Environmental Attitudes and Behaviour in Tropical Community Forests

A case study of Gola Rainforest National Park, Sierra Leone

MSc Thesis Development Economics (DEC-80436)

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June 2018

ACKNOWLEDGEMENTS

I did it! Writing these last few sentences, I cannot believe it's almost over. I'm looking back on a very special, inspiring and most of all nice experience, which I would never have wanted to miss. There are a few people without whom this thesis would not look the way it does now, and who therefore deserve a big thank you.

First of all, I would like to thank everybody who made my stay in Sierra Leone into a success. In the first place, thanks to all staff of the GRNP organisation in Kenema, Sierra Leone, for all the help they provided during my fieldwork and for making me feel most welcome. Benji, Bjorn, Fomba, Pietro, Katie, Aminata, Janneh, Christian, Josephine, Saffa and all the others, here's a big thank you for contributing to this wonderful experience. Camilla, thanks for the fun we had exploring Kenema and its surroundings, and Niccolo Meriggi, thanks for all logistical assistance you provided in Sierra Leone, and for tracing down my luggage. Furthermore, I would like to show my gratitude to all interview participants who welcomed me in their villages and told me about their lives during interviews.

Secondly, I would also like to thank my supervisor, Maarten Voors, for all your guidance and enthusiasm throughout the process of writing this thesis. Thanks also to Beccy Wilebore for providing the help I needed analysing the land cover data.

Another big thank you should go to my beloved parents and brother, for your unconditional support and, last but not least, to my dearest office friends. Esmée, Leah, Chantal, Anne, Joy, Linda and Victor, thanks so much for all the unforgettable hours we spent in that office. Thanks for being there to have a coffee, listen to my complaints, have 'some *'beers after work*' or cheer me up whenever needed, but most of all thanks for all the laughs we had.

ABSTRACT

The severe ecological, social and climatological consequences of the increasing pressure on tropical forests have highlighted the importance of forest conservation. This thesis describes and explains people's environmental attitudes and behaviour in the community forests surrounding Gola Rainforest National Park, Sierra Leone. Conservation of the Gola Rainforest is of high importance, because of its unique biodiversity and its crucial role for the livelihoods of the people living in its surroundings. It is therefore relevant to improve our knowledge on socio-ecological interactions in the area. The thesis tests the predictions of a theoretical model on the causes of forest decline on a specific case. The research uses a mixed-methods approach. It combines quantitative survey data, satellite data on land cover and qualitative interview data to show people's environmental attitudes and behaviour, and the factors correlated with it. I find that the main livelihood is slash-and-burn agriculture. In addition, livelihoods depend on hunting, logging, collection of Non-Timber Forest Products and mining. Multivariate regressions are used to assess the factors correlated with environmental attitudes and behaviour, which serves as a proxy for forest decline. The analysis shows environmental attitudes and behaviour to be negatively correlated with distance to the nearest major town, and positively correlated with forest abundance. This means that, on average, remote communities with a high share of forestland show attitudes and behaviour that put a higher pressure on the forest. Population size is correlated with environmental attitudes and behaviour as well, although the sample size did not allow confirming this statistically. Furthermore, the results suggest that villages make trade-offs between devoting land to agricultural purposes or forestland. The results of this research give insight in the processes that are in place in this specific context and provide guidance for conservation policies as well as for future research.

Keywords: *Community Forests, Conservation Attitudes, Conservation Behaviour, Forest Decline, Socio-Ecological interactions, Forest Abundance*

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ABBREVIATIONS

CD	Community Development
CSSL	Conservation Society of Sierra Leone
FAO	Food and Agriculture Organization
GRNP	Gola Rainforest National Park
MAFFS	Ministry of Agriculture, Forestry and Food Security
NTFP	Non-Timber Forest Products
OLS	Ordinary Least Squares
RSBP	Royal Society for Protection of Birds
WHH	Welt Hunger Hilfe

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1. INTRODUCTION

About one-third of the world's total land area is covered by forests (Keenan, et al. 2015). These forests are of major importance for life on our planet. Not only are they of high ecological value, they are also highly valuable from an economic point of view. Worldwide, millions of people depend on these forests for their livelihoods and an even higher amount depend on at least one product or service provided by these forests, such as food, fuel, construction materials or medicines (Vedeld, et al. 2007). Additionally, it is often argued that forests can provide a safety net when people experience natural or economic shocks (Zeteno, et al. 2013). In such time of scarcity, forests often serve as a source of food or income. Despite their importance, forests are under high pressure. Many are exposed to high degradation and deforestation rates. This forest decline has tremendous effects on biodiversity, climate and soil. Moreover, a declining forest has large economic impacts. Because of these severe impacts, the field of forest conservation has become a hot topic in the academic world as well as amongst policymakers. The necessity to find good conservation strategies placed the topic of forest conservation high on the agenda of policymakers and led to extensive academic conservation literature (Milner-Gulland, et al. 2010).

Dominant views on conservation have evolved a lot over the years. Traditionally, there has been an emphasis on establishing protected areas, such as national parks. These conventional management strategies focussed on the principle of 'fencing and fining': Prohibiting access to the forest and fining those who still (illegally) harvest from it. Although these approaches are effective from an ecological perspective, they often create conflicts, especially in cases where local people depend on the protected area for their income or subsistence needs (Kubo en Supriyanto 2010, Masozera en Alavalapati 2004). In such a situation, traditional conservation efforts will drive people to other areas and leakage will occur. In order to prevent this leakage, it is believed that forest conservation plans should go hand-in-hand with socioeconomic development plans and poverty alleviation strategies (Berkes 2004, Masozera en Alavalapati 2004, Sunderlin, et al. 2005). The success of involving local communities in policymaking was shown in many studies, for example the work of Nobel Prize winner Elinor Ostrom, who showed that local communities are efficient in managing common pool resources in the presence of strong institutions (Ostrom 1990). Insights from both environmental and social sciences have increasingly been incorporated into a growing, more interdisciplinary conservation literature. Combining these insights helps to create a more sophisticated understanding of socio-ecological interactions and improve our knowledge on the socioeconomic factors that contribute to land use change and forest decline (Brook en McLachlan 2008).

It is crucial to assess the factors that influence people's attitudes and behaviour resulting in land use change when studying these socio-ecological interactions. It is important to improve our knowledge on the main pressures on a forest are because only then can conservation policy be effectively targeted. In previous research on conservation behaviour and the human-driven causes of forest decline, the distinction is made between proximate (direct) causes and underlying (indirect) causes. Proximate causes are agricultural expansion (especially shifting cultivation), infrastructure expansion and wood extraction (Angelsen 1995, Hosonuma, et al. 2012, Lambin, et al. 2001, Pendleton en Howe 2002, Schaeffer 2005). Also, ecological factors, biophysical factors and shocks are important (semi-)direct causes (Kalaba, Quinn en Dougill 2013, Masozera en Alavalapati 2004). Underlying causes are demographic pressures, economic factors, technological development, policy & institutions and cultural factors (such as attitudes and beliefs towards the forest) (Cropper, Griffiths en Mani 1999, Freitas, Hawbaker en Metzger 2010, Gibson, McKean en Ostrom 2000, Ostrom 1990).

Various processes have thus been identified as (potential) drivers of behaviour towards a forest. However, processes influencing forest use are complicated and vary across different contexts. Also, they are often inter-related and endogenous. In order to assess these processes systematically, various frameworks have been developed. Geist and Lambin (2001), for example, distinguish between proximate and underlying causes of forest decline and show how these factors are related (Geist en Lambin 2001, Lambin, et al. 2001). This framework serves as an excellent starting point for assessing the factors influencing conservation behaviour in a specific context.

In many contexts, the factors contributing to forest decline and the way in which they interrelate have remained unexplored so far. An example of a situation in which the pressures on the forest remain relatively unexplored is the Gola Rainforest National Park (GRNP) in Sierra Leone. Due to its unique biodiversity, the Gola Rainforest is high on the agenda of both national and international conservation organisations. The National Park is a protected area, but the areas surrounding it are under communal management and not protected. Therefore, many conservation efforts focus on preventing conservation leakage resulting from communities moving their activities into their community forests just outside the National Park (Gola Rainforest Conservation LG 2013). In order for these conservation programs to be effective, it is essential to know if, where and why this leakage behaviour occurs, so that it can be targeted more effectively. Despite the large interests in the area, little empirical evidence exists about the socio-ecological interactions taking place between the forest and the communities living in its surroundings. Therefore, this research is carried out. The research increases our understanding regarding the influence of proximate and underlying causes of forest decline in the community forests around the Gola Rainforest. It is examined if, and to what extent, the causes of forest decline (as described by Geist and Lambin) are applicable in this case. Special attention is given to forest abundance, which is defined as the share of forestland (compared to agricultural land, water and village land) in a village. For reasons of data availability, four conservation indicators are used as a proxy for forest decline. These are Conservation Attitudes, Mining, Logging and Hunting activities, NTFP collection and Agricultural Activities.

From a policy perspective, this study is highly relevant. Determining the most prominent factors correlating with people's behaviour will increase our understanding of the relation between the people and the forests surrounding them. These insights can help conservationists design and target their conservation programs more efficiently. The research is scientifically relevant, since it contributes to the literature on people's attitudes and behaviour with regard to natural resources and land use change. It will provide a better insight into the factors that influence (human-driven) changes in the forest, both in this particular case and in general.

