the water needs of the community because it is only a small quantity of water. None of the respondents have mentioned water access problems.

FIGURE 12 FINCA LOS RÍOS 1 AND 2 (SOURCE: FORESTFINANCE, 2010)

5.3.3 Global

Although the total reforested area of the project is a fraction of the whole deforested and degraded land in Panama and the world, the project activities contribute to endangered species conservation by creating biodiversity corridors and to conservation of rare ecosystems by reforesting and conserving dry tropical forests. In 2014, already more than 800 hectares of the project (25% of the total project area) was conservation area in which no agroforestry or sustainable timber activities take place (ForestFinance, 2014). As one of the management employees explained about endangered species: *"Already fifteen threatened animal species from the Red List have been signalized in our areas"* (Management employee). Tropical dry forests are one of the most threatened tropical ecosystems in Panama and the world, the project attempts to recover this ecosystem in the Chiriquí province.

5.3.4 Differences between project areas

Because the projects of ForestFinance are located in different ecosystems in Panama and consist different activities, there are a variety of differences between project areas. The *fincas* in Bocas del Toro are only suitable for cacao agroforestry activities because of the favourable climate, and therefore require a different management system than in the areas for sustainable timber production. The management of the areas that are especially for carbon sequestration and conservation are obviously different from the aforementioned systems as well. The variety of management systems could result in different (degrees of) environmental co-benefits such as providing a reservoir of forest species or in their role as biodiversity corridor. The *fincas* in areas that are primarily to produce sustainable timber or recently have been replanted with one species to recover soil circumstances, are probably less beneficial for biodiversity than the carbon sequestration and conservation *fincas* that consist of a variety of native tree species and leave room for natural regeneration of trees. The calculation of carbon that has been sequestered by the trees varies between regions as well. The amount of carbon that a tree can store depends on the species, the division above-ground and belowground biomass and soil type. One species grows better in certain climate conditions than others.

5.4 Uncertainties of the carbon sequestration activities

It is hard to claim the "additionality" that reforestation would not have happened in absence of the project, since it is based on predictions. To require for a Gold Standard certification, the proposed area for carbon sequestration should always be abandoned or pasture land. In the business-as-usual scenario, the *fincas* of the project would probably still have been cattle land or abandoned fields. The chances of natural regeneration on abandoned fields are small, since soils have become infertile and native trees are not present in large numbers anymore to spread their seeds. Besides, the chance of reforestation activities by the local population or the Panamanian government is small because of the

lack of financial resources and absence governmental activities of transitioning private abandoned land to forests.

To prevent the risks of "leakage" that due to activities in one project location, deforestation or an increase in emissions will be displaced to another location outside the project area, the project uses an interview method as evidence. One of the management employees explained this procedure: *"We interview the former owners and ask what they do for job nowadays. If the owner is not traceable anymore, we approach the neighbours for obtaining information".* This method is used to guarantee that the former owner does not deforest an area somewhere else to start a cattle farm. However, the project does not encompass a larger geographic area than their own project locations for determining a baseline and monitoring of potential carbon sequestration and deforestation.

The issue of "permanence" refers to potential threats to carbon sinks from natural disturbances or human intervention. ForestFinance is the landowner of all the *fincas*, which implies that they are in principle not dependent on other desires for deciding what will happen with the areas in the future. In addition to this, the overall management system of the project of planting mixed-species on all *fincas* reduces the risk of damage from pests and disease, which will reduce the risks of permanence. Besides that, the project has a crediting period of thirty years which indicates that in the coming decades the forests will be remained. Not all trees planted by the project count for the total carbon sequestration, only the parcels that are especially for this purpose are included. However, the trees planted for other activities, and trees that grow through natural regeneration do also take up carbon from the atmosphere. Therefore, the project has a large buffer in case of disturbances in the parcel for carbon sequestration. Although the project covered the permanence issue quite well, there are still uncertainties in the long term. Unexpected natural disturbances and future hazards of climate change will always be a risk to the permanence of the carbon sequestration. Additionally, what will happen to the areas after thirty years? Or when ForestFinance sells the land to a party that does not have intentions of remaining the reforested *fincas*? When the tree will be chopped and burned, the net reduction of carbon in the atmosphere is not there anymore.

6 Discussion

Carbon offsetting projects are frequently criticized because they give "polluters" the ability to continue with emitting greenhouse gases and uncertainties exist about the real net emission reduction of such projects. However, critical theories on carbon offsetting such as the political ecology thinking and green grabbing also refer to potential harmful situations in which there is a restructuring of rules and authorities over the access, use and management of resources in which natural resources are released for private capital. In the case of the "CO2OL Tropical Mix Reforestation" project, the land was already in private hands; only the use and management has changed from pasture land to forests.

Since many inhabitants of local communities in the surroundings of the project locations are involved in the project, and the company aims at improving sustainable development, the sustainable livelihoods approach fits well to this forest carbon project by providing a framework to assess the contribution to livelihood sustainability made by existing activities. According to the sustainable livelihoods approach, the accumulation of human capital will only be achieved when people themselves are willing and able to invest in their own human capital by attending training sessions or schools (DFID, 1999). The respondents of this research have indicated that learning is important for them, and that they have learned a variety of skills from working in the project. Previous employment of respondents was in most cases informal, requiring no decent training, especially not on sustainability. Although some abilities are quite job-specific such as "maintaining the forest paths", other competences are useful for further development. These so-called transferable skills are defined as the ability to think and reason about new situation through using previous acquired knowledge (Dailey, Conroy, Shelley-Tolbert, 2001). Project education about sustainable agroforestry, sustainable silviculture and wood processing could deliver transferable skills that are crucial for the workforce: decision-making, communications and the ability of working within a group which corresponds to the answers of respondents. Besides, the project could be a source for transferring local learning about sustainable agriculture, agroforestry and silviculture to other communities. One of the feedbacks from the achievement of livelihood outcomes is that higher income is often reinvested in education, the results of this research confirm this fact because many respondents highlighted that their children could go to higher education because of the project. According to the sustainable livelihoods approach, participatory approaches of helping to provide access to appropriate infrastructure or service could build physical capital (DFID, 1999). Although the project does not directly improve energy or sanitation facilities, they could have given indirect support through stimulating transforming structures or processes with managing governments or institutions. Between 80 and 90% of the residents of Chiriquí, Veraguas and Panamá and between 70 and 80% in Bocas del Toro have access to electricity, water and sanitation (UNDP, 2015). The project does help to provide access to infrastructure such as

a business transportation truck or bicycle. One of the feedbacks from the achievement of livelihood outcomes is that increased income is often spent on shelter, and water and power supplies. This is confirmed by the results of this research, since the majority of the respondents indicated that their increased income resulted in making improvements to their house. According to the sustainable livelihoods approach, a more secure access to financial capital could be created by supporting the development of financial services organizations or institutional sustainability of financial services (DFID, 1999). The project supports a more secure access to financial capital by providing formal jobs including a stable income for people working in the project and arranging (health) insurances. Although the respondents of this research mentioned that their income is around $500 per month, the average income for Veraguas and Bocas del Toro is between 100 and 250 balboas (equal to dollars) a month and for Chiriquí and rural Panamá between 300 and 450 balboas a month (UNDP, 2015). One of the feedbacks from achievement of livelihood outcomes is that increased income raises the scope for saving, which has been confirmed by the respondents of this study. Although the project does not create many jobs in total, they are of high quality comparing to the general trend in Panama. At least 37.1% of the working population of Panama performs informal jobs and around 44.4% is not socially insured of which the clear majority (70.5%) works in rural areas (La Fundación del Trabajo, 2016). In addition, mainly in Chiriquí and Veraguas a large number of the working population has emigrated to Panamá in the last decade (UNDP, 2015). Although the company also indirectly creates work somewhere else in the supply chain of timber and cacao through the agroforestry and sustainable timber harvesting activities in the project, the main development generated by the project is through creating employment opportunities locally. However, knowledge transfer about sustainability and promotion of successful reforestation projects is one of the aspects as well.