To reach this objective, the following research question is answered:

What are the most prominent factors correlated with people's environmental attitudes and behaviour in the context of the Gola Rainforest National Park in Sierra Leone and its surrounding community forests, and how can they be explained?

The question is split up in the following descriptive and analytical sub-questions:

I. What are people's environmental attitudes and behaviour in the context of GRNP and the community forests surrounding it?
II. Which factors correlate with environmental attitudes and behaviour in the context of GRNP and its surrounding community forests?

The term environmental attitudes and behaviour requires some clarification. It captures the human attitudes and activities (logging, hunting, mining, agricultural activities and collecting Non-Timber Forest Products (NTFPs)) that impact the forest and may result in land use change. Logging, hunting, mining and farming predominantly have a negative effect on the forest, whereas the collection of NTFPs can have a positive impact on the forest (Steele, et al. 2015). It is important to note that, when it comes to behaviour, the variables that are used focus on behaviour in community forests specifically. However, for reasons of data availability, the variables used to measure conservation attitudes focus on attitudes towards conservation in both the community forests and the GRNP.

Research questions are answered using a mixed-methods approach. Socioeconomic data are combined with satellite data on land use and forest cover. The socioeconomic data consist of pre-existing quantitative (survey) data, as well as qualitative (interview) data that were gathered during field work in Sierra Leone. These different types of data complement each other and therefore allow for an extensive analysis.

The remainder of this thesis will be structured as follows: The subsequent section summarises recent literature and presents the theoretical framework. After which, Section 3 provides information on the study site and context is provided. Thereafter, Section 4 describes the methodology, including a translation of the theoretical model into an empirical strategy. Section 4 also includes information on data and data analysis. Section 5 presents and explains the qualitative and quantitative research results, followed by a discussion. Finally, the conclusions of this research are presented in Section 7.

2. THEORETICAL FRAMEWORK

In previous research, multiple factors have been indicated as important influencers of forest decline. When considering these influencers, a distinction must be made between natural influences (such as pests, floods and forest fires) and human influences. This research only focuses on the human influences. These human influences can either be direct causes (i.e. the direct consequences of human actions) or indirect causes (i.e. processes that drive people to certain actions) (Carodenuto, et al. 2015). In this research, a theoretical framework on human-driven influences of forest decline is used to guide the research hypotheses.

Based on an extensive meta-analysis of 152 sub-national case studies on deforestation and forest decline, Geist and Lambin (2011) developed a framework that shows the linkage between proximate and underlying causes. Proximate causes are human activities that directly affect the environment (and therefore impose a direct effect on the ecosystem). Underlying causes are seen as the fundamental forces that underpin the (more obvious) driving forces. Besides proximate and underlying causes, they also defined a category of other factors: A group of rather heterogeneous variables concerning the temporal (and spatial) dynamics of land use and land cover change. These are social as well as environmental factors that have proven to influence both the proximate and the underlying causes of deforestation (Geist en Lambin 2001, Lambin, et al. 2001).

Geist and Lambin grouped the proximate causes into three categories: agricultural expansion, wood extraction and infrastructure expansion. Of these, agricultural expansion (and, more specifically, shifting cultivation) is most important. It is expected that some 45-60% of all deforestation is the consequence of agricultural expansion, mainly done by smallholder farmers. The five broad categories of underlying forces are demographic factors, economic factors, technological factors, policy and institutional factors and cultural factors. Within this group, it is difficult to say which of these categories contributes most to forest decline, as it is more context-dependent. When forest decline is, for example, more poverty-driven, demographic and institutional factors turn out to be the most important, whereas, in a situation of more capital-driven forest decline, technological factors are proven to have a higher share. The framework is shown in Figure 1.

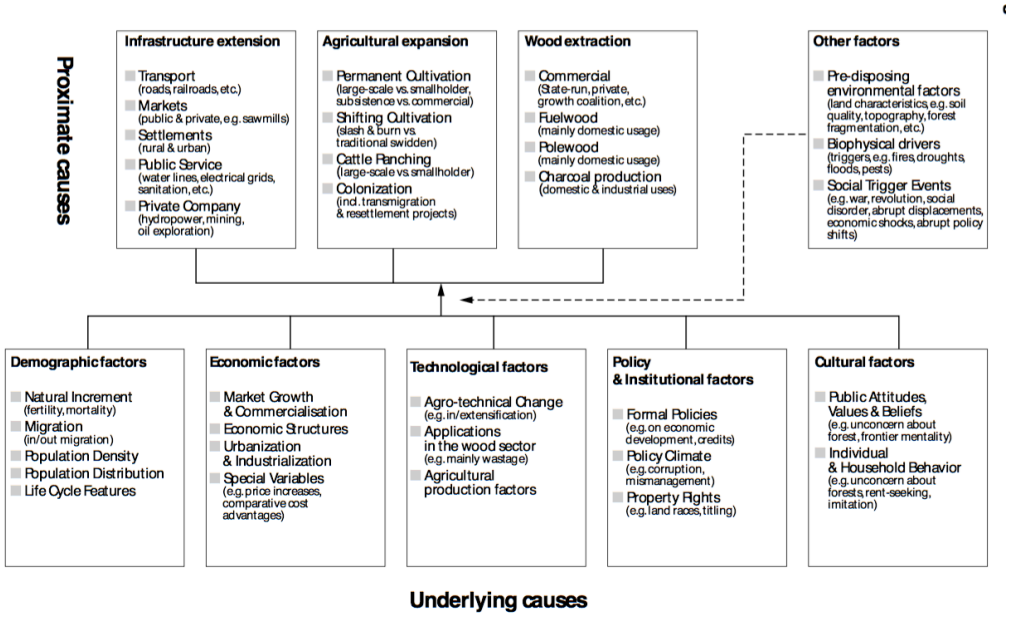

FIGURE 1: UNDERLYING AND PROXIMATE CAUSES OF FOREST DECLINE (GEIST AND LAMBIN 2001)

As can be seen in the framework, the three proximate influences are infrastructure extension, agricultural expansion and wood extraction. Agricultural expansion is the most important factor that influences conservation behaviour. Studies have shown that about half of all deforestation in the world results from the expansion of traditional agriculture (shifting cultivation) (Angelsen 1995, Hosonuma, et al. 2012, Lambin, et al. 2001, Pendleton en Howe 2002). Shifting cultivation requires the clearance of a plot of forestland every period. When agriculture expands, more and more land is being cleared every year, and the periods in which the land is left to regenerate become shorter (Pollini 2014). Therefore, agricultural expansion leads to both deforestation and forest degradation (mainly through biodiversity loss and soil degradation). In relation to agricultural expansion, many authors highlighted the importance of population pressure (Angelsen en Wunder 2003, Angelsen 1996, Cropper, Puri en Griffiths 2001, Rosero-Bixby en Palloni 1998).

The second proximate cause of forest decline is increased demand for forest products, especially timber (Schaeffer 2005). The higher the demand (and therefore the price) of forest products, the higher the incentives to extract them. This applies for commercial logging, but to a lower extent also to domestic use of timber, for example usage for fuel or housing. This factor is related to economic factors and market integration (Indrabudi, de Gier en Fresco 1998). That is, because a community that is integrated into the market, faces lower constraints to sell products that are extracted from the forest and they get more (price) incentives to produce for the market.

Furthermore, proximity to the forest, the market and the nearest road are major drivers as well. Therefore, the third proximate cause is infrastructure extension. Infrastructure extension is not only about transport infrastructure (such as roads and railways), but also about market infrastructure, public services (such as water and sanitation services and electrical grids) and private enterprise infrastructure (such as hydropower development, oil exploration and mining). Communities that are located closer to roads, markets and the forest itself - especially when the infrastructural quality is high - can extract forest resources and sell them in the market easily and at relatively low costs. To a lesser extent, the geographical characteristics of an area (such as altitude, slope and weather conditions) also matter, since it indicates how reachable an area is (even if roads exist) (Müller, et al. 2012).

These three proximate causes are driven by the five underlying causes: demographic factors, economic factors, technological factors, policy & institutions and cultural factors, which will be elaborated further. First, as already briefly mentioned in relation to agricultural expansion, demographic factors are an important underlying cause. Population growth and population density are the most prominent factors within this category, but the category also includes natural increment (fertility, mortality) and migration. The main link through which demographic factors influence the proximate causes is through higher population pressure, which mainly increases the demand for food and (to a smaller extent) income. This increased demand for food and income stimulates agricultural expansion and the extraction of forest products (Angelsen en Wunder 2003, Angelsen 1996, Cropper, Puri en Griffiths 2001, Rosero-Bixby en Palloni 1998).

The second category of underlying causes concerns economic factors. The most important factors in this group are people's economic situation, displayed in their (average) income, and market factors. Although the influence of income on conservation behaviour is often researched, its effects vary. In previous research, the effect of income on forest decline was found to be positive in some cases, but negative in others. That is because two potential underlying processes can take place. On the one hand, an increase in income can decrease people's incentives to take resources from the forest (Godoy, Brokaw en Wilkie 1995, Jha en Bawa 2006). When people earn income from other sources, they have fewer incentives to exploit new agricultural lands, to engage in mining activities or to go hunting. In

such a case, there is a negative relationship between income and forest decline. On the other hand, however, the effect can also work the other way around: when people get wealthier, they have more money to invest in increasing their capacity to extract forest resources (Cuaresma, et al. 2017). In such a scenario, there is thus a positive relationship between income and forest decline.