In many historical cases of reforestation projects, land for large-scale plantations have been acquired by ignoring local land rights, inadequately compensating local communities or have resulted in involuntary resettlement of people (Smith & Scherr, 2003). Asquith, Vargas Ríos and Smith (2003) indicated in their analyses of the Noel Kempff Mercado Climate Action Project in Bolivia that forest carbon projects have great potential to sequester carbon, protect biodiversity and contribute to sustainable development of local communities at the same time. Although this project is a community reforestation project, one of the requirements for all projects aiming to contribute to the improvement of livelihoods is that the carbon project should be implemented with local stakeholder participation from the earliest stages of project development. In the Bolivian project, there were high risks of leakage because the local communities were not equally and sufficiently compensated for the project implemented in their livelihoods. Another livelihoods impact study of a forest carbon project has been conducted in Uganda and has even found adverse livelihood impacts such as destruction of crops,

housing and trading centres alongside the plantation activities. In this project, forestry plantations were privatized and have benefited only private investors (Lyons & Westoby, 2014). Although the last example fits perfectly in the "green grabbing" theory, the project of the current study has no similarities to this kind of cases. In the situation of the reforestation project in Panama, the land has already been converted to cattle land and privatized land decades ago. Because this transitions of deforestation and land tenure has already happened and land of the project is in private hands, there are no issues of local land rights, resource competition, compensation for local communities or resettlement of people.

The findings of the environmental indicators of this research bring forward that one of the priorities of the project is to plant a variety of tree species. In the parcels used for nature conservation or carbon sequestration purposes only native tree species have been planted. In these areas, there is room for natural regeneration as well. Jindal, Swallow and Kerr (2008) highlight the importance of planting mixed forest for new plantations, because by planting only one species, local biodiversity, native species and soils could be harmed. They mention in their study that through reforestation locally valued ecosystem services could be generated and biodiversity conserved, which points out the importance of the role of the project in being a reservoir of forest species, as biodiversity corridor and on erosion control and hydrology. To recover the eroded soil, first one type of tree species is being planted at some new *fincas* in this project. That this kind of management is beneficial for reforestation has been confirmed by Healey and Gara (2003), who indicate that plantations may jumpstart succession by at least improving soil conditions, increasing availability of nutrients and storing more organic material. When looking at reforestation activities in Panamá the past years, there have been multiple other reforestation initiatives varying in commercial, community, NGO and governmental projects. Although the exact numbers of reforested hectares are missing, the majority of the initiatives have been commercial ones (Ministerio del Ambiente, 2016).

The Gold Standard certification of the project should ensure that issues of additionality, leakage and permanence are covered. However, a measured regional baseline for forest emissions has not been made, while this could provide a basis for assuring permanence and minimizing leakage. The project's management system tries to prevent those uncertainties by for example purchasing the land and replanting more than the carbon-equivalent in other parcels of the project. This corresponds with Chomitz (2002) who states that by embedding enforcement in a broader legal structure for land use regulation, the expectation of permanence of sequestration of the system is reasonable. As also indicated by Olsson, Grönkvist, Lind & Yan (2015), mitigating the risk of non-permanence is possible by setting up insurances, crediting per year or replanting the carbon-equivalent forest in another place.

The current research has been conducted in one specific project that has their own values and management system, and is built on the investments of other individuals and businesses or organizations. Therefore, one should not generalize the results of this research to other forest carbon projects. However, it is interesting to compare the results with similar forest carbon projects or specifically Gold Standard certified forestry projects of which the core values on sustainable development should be slightly the same. Due to time limits, the remote location and accessibility of several project locations and the absence of workers working in the places that have been visited, only twenty-five employees participated in the research. Although this is a small sample which makes running statistical tests impossible, it is still about one sixth of the total number of employees working in the project.

To find impacts of a project or intervention, optimal research should have a before-and-after design with a pre-intervention measurement and a post-intervention measurement including a control group. However, in most cases this is too costly and time-consuming. In future projects, it should be useful to set up a pre-intervention research to establish a valuable baseline of social and environmental indicators. In future research, prospective evaluation should have the preference because in this case baseline data could be collected. Besides, it would be interesting to gain more knowledge on the broader community impacts of such a forest carbon project and to compare results with other projects.