Another economic factor is the (potential) economic value of a forest, which is determined by the types of resources that can be extracted and the demand for these resources (Cropper, Puri en Griffiths 2001, Freitas, Hawbaker en Metzger 2010). If there is richness in species (NTFPs) that can be sold in the markets, people are often found to be more resistant in clearing forest for agriculture or other purposes. Finally, forest dependency is another important economic factor, although it is not a driver of deforestation itself. It is a characteristic that indicates the persistence of forest decline. If forest dependency is high, it means that there is (most likely) little flexibility to switch to other sources of income. The higher the forest dependency, the higher the need for conservation plans that incorporate socioeconomic development aspects. In order to infer the relationship between communities and the forest, it is therefore essential to know what part of their income is derived from forest resources, and what part is from other sources (Masozera en Alavalapati 2004). Together with forest dependency, comes forest abundance and forest scarcity. If a community is surrounded by forests, it is more likely that they will turn to this forest for their income and subsistence goods. However, if a community has a larger share of agricultural land, this is an indication that the community gets its goods from other sources than just the forest. Therefore, the share of a community's land devoted to forestland and agricultural lands are important factors to take into account.

In the third place, technological factors are classified as underlying cause. Technological development and increased access to technology make it easier for people to clear land for agriculture and extract forest resources. Also, technological progress increases agricultural profitability. Consequently, the incentive to engage in such behaviour is higher (Geist en Lambin 2001, Villoria, Byerlee en Stevenson 2014). However, it should be noted that this effect mainly occurs when communities are integrated in markets (Angelsen, et al. 2001).

In the fourth place, policy and institutions are important since these factors determine how natural resources are managed (if managed at all, since many forests are open-access resources). If institutions are strong it is more likely that forests are managed sustainably than it is in a situation with absent or weak institutions. For effective (community) management of natural resources, the existence of formal and informal rules is essential (Ostrom 1990). The enforcement and legitimacy of rules are even more important, since rules only work if people stick to them and get punished when they break them (Ostrom 1990). Another institutional factor is the existence of property rights. Furthermore, good or bad leadership (especially the degree of corruption) can also affect forest decline (Burgess, et al. 2012). Besides these direct effects, there are also indirect effects, since (local) institutions can strengthen or weaken the effect of all other causes of forest decline (Gibson, McKean en Ostrom 2000).

The fifth underlying cause of forest decline is the category of cultural factors. These include public values, attitudes and beliefs about the way people and ecosystems should interact. Examples of variables in this category are religious and traditional beliefs about the forests and the importance people attribute to sustainability, but also individual behaviours, such as individual rent-seeking and the continuation of inherited modes of resource use (Geist en Lambin 2001).

Finally, the category with other factors captures the factors that are found to be of importance, but cannot be classified as proximate or underlying causes. These are land characteristics, biophysical

drivers and social trigger events (such as violence, health and economic crisis conditions, abrupt population displacements and government policy failures). The latter category is of specific importance in the context of Sierra Leone, as the country has had to cope with various important shocks, for example the civil war and the Ebola crisis. Shocks (natural as well as socioeconomic shocks) are found to increase resource extraction from a forest, since people often use the forest as a safety net (Kalaba, Quinn en Dougill 2013). This safety net can be in the form of food, alternative income strategies or even shelter (Paumgarten 2005, de Merode, Homewood en Cowlishaw 2004). However, other studies have shown that when forests are used for livelihood activities (rather than a safety net) peacetime stability pressures (such as bushmeat trade, clearance for agriculture, logging and mining) can outweigh the pressures from a social shock, such as a civil war (Lindsell, Klop en Siaka 2001).

Thus, the factors that have proven to contribute to forest decline are numerous. This research takes the predictions from this framework, and tests to what extent they are applicable in the case of Sierra Leone. The main reason for choosing this specific model lies in its depth. The model incorporates many relevant variables. Furthermore, by making the distinction between proximate and underlying causes, it becomes clear how one impact leads to another. It also explains how impacts can be strengthened by the interaction of variables. This model provides a solid theoretical basis upon which the hypotheses of this research will be based. After an description of the context, Section 4 explains how this theoretical model is translated into an empirical strategy.

3. CONTEXT AND STUDY SITE

This research is about the Gola Rainforest National Park and its surrounding community forests. The Gola Rainforest is a tropical forest situated across the West African Upper Guinean Forest Belt. It is located in the Eastern province of Sierra Leone, and spans across 3 districts (Kenema, Pujehun and Kailahun) and 7 Chiefdoms (Malema, Gaura, Nomo, Tunkia, Koya, Makpele and Barri). Its area covers around 71,000ha. The forest is known for its unique biodiversity and richness in plant and animal species (FAO 2014). Recent estimates indicate over 300 species of birds (such as the White-necked Picathartes and the Gola Malimbe), 49 species of larger mammals (such as the pygmy hippopotamus, the African forest elephant, the Zebra duiker, the Western Chimpanzee, the Diana monkey and the Western Red Colobus), 43 species of amphibians and 970 types of plants and trees (of which 599 forest species are endemic to the Upper Guinean Forests) (Klop, Lindsell en Siaka 2008). Because of this enormous variety of species, the forest is identified as one of the world's 25 major biodiversity hotspots (Myers, et al. 2000).

Due to its unique biodiversity, the area has been high on the agenda of national and international conservation initiatives for a long time. The area has a long history of conservation, but it was only established as National Park in 2011 (Laurin, et al. 2014, FAO 2014). Today, the forest is collaboratively managed by the Royal Society for Protection of Birds (RSPB), the Conservation Society of Sierra Leone (CSSL), and the Forestry Division of the Government of Sierra Leone (MAFFS). Together, these organisations form the GRNP organisation, which is in charge of the daily management of the park. Most conservation efforts focus on the communities living around the forest. The majority of people living in the immediate surroundings of the forest suffer from severe poverty and rely on the forest for (part of) their livelihoods, which means that restricting forest access highly impacts them (Gola Rainforest Conservation LG 2013). For this reason, much attention and conservation resources are attributed to monitoring the behaviour of these individuals and improving their livelihoods in order to decrease incentives for extracting forest resources. Moreover, the GRNP aims to promote sustainable resource use in the areas just outside the boundaries of the national park. It especially targets the people living in a four-kilometre leakage belt surrounding all park borders (except the eastern one, as Sierra Leone borders Liberia there) (Gola Rainforest Conservation LG 2013). In contrast to the national park itself, resource extraction is not restricted in the surrounding areas, which are almost completely under communal management. Consequently, it is possible that conservation activities inside the national park will drive people to the community forests directly surrounding it, causing forest decline there. Since this leakage can lead to habitat fragmentation, it is undesirable and therefore of high priority among conservationists (Ament en Cumming 2016). Although there is an emphasis on the behaviour of local people (living in this four-kilometre leakage belt), the initiative also monitors the behaviour of other actors, such as commercial companies that extract forest resources.

Local community involvement in the GRNP project is high, since incorporation of these communities is regarded essential for the project to be successful. As already briefly mentioned, local forest dependency is high, so people will experience large impacts of any changes in the forest or forest policies. Also, because of this high forest dependency, they are the ones with the largest interest in sustainable management. At the same time, making sure these activities are carried out sustainably is essential to secure people's future livelihoods, since the activities that people do in their community forest are a high pressure on these forests.

People's livelihoods are almost entirely provided by the various forest activities they engage in. The main activity in community forests is agriculture. In 2013, 95% of the people living in the leakage belt

engaged in agriculture. Subsistence agriculture forms the basis of the livelihoods of the large majority of them (90%) (Bulte, et al. 2013). The majority of agricultural activities is so-called 'slash and burn agriculture', a farming method that involves the annual clearance of forestland in order to create agricultural fields. The fallow cycle of the land (the amount of years the land is left to regenerate) is on average 9 years for upland farms and 2.5 years for swampland farms. However, these numbers highly differ between villages.

Besides agriculture, nearly all households engage in hunting. Although the main purpose of hunting behaviour is household food provision, hunting also serves as a means of protecting one's farm against animal pests (e.g. cane rats, bush hogs or porcupines). Additionally, almost all households gather a large variety of NTFPs, which they use for food, medicines and construction purposes. Furthermore, people also engage in logging and (occasionally) in mining activities. Logging mainly happens for construction purposes, although some people engage in commercial logging. Mining activities are of a commercial nature as well.

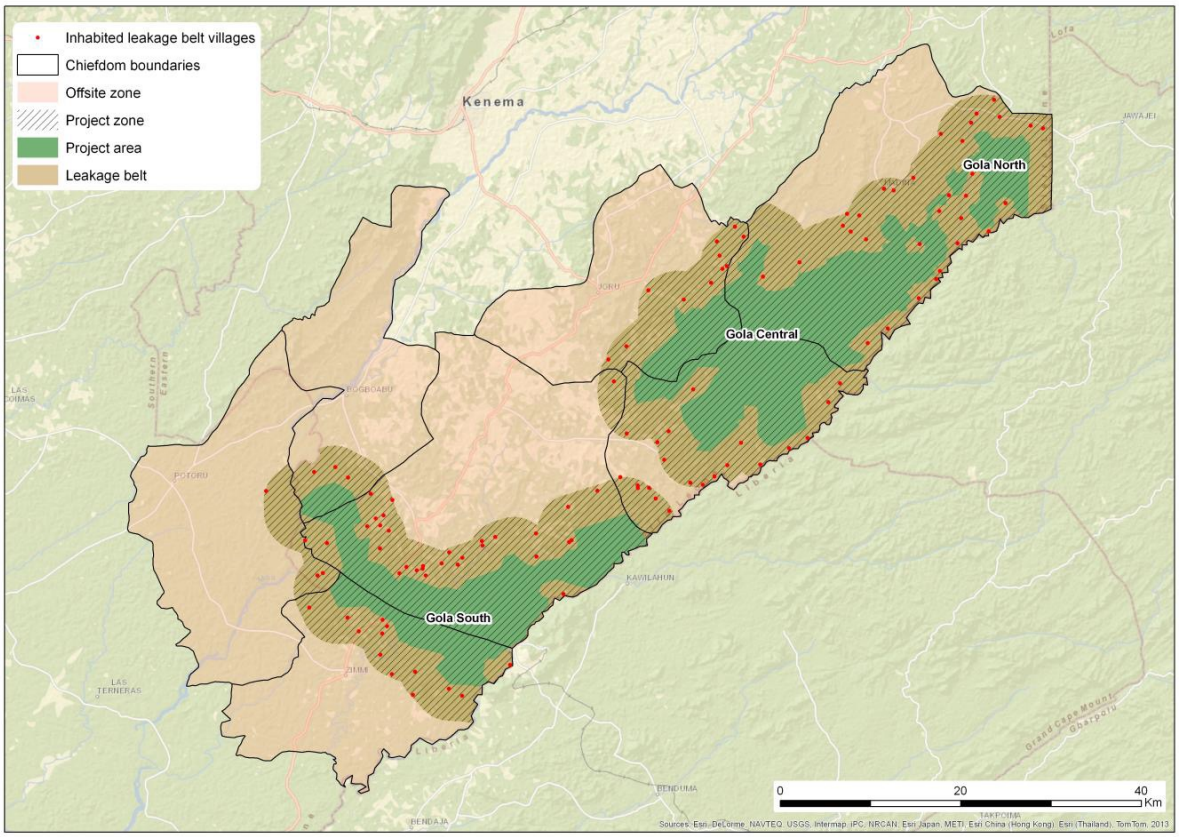

FIGURE 2: GOLA RAINFOREST NATIONAL PARK AND ITS SURROUNDING COMMUNITIES (GOLA RAINFOREST CONSERVATION LG, 2012)

This research focuses on conservation behaviour in the community forests surrounding the park, which is particularly relevant since that is exactly the kind of behaviour the conservation initiative targets. Improving our insight in the relation between (local) people and the forest will help to improve conservation strategies not only in Sierra Leone, but also in other parts of the West African Upper Guinean forests. With this knowledge, conservation strategies can be improved in such a way that they are beneficial for both people's livelihoods and forest biodiversity.

4. METHODOLOGY

This research uses a mixed-methods approach that combines various data sources. This section presents the methodology of the research. The section first presents the data that are used, then operationalizes the theoretical framework into an empirical strategy and finishes with a description of the empirical strategy used for data analysis.

4.1 DATA AND SAMPLE

Multiple data sources are combined in this research. In the first place, four socioeconomic datasets (gathered in the period 2011-2013) are combined. These are: A 2011 village level survey (*n=109*), a 2013 village level survey (*n=92*), a 2013 village level NTFP survey (*n=92*) and a 2013 individual survey (*n=2251*).

Furthermore, the research uses a 2011 dataset obtained from high-resolution RapidEye satellite imagery. This data provides information on land use around the surveyed villages (*n=487*). Based on pixel colours of these satellite images, it is determined whether a plot of land is bare soil or village land (brown pixels), non-forest vegetation, such as farm bush, gardens or grass (light green pixel), forest vegetation (dark green pixel) or water. When land holdings are known, this data can be used to determine the shares of village land, agricultural land and forestland in a community. In the context of Sierra Leone, however, communities' land holdings and the locations of village boundaries often remain ambiguous. Therefore, they are estimated using previous survey data in combination with weighted Voronoi polygons. Those polygons are created based on the assumption that the owner of a plot of land lives in the village with the shortest Euclidean distance to that plot. These polygons are weighed based on population size. In practice, this means that larger communities are expected to have larger amounts of land.

These data are supplemented by qualitative interview data, which were gathered during field work in Sierra Leone. The data originate from 21 interviews with people living in 14 Forest Edge Communities situated across Malema, Tunkia and Gaura Chiefdoms. Interviews took place with the help of a translator. Interviews were not recorded, since they were sometimes done during multiple-day field trips and accommodations lacked the facility to charge any recording devices. Instead, answers were written down as elaborately as possible. Semi-structured interviews were preferred but for practical reasons (multiple translators being involved and translators needing to see the questions beforehand) interviews were structured. There was, however, diverged from the previously set-up list of questions when the researcher felt additional information was needed. 9 participants were male and 12 were female. All of them participated on a voluntary basis and under full informed consent. In fact, the amount of people interested in participating was high. In case multiple people wanted to participate, one male and one female candidate were selected. In some communities, participants were appointed by the community, in others two people were selected through a small lottery. During the interviews, questions were asked about multiple topics, including: conservation attitudes, structures & institutions, logging activities, mining activities, hunting activities, NTFP collection and agriculture. Besides being very useful for understanding the local context in general, the interview data are a useful addition to the quantitative data, since they are more in-depth and provide explanations for the correlations found in the quantitative analysis.

4.2 THEORETICAL FRAMEWORK TRANSLATED INTO EMPIRICAL STRATEGY

As explained above, the theoretical framework developed by Geist and Lambin (2001) provides a solid theoretical basis upon which this research is based. The model clearly indicates the factors that are predicted to influence forest decline. This model now has to be translated into an empirical strategy, so that the validity of its predictions can be tested for the context of the GRNP in Sierra Leone. The main aspects that are taken into account in the translation of the model are data availability and context-specific information.

To start with, each factor mentioned in the theoretical framework is linked to a variable corresponding to that factor. These variables can be found in Table 1. After linking factors to variables, the model is translated into an empirical strategy.

TABLE 1: VARIABLES CORRESPONDING TO FACTORS IN THE THEORETICAL FRAMEWORK

FACTOR IN THEORETICAL FRAMEWORK	VARIABLE CORRESPONDING TO THAT FACTOR
Agricultural expansion	Amount of Agricultural Land
	Share of Agricultural Land
Infrastructure extension	Distance to Road, Market & Forest
	(Public) Amenities
Population	Population size
	Population density
Economic factors	Household Wealth (based on household income and assets)
	Forest Abundance
	Economic value of the forest
Technological factors	-
Policy and institutions	Institutional Quality (Index that measures the quality of leadership)
Cultural factors	Conservation Attitudes
Other factors – Shocks	Number of agricultural shocks and conflicts

4.2.1 DEPENDENT VARIABLES

The first translation that must be made is the creation of a (set of) dependent variable(s). The outcome variable in the model is forest decline. However, no such variable (of combination of variables) exists in the available datasets. Therefore, four dependent variables that serve as conservation indicators are created. Together, these dependent variables are combined into a composite indicator serving as a proxy for forest decline: Environmental Attitudes and Behaviour. This variable is defined in such a way, that it takes high values when people have Attitudes and Behaviour that put more pressure on the forest. The four dependent variables are the following:

Y_1: Conservation Attitudes
Y_2: (Illegal) forest activities: Mining, Hunting and Logging
Y_3: NTFP Collection
Y_4: Share of Agricultural Land

These variables are chosen for two reasons. In the first place, these activities are all widely practiced by the communities living in the surroundings of the GRNP. Secondly, these are all variables that, in previous research, are shown to have a large impact on forest decline.

Most dependent variables are composite variables, which means that they are generated based on multiple other variables. Various survey questions are combined, so that one aggregate variable is

created for each dependent variable. Most of these survey questions are binary variables (0/1). The other variables are either transformed into dummies or, if the distribution of answers is very unequal, transformed in such a way that answers on these questions also range from 0 to 1. For most dependent variables (Y_1, Y_2, Y_3), the average score is taken (by dividing the cumulative answers by the total number of questions), since they are almost fully based on dummy variables. For variable Y_4, no average value is created, since the share of agricultural land is not a composite indicator, it is based on one variable. The composite proxy variable for forest decline, Environmental Attitudes and Behaviour, is then generated by taking the average of the standardized values of Y_1, Y_2, Y_3 and Y_4. More detailed information on the creation of these composite variables can be found in Appendix 3.

One of the most important deviations from the theoretical framework, is defining *Agricultural activities* as dependent variable, while the theory classifies it as one of the most important predictors. The rationale behind this decision is the fact that a strong relationship between agriculture and deforestation in the areas surrounding the GRNP is expected. This strong linkage was not only shown in previous (quantitative) research, but to a high extent also came back in the qualitative data gathered in this research.

Another deviation from the theoretical framework concerns the variable *Conservation Attitudes*. According to the theoretical framework, this variable would fit under cultural factors, and would therefore be an independent variable. However, in the context of GRNP, it is very relevant to gain insight in how people's attitudes are formed and influenced. Therefore, it is decided to take conservation attitudes as dependent variable. Since correlations between the dependent variables themselves are also taken into account, the relation between attitudes and the other dependent variables is not completely ignored. Other cultural factors on the local importance and meaning of the forest are hard to capture in a quantitative variable. Hence, these aspects are not included in the analysis in another form.