This study has provided an overview of several direct and indirect influences on the people working for the project and living in the neighbourhood of it, as well as on the environment. It illustrates several impacts that a forest carbon project could have, next to the benefit of carbon sequestration by planting trees. The results could be useful for the project owner because it gives insight in impacts that have not been investigated until now, which could eventually lead to improvements for sustainable development in the management system. Organizations and businesses that are considering to invest in forest carbon projects could learn from this research that several influences and uncertainties go hand in hand with such a project.

7 Conclusion

The following question was central to this research:

> *To what extent has the forest carbon project "CO_2OL Tropical Mix Reforestation" in Panama influence on local development and the environment?*

The aim of this study was to contribute to the literature by conducting an exploratory impact study of a carbon offsetting project relating to forestry and to give a comprehensive evaluation of the social and environmental influence of this specific project.

To define the influence on local development, the human-, physical- and financial capital of directly involved people have been assessed. By providing basic education for (nearly) illiterate people, training about sustainable forms of agriculture and silviculture, and access to information about their work, the company contributes to the improvement of human capital of employees. Project education and experience in sustainable methods and personal development could deliver transferable skills that are crucial for the workforce: decision-making, communications and the ability of working within a group. By providing access to infrastructure such as a business transportation truck or bicycle the project helps a little to build physical capital. The project does not directly contribute to enhancing other services such as improved shelter, access to drinking and sanitation facilities or access to clean and affordable energy. It has a greater influence on the financial capital of employees: by offering permanent jobs with a stable income above the national minimum wage, and providing (health) insurance for all employees, the project supports a more secure access to financial capital. Since nearly all employees of the project live in villages in the surroundings of the project, the project has a direct influence on the local communities as well. Knowledge about sustainable agriculture, agroforestry and silviculture could be transferred to other communities. Additionally, feedbacks occur from the achievement of livelihood outcomes of employees such as that higher income is often reinvested in education; often spent on shelter and water and power supplies; and increases the scope for saving that in turn improve human-, physical- and financial capital.

To define the influence on the environment of the project in reducing carbon emissions, conserving forests and improving biodiversity and other ecosystem services, three scales have been assessed: local species and population, regional landscape and globally. For assessing the local species and population level, changes in size, distribution and population structure have been included. The number of trees in the region has been increased since the project, and in areas for nature conservation and carbon sequestration, there is especially space for natural growth of vegetation. Although the project has other activities such as harvesting timber, this is executed on a sustainable

way in which not all trees of the parcel are selected for harvesting. Besides, the project has a small-scale sustainable cacao production, in which risks of monoculture are being prevented by planting different species of cacao. For assessing the regional landscape has been looked at the role of the project as a reservoir of forest species, as biodiversity corridor and on erosion control and hydrology. On most parcels, eight different tree species (of which at least 60% native) have been planted to create a mixed forest which makes the project a reservoir of forest species. In parcels that are designated for carbon sequestration and nature conservation, only native tree species are being planted. One remark is that project locations are most frequently scattered over the regions, which results in not being one large forest. However, the reforested *fincas* serve as bridges for animals seeking new habitats because bird and wildlife species have been returned to the areas. Although real ground measurements not have been executed, according to the literature there is a large chance that the project fulfils important ecosystem functions for protecting water and controlling erosion. In addition, these functions also contribute to the natural capital of local communities and individuals. On the global level, the project activities contribute to endangered species conservation by creating biodiversity corridors and to conservation of rare ecosystems by reforesting and conserving dry tropical forests. The variety of management systems could result in different (degrees of) environmental co-benefits, but in general the project performs well on the different environmental indicators.

To define the uncertainties of the project, three main risks of the carbon sequestration component of the project have been assessed: additionality, leakage and permanence. The project could prove their additionality by always reforesting abandoned or pasture land. Besides, the natural and political circumstances show that the chance of reforestation in those areas in absence of the project would be small. The issue of leakage has been covered by an interview method with former owners or neighbours, although the project does not encompass a larger geographic area than their own project locations for determining a baseline. The risk of non-permanence has been covered because ForestFinance is the landowner of all the *fincas* which makes them independent, the overall management system relies on planting mixed-species what reduces the risk of damage from disease, the project has a crediting period of thirty years and it has a large buffer in case of disturbances in the parcel of carbon sequestration. However, unexpected natural disturbances and future hazards of climate change will always be a risk to the permanence of the carbon sequestration.