4.2.2 INDEPENDENT VARIABLES

Another translation that has to be made concerns the independent variables. These independent variables are based on the underlying and proximate causes of forest decline (as presented in Figure 1 and translated into variables in Table 1). Given the extensiveness of the datasets used in this research, information is available on most categories mentioned in the model. Data only lacks for the category of Technological Factors (see Table 1). However, in the context of GRNP, the bias resulting from lacking data in this category is limited, since technological factors are shown to mainly be of influence in the situation of capital-driven forest decline, while the forest decline around the GRNP is mainly poverty-driven.

An more serious issue omitting Technological Factors arises when taking into account the endogenous nature of many of the variables. Because of endogeneity issues, not all factors mentioned in the framework are incorporated in the multivariate analysis. In the next section, the issue of endogeneity is discussed in more detail.

4.2.3 ENDOGENEITY

As mentioned before, serious endogeneity issues arise for some of the factors mentioned in the framework. Consequently, some variables that were initially listed to be incorporated in the analysis have to be left out.

The first variable that has endogeneity problems is *Household Wealth* (which consists of household income and household assets). Income is a predictor for conservation behaviour, but is also highly

correlated with the dependent variables. The same situation applies for the variable *Household Assets*, which is seen as an additional, more reliable measure of household income. For that reason, the variable household wealth is no longer included in the analysis.

A similar situation exists for *(Public) Amenities* present in a village. Whether a village has amenities like electricity, a public toilet or a generator is not determined exogenously. There are many potential factors, such as wealth and institutional quality that are likely to influence this variable. Consequently, this variable is also left out of the analysis.

The remaining variables will not be dropped, since they are more exogenous than the above variables. The *Distance to Roads, Markets and Forest* are exogenous variables, which are not influenced by other variables in the model. Not as exogenous, but still relatively independent, is the variable *Institutions* (measured by the quality of leadership). Institutions take time to change and are relatively independent of other variables. Additionally, *Economic value of the forest*, which is estimated by using the prices community members get for the 10 most-gathered NTFPs as a proxy, is also considered as exogenous. Since individuals (or even villages) have little ways of influencing the market for these products in the market, these NTFP prices can be considered exogenous as well.

Furthermore, *Agricultural Shocks* are (mostly) exogenous, since individuals cannot control matters such as the amount of rainfall and individuals have no influence on the occurrence of a drought or a flood. Other matters, such as pests and yields can in theory be influenced by the usage of pesticides and fertilizer. However, usage of these inputs is very low in the forest edge communities surrounding GRNP, since most people cannot afford them. Besides agricultural shocks, it was initially planned to also incorporate the frequency conflicts occurred in the variable shocks. Since conflicts are way more endogenous, it is decided to leave conflicts out, and to only consider agricultural shocks.

Then, there are two other variables that are not as clearly exogenous as the ones mentioned above, but, for motivated reasons, are still incorporated in the model. The first of them is *Population*. Although the variable is not completely independent and might correlate with at least some other variables in the model, the variable will still be taken into account. In this research, population is considered more or less stable, since migration in Sierra Leone is limited, and changes in population numbers resulting from fertility and mortality take time.

In the second place, *Forest abundance* is semi-endogenous as well. In this research, forest abundance is defined as the forestland in a community as a share of total village land holdings. A community can to some extent influence this, for example by decisions about how much land they are brushing for agriculture. However, since this is an annual decision, and does not differ a lot over the years, forest abundance is included in the analysis carried out in this research. Since the various surveys were all done at only one point in time, these data can be regarded as fixed in the short term.

After the endogenous variables are left out, the independent variables will be the following:

Z_1: Distance to the nearest major town (market)
Z_2: Distance to the GRNP
Z_3: Distance to the nearest vehicle road
Z_4: Population
Z_5: Forest abundance
Z_6: Economic value of the forest
Z_7: Institutions
Z_8: Shocks

4.3 HYPOTHESES

Based on the theoretical framework, the following hypotheses are derived.

$H0_a$: Distance to the nearest major town is not correlated with environmental attitudes and behaviour.
$H1_a$: Distance to the nearest major town is negatively correlated with environmental attitudes and behaviour.

$H0_b$: Distance to GRNP is not correlated with environmental attitudes and behaviour.
$H1_b$: Distance to GRNP is positively correlated with environmental attitudes and behaviour.

$H0_c$: Distance to the nearest vehicle road is not correlated with environmental attitudes and behaviour.
$H1_c$: Distance to the nearest vehicle road is negatively correlated with environmental attitudes and behaviour.

$H0_d$: Population is not correlated with environmental attitudes and behaviour.
$H1_d$: Population is positively correlated with environmental attitudes and behaviour.

$H0_e$: Forest abundance is not correlated with environmental attitudes and behaviour.
$H1_e$: Forest abundance is positively correlated with environmental attitudes and behaviour.

$H0_f$: Economic value of the forest is not correlated with environmental attitudes and behaviour.
$H1_f$: Economic value of the forest is positively correlated with environmental attitudes and behaviour.

$H0_g$: Institutions are not correlated with environmental attitudes and behaviour.
$H1_g$: Institutions are negatively correlated with environmental attitudes and behaviour.

$H0_h$: Shocks are not correlated with environmental attitudes and behaviour.
$H1_h$: Shocks are positively correlated with environmental attitudes and behaviour.

4.4 EMPIRICAL STRATEGY

Quantitative data and qualitative data are combined according to a mixed methods approach using sequential explanatory design. This method emphasizes the collection and analysis of quantitative data in the first stage of research. Afterwards, in a second stage, qualitative data are gathered in order to explain, or elaborate on quantitative results found in the first stage (Cresswell, et al. 2003).

Quantitative analysis in this research is based on multiple datasets, most of which were collected at village level. However, one of the datasets was collected at household level. In order to prevent bias resulting from unequal amounts of household observations across villages, household data is compiled at village level. All analysis will therefore take place at village level.

Data will be analysed using multivariate regression analysis. In order to investigate the correlations between the dependent and independent variables, I estimate the following multiple linear regressions, using Ordinary Least Squares (OLS) technique.

At first, I estimate rough correlations between the dependent variable Y and each of the independent variables ($Z_1, \ldots, Z_8$) separately.

$$Y_i = \beta_1 Z_u + \beta_2 CFE_k + \beta_3 C_j + \varepsilon_i \qquad (1)$$

In which Y_i stands for Environmental Attitudes and Behaviour in village *i* (*i = 1, ... , 92)*. Z_u are the 8 independent variables (*u = 1, ..., 8)*. CFE_k is a vector of chiefdom fixed effects (*k = 1, ..., 7*) and C_j is a vector of control variables (including average income, gender and bylaws). After estimating the rough correlation coefficients, I estimate the predictive value of the full model (i.e. all independent variables included), using the following model:

$$Y_i = \beta_1 Town + \beta_2 GRNP + \beta_3 Road + \beta_4 Pop + \beta_5 Abundance + \beta_6 Value + \beta_7 Inst + \beta_8 Shocks + \beta_9 CFE_k + \beta_{10} C_j + \varepsilon_{i.} \quad (2)$$

In which Y_i stands for Environmental Attitudes and Behaviour in village *i* (*i = 1, ... , 92). Town, GRNP, Road, Pop, Abundance, Value, Inst* and *Shocks* stand for the 8 independent variables Z_1 (...) Z_8, and ε_i is the error term (with $\varepsilon \sim N(0 , \sigma)$). Again, a vector of chiefdom-level fixed effects, CFE_k (*k = 1, ..., 7*), is included, to control for unobserved regional differences across regions. Vector C*j* contains a set of control variables, including average income, gender and bylaws. Since all variables are village level variables, there is no need to cluster the standard errors.

The analysis will be repeated for the four dependent variables separately, in order to assess the correlations in more detail:

$$Y_{ai} = \beta_1 Z_u + \beta_2 CFE_k + \beta_3 C_j + \varepsilon_i \quad (3)$$

In which Y_{ai} stands for dependent variable *a* (*a = 1, ..., 4*) in village *i* (*i = 1, ..., 92*). As before, Z_u are the 8 independent variables (*u = 1, ..., 8)*. CFE_k is a vector of chiefdom fixed effects (*k = 1, ..., 7*) and C_j is a vector of control variables (including average income, gender and bylaws). Again an analysis of the full model follows:

$$Y_{ai} = \beta_1 Town + \beta_2 GRNP + \beta_3 Road + \beta_4 Pop + \beta_5 Abundance + \beta_6 Value + \beta_7 Inst + \beta_8 Shocks + \beta_9 CFE_k + \beta_{10} C_j + \varepsilon_{i.} \quad (4)$$

Subsequently on the main analysis follows a secondary analysis. This analysis includes a comparison of pairwise correlation coefficients, in order to assess the correlations between the dependent variables themselves.

5. EMPIRICAL RESULTS

In this section, the empirical results are presented and discussed. The section presents basic sample characteristics, followed by a description of current environmental attitudes and behaviours. The section ends with a presentation and discussion of multivariate regression results.

5.1 BASIC SAMPLE CHARACTERISTICS

This section presents descriptive statistics. Table 2 presents some background characteristics on the study population. Subsequently, the independent variables are described in Table 3.

TABLE 2: PARTICIPANT CHARACTERISTICS INDIVIDUAL SURVEY

Variable	n	Mean	St. Dev	Min	Max
Age	92	42.52	6.55	34.33	90
Gender (0 = Female, 1 = Male)	92	0.59	0.14	0.33	1
Income (in 1000 Leones)	132	248.37	267.88	0	1696.83
Extreme values excluded	129	232.43	227.12	0	1133.00
Income = 0 excluded	91	393.53	260.29	37.00	169.68
Amount of household assets	92	4.49	0.72	2.48	6.26
Tin Roof	92	0.33	0.23	0	0.87
Mobile Phone	92	0.21	0.13	0	0.5
Bed	92	0.92	0.08	0.52	1
Table	92	0.60	0.16	0.17	1
Torchlight	92	0.93	0.09	0.52	1
Machete	92	0.89	0.08	0.70	1
Radio	92	0.35	0.14	0	0.7
Private Toilet	92	0.37	0.22	0	1

All variables are village level averages. Descriptive statistics on income are presented for the entire sample, as well as for different subgroups in the sample (extreme values excluded, people who reported to have no income/job excluded). For assets, it was assessed how many assets households in the villages owned on average, out of 8. Afterwards, results are specified for each of these assets (in which 1 means 100% of the participating households in that village owns that asset, 0 means that none of the participating households in that village owns that asset).

Table 2 shows background characteristics of the villages that participated in the surveys. These characteristics are included to provide background information on the communities. Participants were, on average, 42.5 years old. Of all participants, 59% were male and 41% were female. The minimum value of 0.33 indicates that there were no villages in which only women participated. There was 1 village in which only men participated (indicated by the maximum value of 1). On average, participants reported to work 5.4 hours per day. This work was mainly farm work, as the vast majority (95%) of participants reported to be a farmer. Those people sowed, on average, 2.7 bushels of rice in the year prior to the survey, and harvested 7.6.

In 2013, average annual income was SLL 248,370, which, at the time of the survey, equalled about 57 USD[1]. Average income without outliers was SLL 232,434 (USD 54). A significant amount of people (27% of the study sample) reported not to have any income the previous year. Excluding those

[1] On May 31, 2013, 1 USD equalled 4323.464 SLL.

observations provides the average income for those who have a job/occupation: 393,527 SLL (USD 91).

When assessing average incomes of men and women separately, a large difference is found: whereas men earned SLL 501,202 (USD 116) on average, women only earned SLL 164,158 (USD 34). This difference is found to be statistically significant at the 1% level (P-value = 0.000).

However, when looking at (reported) income levels, especially when it comes to annual income, a note needs to be made. As can be seen in Table 2, there is large variance in the data, as standard deviations for income are very high. It is hard to obtain accurate measures of people's income, since income data is very sensitive to measurement or reporting errors. Previous research has repeatedly shown that asking people about their income is not always fully accurate. For various reasons (for example seasonality of income in the agricultural sector), it turns out hard for people to estimate their income. Therefore, many surveys in developing countries focus at measuring proxy variables for income, such as expenditures (which are generally more stable than income) or assets (as a measure for household wealth demonstrated by the household's capacity to purchase those assets). Accordingly, the presence or absence of 8 major assets in a household is also analysed[2]. Those assets are: A tin roof, mobile phone, bed, table, torchlight, machete, radio and a private toilet. On average, households owned 4.5 of these assets. More specifically on each of these assets separately: 33% owned a tin roof, 21% owned a mobile phone, 92% owned a bed, 60% owned a table, 83% owned a torchlight, 89% owned a machete, 35% owned a radio and 37% had a private toilet. Maximum values show that there were no villages in which everybody owned a tin roof, mobile phone or radio. Minimum values of 0 indicate that there were villages where nobody owned a tin roof, mobile phone, radio or private toilet. Maximum values of 1 show that there were villages in which everybody owned a bed, table, torchlight or machete.

Now that the characteristics of the people living in the area around GRNP have been described, summary statistics on the dependent variables are presented. Table 3 shows descriptive statistics on the eight dependent variables.

TABLE 3: DESCRIPTIVE **STATISTICS - INDEPENDENT VARIABLES**

Variable	n	Mean	St. Dev	Min	Max
Z_1: Distance to nearest major town (km)	104	8.25	17.50	0.80	160.77
	96	5.23	2.35	0.80	11.26
Z_2: Distance to GRNP (km)	129	5.46	3.08	0.97	16.59
Z_3: Distance to vehicle road (km)	129	3.07	2.78	2	12.84
	124	2.76	2.32	2	8.77
Z_4: Population (households)	131	324	501.71	8	3000
	119	191	167.53	8	764
Z_5: Forest abundance	118	0.16	0.13	0.008	0.65
Z_6: Economic value of the forest (1000 Leones)	92	54.93	64.33	0	273.50
	87	45.08	50.11	0	186.00
Z_7: Institutions	91	0.78	0.07	0.59	1
Z_8: Shocks	91	3.56	0.521	3	5

Variables Z_1 Z_2, Z_3, Z_4 and Z_6 have two sets of summary statistics: summary statistics on all observations (first row) as well as summary statistics on observations excluding outliers (second row) are reported. Outliers were

[2] In this dataset, variables on income and assets are strongly correlated (P=0.000), which indicates that both are accurate to use.

excluded when their value extended the value of Q3+ 1.5iqr. Since no serious outliers were reported for Z_5, Z_7 and Z_8, only summary statistics on all observations are presented.

Variable Z_1 measures the distance to the nearest major town, which indicates the distance to the nearest market as well. On average, villages are 8.25 kilometres away from the nearest major town. Outliers excluded, this distance narrows down to 5.2 kilometres. For 25% of observations, the nearest major town is the chiefdom headquarter town, for the remaining share of observations the chiefdom headquarter town is further away.

Distance to the GRNP is, on average, 5.5 km. This value raises some suspicion, since the villages in the leakage belt are by default at a maximum distance of 4 kilometres from the borders of the GRNP. However, no outliers (values higher than Q3+1.5iqr) are found.

On average, villages are 3.07 km removed from a vehicle road. Again, extreme values seem to influence the average. Outliers excluded, the average distance to the nearest vehicle road is 2.76 km.

Variable Z_4, *Population*, shows the amount of households in the village. On average, villages consist of 324 households. This is rather large, and so are the standard deviation (501.7) and the maximum value (3000). As such, outliers are excluded, which results in an average of 191 households per village.

Variable Z_5 measures *Forest abundance*, by looking at the share of forestland present in a village. On average, 16% of the land villages own is covered by mature forest, with a minimum value of 0.8% and a maximum value of 65%. Assessing the types of land use more specifically, it can be concluded that, on average, 21% of village land is bare soil, 61% is non-mature vegetation (such as farm bush, gardens or grass) and 1% is water. However, for water it is important to mention that only 52% of the villages has a (detectable) water source.

Variable Z_6 is a proxy variable. The economic value of the forest is estimated by asking people about the price they receive for the 10 most-gathered NTFPs on the market. The reported prices of men and women are added in order to get an estimated value of the NTFPs gathered in the community forest. The average value people receive for one unit of forest products is SLL 54,927 (which, at the time, equalled 12.7 USD[3]). Outliers excluded, the average value is SLL 45,081 (10.4 USD). Standard deviations are large for both the average with outliers and the average without outliers.

Variable Y_7, *Institutions*, is an index for institutional quality. A value of 0 means that people perceive the institutional quality (measured by the quality of leadership) in their village as very bad, a value of 1 means that people perceive it to be very good. The minimum value of 0.59 indicates that, overall, people are rather positive about the institutional quality in their village. Also, the standard deviation of 0.07 indicates that there is little variation in the sample.

Variable Y_8, *Shocks*, shows the amount of agricultural shocks a village experienced during the past year. The variable is composed of data on droughts, floods, crop disease and extremely low or high yields. The summary statistics on this variable show us that villages experienced, on average 3.5 shocks, with a minimum of 3 and a maximum of 5. Variation in the sample is small. Of all possible shocks, crop diseases and low yields were experienced most, while draughts were experienced least.

[3] On May 31, 2013, 1 USD equalled 4323.464 SLL.

The above summary statistics improve our background knowledge about the context as well as the independent variables. The subsequent section presents information on the dependent variables. This information is used to answer research question 1.

5.2 DESCRIPTION OF CURRENT ENVIRONMENTAL ATTITUDES AND BEHAVIOUR

This section presents results for RQ1: *What are people's environmental attitudes and behaviour in the context of GRNP and the community forests surrounding it?* The research question is answered by assessing descriptive information on the dependent variables, as well as results from the qualitative data. Descriptive statistics on the dependent variables are presented in Table 4.

TABLE 4: DESCRIPTIVE STATISTICS - DEPENDENT VARIABLES

Variable	n	Mean	St. Dev	Min	Max
Y_1: Conservation Attitudes	92	0.78	0.077	0.54	0.88
Y_2: Activities in Community Forest	83	0.37	0.16	0.13	0.86
Y_{2a}: Mining	86	0.11	0.22	0	0.98
Y_{2b}: Logging	87	0.35	0.32	0	0.98
Y_{2c}: Hunting	90	0.62	0.13	0.38	0.90
Y_3: NTFP Collection	92	1.36	0.93	1	9
	91	1.28	0.47	1	2.9
Y_4: Share of agricultural land	118	0.61	0.12	0.25	0.85

Variables Y_1 and Y_2 take values between 0 and 1 (in which value 0 corresponds to very negative attitudes and no activities taking place, and value 1 stands for very positive attitudes and very much activities taking place). Variables Y_3 and Y_4 are continuous variables. For variable Y_3 applies: the lower the value, the more NTFP collection is taking place. Answers for this variable range between 1 and 10, in which 1 means many NTFPs are gathered and 10 means no NTFPs are gathered at all. Variables Y_3 has two sets of summary statistics: summary statistics on all observations (first row) as well as summary statistics on observations excluding outliers (second row) are reported.