Although an increasing number of researchers suggest that carbon offsets are not an appropriate way to mitigate climate change because there is need for structural and behavioural changes, this project shows that the co-benefits deriving from carbon sequestration purposes could be useful for local development and sustaining the environment. Therefore, the conclusion is for this specific project that one should not speak of moving problems but of two-sided solutions.

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Appendices

1. Questionnaire

Parte I: el Cuestionario

Gracias por participar en esta investigación. Este cuestionario es parte de una investigación realizada por una estudiante de la Universidad Utrecht en Holanda. Está escribiendo una tesis para la Maestría en Desarrollo Sostenible en la mayor aerolínea holandesa. El objetivo de la investigación es aprender sobre los impactos ambientales y sociales del proyecto. El cuestionario le tomará alrededor de veinte minutos para completar. Su participación es voluntaria y anónima.

1. **¿Usted trabaja para el proyecto de reforestación?**

   ☐ Sí ☐ No

2. **¿Hace cuánto tiempo que empezó a trabajar para el proyecto?** ……

3. **¿En qué sector trabajó antes de trabajar para este proyecto?**

   ☐ Agricultura (incluida la silvicultura y pesquería) ☐ Industrial (construcción, manufactura)

   ☐ Turismo ☐ Otros servicios (comercio, educación, médico) ☐ Yo no trabajé

4. **¿Qué tipo de contrato de trabajo tiene?**

   ☐ Empleo temporal ☐ Empleo permanente ☐ Ocasional

5. **¿Cuál es su función en el proyecto?** ……

6. **¿Cuántas horas diarias trabaja usted en el proyecto?**

   ☐ 0-6 horas ☐ 6-8 horas ☐ Más de 8 horas

Eliga si y lo fuerte usted está de acuerdo en las siguientes afirmaciones:

	No, en absoluto	**Más bien no**	**Ninguno**	**Más bien sí**	**Sí, total-mente**
7. Mi trabajo en este proyecto tiene mayor calidad que el trabajo que he hecho antes de este proyecto					
8. El proyecto me enseña sobre la agricultura sostenible					
9. Tengo más conocimientos sobre la agricultura sostenible que antes de trabajar en el proyecto					
10. El proyecto me ha enseñado como tomar el liderazgo					
11. El aprendizaje es importante para mí					
12. Mis hijos pueden ir a universidad porque yo trabajo en este proyecto					
13. Tengo acceso a la informacíon que necesito					
14. Tengo acceso a las tecnologías que necesito					

15. Hemos podido mejorar nuestra hogar ya que trabajo en el proyecto					
16. Tenemos mejor acceso al agua potable y al saneamiento debido a el proyecto					
17. Tenemos mejor acceso a los servicios energéticos limpios y asequibles debido a el proyecto					
18. Hemos mejorado el medio de transporte ya que trabajo en el proyecto					
19. La infraestructura local ha mejorado debido al proyecto					
20. Gracias al hecho de trabajar en el proyecto mis ingresos han cambiado					
21. Todo el año gano la misma cantidad de dinero					
22. Puedo ahorrar una cierta cantidad de mis ingresos					
23. Estoy satisfecho con mis ingresos					
24. Estoy asegurado en caso de accidentes o enfermedades					
25. El número de árboles en esta región ha aumentado durante el proyecto					
26. Condiciones del suelo en esta región han mejorado debido al proyecto					
27. Especies silvestres y de aves regresan a esta región debido al proyecto					
28. La calidad del ambiente es importante para mí					

Preguntas personales

29. Sexo

☐ M ☐ F

30. Edad: ……

31. ¿Cuantos miembros tiene su hogar? ……

32. ¿Dónde vive usted? …….

33. ¿Desde hace cuantos años vive usted allí? ……

34. ¿Qué tipo de enseñanza siguió y aprobó?

☐ Primaria ☐ Educación Media ☐ Universidad ☐ No he ido a la escuela

Este es el final de la encuesta. Si tiene algún comentario sobre esta encuesta, por favor menciónelo aquí abajo.

2. Interview guide

Desarrollo humano
35. ***8-9-11*** → ¿Qué aprende usted en el proyecto? **36.** ***13-14*** → ¿Cuáles son sus fuentes de información? Piensa que usted puede obtener la información usted necesita? **37.** ***13-14*** → ¿Por qué (no) tiene acceso a información y tecnología? Y entre sus compañeros en el proyecto?
Desarrollo físico
38. ***15*** → ¿Qué en el proyecto ha causado que podía mejorar su casa? Qué ha mejorado en su casa? **39.** ***16*** → ¿Por qué (no) tiene mejor acceso a infraestructuras de agua y saneamiento debido a el proyecto? **40.** ***17*** → ¿Por qué (no) tiene mejor acceso a servicios de energía asequibles y limpios debido a el proyecto? **41.** ***18*** → ¿Qué tipo de transito usa actualmente? Y qué tipo antes?
Desarrollo económico
42. ***20*** → ¿Cuánto ha aumentado/disminuido sus ingresos? Por qué? ☐ 0-50% ☐ 50-100% ☐ Más que 100% **43.** ***21*** → ¿Cuándo gana más/menos? (en el año, el invierno, el verano) Por qué? **44.** ¿Qué otras fuentes de ingresos tiene? (y otras personas en su hogar?) **45.** ***22*** → ¿Siempre ha podido ahorrar dinero de sus ingresos? Por qué?
Final
46. ¿Qué opinión tiene sobre del proyecto? (en general)

3. Respondent list

1. Works in Panamá in the field, male, has the age of 63 and did primary education.
2. Works in Panamá in the field, male, has the age of 37 and did primary education.
3. Works in Panamá in the field, male, has the age of 42 and did primary education.
4. Works in Chiriquí in the field, male, has the age of 42 and did primary education.
5. Works in Chiriquí in the field, male, has the age of 25 and did primary education.
6. Works in Chiriquí in the field, male, has the age of 50 and did primary education.
7. Works in Chiriquí in the field, male, has the age of 29 and did secondary education.
8. Works in Chiriquí on the tree nursery, male, has the age of 42 and did primary education.
9. Works in Chiriquí on the tree nursery, has the age of 53 and did primary education.
10. Works in Chiriquí on the tree nursery, female, has the age of 40 and did secondary education.
11. Works in Chiriquí in the wood processing, female, has the age of 42 and did university.
12. Works in Chiriquí in the wood processing, male, has the age of 57 and did primary education.
13. Works in Chiriquí in the wood processing, male, has the age of 25 and did secondary education.
14. Works in Chiriquí in the wood processing, male, has the age of 26 and did secondary education.
15. Works in Chiriquí in the wood processing, male, has the age of 50 and did secondary education.
16. Works in Bocas del Toro in the cacao field, male, has the age of 49 and did primary education.
17. Works in Bocas del Toro in the cacao field, male, has the age of 39 and did primary education.
18. Works in Bocas del Toro in the cacao field, male, has the age of 38 and did primary education.
19. Works in Bocas del Toro in the cacao field, male, has the age of 38 and did primary education.
20. Works in Bocas del Toro in the cacao plant, female, has the age of 37 and did secondary education.
21. Works in Veraguas in the field, male, has the age of 47 and did secondary education.
22. Works in Panamá and other provinces in a technical management function.
23. Works in Chiriquí as Manager of the Forestry Department.
24. Works in Panamá and Chiriquí as Manager of Sustainable Timber production.
25. Works in Bocas del Toro as Manager of the Cacao production.

4. List of visited project sites

Finca	**Region**	**Size**	**Planting year**
Mamoní 2	Panamá	?	2015
Mamoní 1	Panamá	95.96	2013
Madera Fina	Chiriquí	24.52	1995
Pampanillo	Chiriquí	27.69	1997
El Espejo	Chiriquí	19.27	2004
Santa Cruz 2	Chiriquí	92.74	2012
Los Ríos 1	Chiriquí	16.50	1999
Los Ríos 3	Chiriquí	24.09	1999
Los Monos 3	Chiriquí	54.90	2000
El Catival	Chiriquí	41.46	2003
Quebrada Limón	Bocas del Toro	72.94	2010
Las Canas	Veraguas	44.19	2005