5.2.1 ATTITUDES

Since most variables are composite indicators, their absolute values by themselves do not give us a lot of information. However, it is still possible to tell whether they are relatively high or relatively low. With a mean value of 0.78 for *Conservation Attitudes*, it can be concluded that people have, on average, very positive attitudes towards the conservation. The low standard deviation (0.077) for this variable indicates that attitudes are uniform as well.

This is confirmed by qualitative data. During interviews, people took very positive stands towards conservation. Based on all interview questions, it can be concluded that forest dependency is high and the services the forest provides are numerous. When participants were asked about the importance of the community forest in their lives, they all replied that the forest is of high importance for them, primarily because it provides them space for agriculture. Furthermore, the forest provides people with almost all products they use, especially construction materials, fruits, medicines, (bush)meat and fish. Because forest dependency is so high, people pointed out the relevance of the forest in their lives now and in the future, and took positive stands towards conservation.

However, there seems to be a gap between people's (reported) attitudes and their behaviour, since many people who said they consider conservation important did not act according to these beliefs. This demonstrates in the efforts villages take in terms of conservation. On a small scale, community forest plots are designated as protected land. Mostly, these areas are meeting areas for the members of the male and female secret societies. Besides protection for secret society purposes, some villages protect parts of their community forests for conservation purposes as well, albeit on a low scale. People living in two communities that were visited during the interviews stated they protected part of their community forest, so that they will be able to make good use of it in the future (Interview 14, Interview 15). However, it must be noted that land was in abundance in both these communities, which means protecting the land did not have serious consequences for people's activities. In communities where land is scarcer, people indicated that limiting access to a certain part of the community forest for conservation purposes was not in their interest.

The above points suggest that people are potentially willing to engage in conservation, but only if it does not affect them directly. An interesting point turns up when assessing the (perceived) benefits of conservation. Since forest dependency is extremely high, it was expected that people would consider the future possibility to make use of the community forest to be the main benefit of conserving it. However, when asking people about the benefits, different points were mentioned. The benefits of conservation mentioned most frequently were the benefits they get from NGOs. They mostly spoke about the GRNP organisation (from whom they receive FEC scholarships and community development (CD) projects like rice mills and community barries), but also about WHH, which provided some of the communities with seeds. People consider those benefits a reward for working together with the GRNP and other NGOs. Other points that were often mentioned are the ability of the forest to provide them with fresh air, and the sources of drinking water that can be found in the forest throughout the year. Furthermore, some participants mentioned provision of shade, as well as the forest stopping the wind. Finally, two people mentioned the historical importance of the community forest and the importance to show this forest to their children.

Hence, the benefits mentioned by the interview participants are broad and general, instead of focussed on the future importance of the forest for their communities (which was expected). A possible explanation for this gap is the presence of a knowledge gap on the costs and (future) benefits of conservation. The aspects that were mentioned are general benefits of the presence of a community forest (some of which they may have learned from NGOs), but even after specifically asking most people did not mention the availability of forest products, services and farming sites in the future. This, in turn, is presumably related to high discounting of future benefits: even when people know they will need the forest in the future, they have such high discount rates that those future benefits cancel out.

Thus, in general people take positive stands towards conservation and attach high importance to the forest for various reasons. These attitudes are translated into structures and bylaws managing community forest. The subsequent paragraphs describe and explain the role of structures in the study sample.

The communities that were visited for this study are all led by a town chief, which is a traditional authority in Sierra Leone. Chiefs have the power to "raise taxes, control the judicial system and allocate land", and are therefore important figures in every village (Acemoglu, Reed and Robinson 2014, 320). Interview results confirm that chiefs play a large role in the management of the community forest, together with the community elders. Consultation of the other community members differed per community but was on average low.

Every visited village had systems in place to regulate the usage of the community forest. Those systems are rather informal, but are in general acknowledged by community members. The most common way of making rules is the creation of village bylaws. Out of 21 interview participants, only 2 declared that their villages did not have any bylaws in place (Interview 16, Interview 19). In the other villages, most bylaws are about access to land. Many bylaws state that a plot of land is not to be cultivated, harvested or even entered without chief permission.

Other aspects often incorporated in bylaws are (commercial) logging and mining in the community forest. Only a small minority of the villages forbid mining. More bylaws exist for logging. Logging bylaws usually make a distinction between commercial logging (which is often forbidden) and logging for construction purposes (which is allowed for members of the community). The distinction between community members and outsiders is made in other bylaws besides logging as well. Laws are usually stricter for people who live outside the community. In some cases, it is not even allowed to enter a community forest if you come from another village. Sometimes tax systems are in place for non-community members who want to access other villages' forest or do work in the community forest.

A last group of bylaws that were mentioned multiple times concerns bylaws on agriculture. Some villages have bylaws about the minimum required fallow period of land (ranging from two to ten years). In one community a rotating system was in place to regulate farming sites: per season, farmers switch between upland and swampland farms (Interview 4). Another community had a system of group farming in place, which requires every community member to work a certain amount of hours on the communal farms (Interview 9).

Many bylaws thus exist. Every community had at least a few bylaws that specifically address the community forest. Those bylaws are of course only effective if they are actively enforced. Since social control is strong, this is usually the case. The most common punishment for violating bylaws is monetary punishment in the form of fines, given to the violator by the chief. In the villages where the interviews were conducted, fines ranged from 10.000 Leones to 70.000 Leones. Depending on the severity of the violation, some chiefs forward violators to the native administration authorities in the chiefdom headquarter town. In practice, this comes down to punishment by the Paramount Chief. Two communities have incorporated national laws in their bylaws, since it increases the level of enforcement of these laws. An example of a national law that is incorporated in community bylaws is the ban on hunting with guns. Another example is forbidding people to engage in logging and hunting inside the GRNP. These are laws that apply for everybody in Sierra Leone, but were still incorporated in community bylaws because monitoring is higher within communities, making enforcement easier.

In general, people are satisfied with the bylaws, though some participants mentioned the wish to have more influence on the creation or approval of bylaws that have been created by chiefs or elders. Out of 21 interview participants, 18 answered to support all bylaws, 1 person stated that she only supported part of the bylaws (depending on whether they were good laws or not), and two people refused to answer the question.

Besides creating bylaws, communities can also establish a conservation organisation in order to support nature conservation. A conservation organisation guides forest use. They stimulate community members to engage in sustainable practices and discourages any destructive activities. Furthermore, they sometimes organise group agricultural work in the community forest. The creation of such organisations is often promoted amongst (environmental) NGOs. Yet, such organisations were only present in 3 communities. In the communities without a conservation association, some participants wished for such an organisation to exist in their village, but most of them did not see the relevance.

Summarised, attitudes towards conservation are in general very positive, and they are translated into structures that are supposed to manage forest use. In the subsequent sections, it is discussed to what extent these structures influence the activities that take place in community forests.

5.2.2 ACTIVITIES IN THE COMMUNITY FOREST

Variable Y_2 captures activities done in the community forest. The *n* of 83 indicates quite a few missing values, which is most likely caused by participants refusing to answer certain questions, either because they did not want to answer, or because they did not know the answers to certain questions. Since variable Y_2 is composed of three variables, information on these variables is provided as well. Figure 3 shows the response patterns of the various components of variable Y_2 separately. A few things stand out. In the first place, of all three activities, hunting is the most widely practiced, while mining activities occur significantly less than logging and hunting activities (P-value = 0.000). However, despite this low first quintile, median and third quintile values, quite a lot of extreme values occur. Another thing that stands out is the large variation in logging activities, compared to the variation in mining and hunting. This shows that villages are way less homogeneous when it comes to logging than when it comes to mining and hunting.

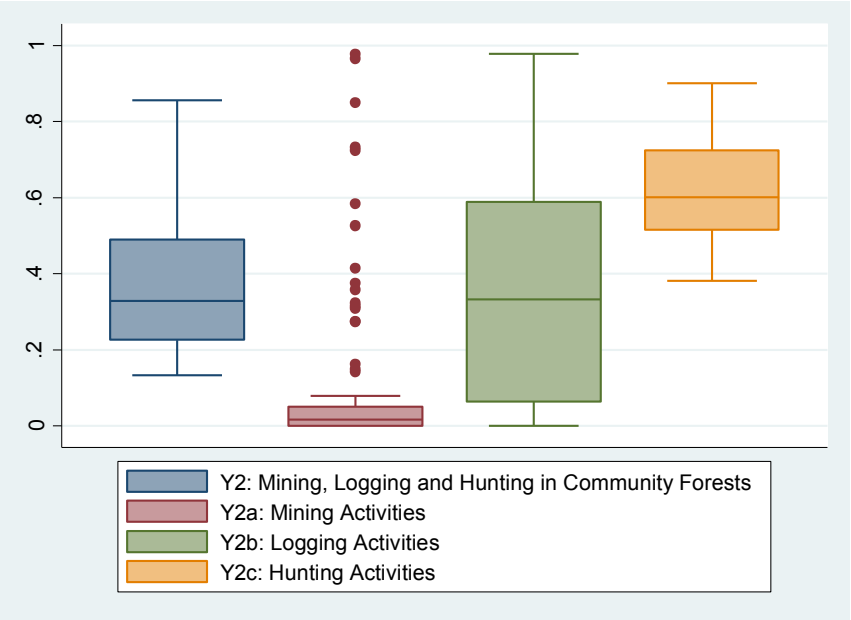

FIGURE 3: BOX PLOT ON VARIABLE Y_2 AND ITS THREE COMPONENTS

MINING

When it comes to mining, the interview results are very much in line with Table 4. When assessing interview results, it immediately stands out that mining occurs on a less frequent basis then initially expected. Follow-up questions indicated three reasons for this. Firstly, the availability of minerals people mine for differs per area. Mining spots are more widely available in certain chiefdoms than in others. Interview participants in Tunkia Chiefdom all indicated that mining did not take place in their area, due to the absence of minerals. This is backed up by regression results, which show that significantly more mining activities take place in Koya Chiefdom ($P<0.1$) as compared to the other chiefdoms, while significantly less mining activities take place in Tunkia Chiefdom ($P<0.05$). Hence, discussing mining activities is more relevant in some communities than in others. Secondly, participants told it is often not individuals that engage in mining, but large companies. Individual mining is extremely labour intensive and takes a lot of energy. Some participants told that they themselves or their husbands had tried to find mining materials, tempted by the promise of high

profits, but stopped their efforts after a couple of unsuccessful days. Finally, a thing that stood out was the reluctance people showed to speak about mining practice. The reason for this is that people experience regulations to be ambiguous or complicated and they are afraid to get in trouble with the village chief, Paramount Chief, commercial mining companies or the GRNP rangers (even though questions focussed specifically on community forests, people still indicated fear getting arrested by rangers).

The latter point stresses the complexity of the situation regarding mining. Many areas are licenced to commercial mining companies. The people that were interviewed did not know who gave out these licences, but they suspect it to be either the Paramount Chief or the federal government. When such licences are given out, village bylaws are overthrown. Furthermore, people found it hard to distinguish between the GRNP (where no mining is allowed at all) and the community forests (where regulations on mining vary a lot).

Two participants indicated that people in their village did engage in mining (Interview 1, Interview 6). In one case it concerned diamond mining, in the other case gold mining. Both participants said that the minerals they mine for have become increasingly scarce and that it is harder to find them nowadays. One respondent told they found diamonds in their community forests, and outed the wish for support in diamond mining, for example from an organisation such as GRNP (interview 9). Products obtained in mining are typically sold to middlemen traders in chiefdom headquarter towns, who then take it to larger markets such as Kenema.

LOGGING

Logging practices were also assessed during interviews. It was found that many villages incorporated logging activities in their bylaws. Bylaws differ between forbidding people to cut trees, limiting the amount of trees that can be logged, or demanding taxes from everybody that wants to engage in logging in the community forest.

Most of the time, bylaws distinguish between logging for commercial purposes and logging for construction purposes. In general, the two types of logging concern different types of trees. Large differences in perceptions were found between logging for construction purposes and logging for commercial purposes. Aside from a few exceptions, the majority of participants stated that, in their opinion, logging is acceptable as long as it was done to build houses, but was unacceptable when done with the purpose of commercial profitmaking. The reason logging for construction purposes is accepted is straightforward: people just need a house to live in and are unable to afford the costs of getting material elsewhere.

Although people stated to be against large scale logging at this point in time, many pointed out the benefits their community used to get in the past. These benefits were primarily loyalties obtained from commercial loggers and (to a lower extent) personal profitmaking. Especially loyalties were favourable for communities as a whole, since they were often stored in community funds and used for community development (such as constructing a mosque or lavatory).

The main reason for the negative stands people took towards commercial logging, was the exhaustion of available trees during the past years. People indicated that, even though logging brought them substantial benefits before, the reduction in the amount of trees suitable for logging was so drastic they now oppose to any form of commercial logging. People stated that it was important to preserve the trees in their community forest, so they would have a source of construction material for houses in the future, and a potential source of income for the future.

However, the creation and enforcement of bylaws as such does not mean logging is fully eradicated, as is reflected by the high average values shown in Table 4 and Figure 3. Some of the villages that incorporated bylaws on logging reported to experience issues arising from legal pluralism. Loggers often obtain permission to engage in logging at the chiefdom headquarters from the Paramount Chief himself. Paramount Chief permission outweighs local bylaws, so once permission is given, village chiefs have no opportunity but to follow and give permission as well. As one of the participants said: "We have our bylaws here. We don't want to permit logging to anyone. But when loggers come, they take letters from the PC, and we have to give them permission. We ask them for taxes, but most royalties are left at the [chiefdom] headquarters. Royalties are very little." (Interview 9).

HUNTING

The third component of variable Y_2 is hunting. Figure 3 shows that hunting levels are high compared to the other activities. In the 2013 survey, households were asked which animals they hunted for. The quantitative data provides information on 10 species. Out of the ten species participants were asked about, the Greater cane rat, locally known as Cutting Grass, was hunted for most. 88% of the participants reported to hunt this animal. In the second place comes the Brush Tailed Porcupine (74%), followed by Bushbuck (23%) and Maxwell's Duiker (21%). Animals that were hunted in smaller frequencies are the Sooty Mangabey (12%), Diana Monkey (6%), Black and White Colobus (4.4%), African Civet (2.4%), Water Chevrotain (2.1%) and Bay Duiker (1.1%). The qualitative data gathered for this thesis shows that households hunt for more types of animals besides those ten, including some protected animals, such as Western Red Colobus and Chimpanzee. Furthermore, people indicated to hunt for red river hog, squirrels and bats.

People gave different reasons for engaging in hunting. The main reason for hunting is food provision. As two participants indicated, "it [hunting] adds meat and protein to our diets", and "We do not have money to buy fish in the market and bushmeat makes our food very delicious." (Interview 5, Interview 6). 17 out of 21 participants said that the meat they hunt in their community forest is important for their nutrition. In the forest edge communities, the variety of available food is low and diets are monotone in terms of nutritional value. Bushmeat is regarded as a source of protein, and is locally believed to give people strength. The large majority of the bushmeat that is caught is consumed within the village itself. When people catch an animal, they usually first consume its meat themselves after which they share the rest of it with their neighbours and other villagers. Only when the amount of meat that was caught is very high, people start selling it in the market. The frequency in which this occurs is illustrated by one of the 2013 village survey questions, which show that 48.6% of the respondents hunt purely for food consumption. 50% hunts partly for consumption and partly for selling, and only 1.35% hunts solely out of commercial interests. The purpose of bushmeat hunting is thus primarily subsistence usage, rather than commercial interests.

The second important reason people engage in hunting concerns the protection of farms. 14 participants indicated that they (also) hunt in order to protect their farms. However, even when animals are primarily hunted for protection purposes, their meat is still eaten. Hunting practices take place all year round, though a peak can be observed just after the planting of new crops (for protection purposes). Surprisingly, and against expectations, hunting levels do not seem to increase in the dry season and hunger season, because animals are then further away, which makes it harder to locate and catch them.

Hunting is practiced in various ways. After asking about hunting methods, people initially all mentioned trap setting. However, after asking supplementary questions, a few participants admitted that hunting with guns is also still widely practiced. The reason why people were hesitant to speak

about hunting with guns has to do with the fact that Sierra Leonean law prohibits the ownership and usage of guns.

Trap setting is a method that is primarily used in order to protect agricultural lands. People 'fence' their farms with traps, to prevent animals from accessing the farm. Besides trap setting around farms, people also set traps in the more densely covered parts of the forest, hoping to catch animals for the purpose of food consumption. Gun hunting happened when hunting was done purely for food consumption purposes, especially when aiming to catch animals that are hard to catch in traps (such as monkeys, who spend much of their time up in the canopy).

People are well aware of the species that are unprotected (which means they are allowed to hunt them when they are inside their community forest) and the species that are protected (which means they cannot be hunted at all). Some people told they knew they could not kill those animals, as was illustrated by a woman who said: "We drive them [monkeys] away by stoning them, since we are not allowed to have guns and we are told not to kill them." (Interview 14). However, other people seemed unconcerned by this distinction between protected and unprotected animals, and felt it was their right to kill any animal that approached their farm or village. People said they knew certain animals are rare, and half of them even indicated to have noticed a decrease in the amount of times they encountered certain species (as compared to previous decades). Nevertheless they are primarily concerned with their crops and mainly think of the animals as a nuisance. As one woman stated: "When a monkey comes to our farms and eats our crops and fruits, we kill them and eat them as revenge. We did this once when a chimp came. They taste even more sweet because we know they wanted to take our crops." (Interview 19).

Although many people felt the amount of species in their community forest decreased over the years, there was another group of participants (about one third of the qualitative sample) who indicated to have noticed an increase in the amount of animal encounters due to the protection of animals inside GRNP. Most of them said they were happy with this development.

In general, questions on bushmeat hunting were sensitive. Therefore, the answers have to be treated with some caution. The main reason for this sensitivity is the fact that people were hesitant to speak about gun hunting and hunting for protected animals. However, as the interviews proceeded, a lot of people did open up about it, although the degree of openness on such matters varied a lot per participant. In general, female participants seemed to be more open then male participants, and young people shared more information than village elders or the town chief.

5.2.3 NTFP COLLECTION

Variable Y_3 captures NTFP collection. This variable ranges from 1 to 10. An important note has to be made here. For this variable applies: the lower its value, the more NTFPs are gathered. For example, value 1 means a very large amount of NTFPs is gathered, 10 means that no NTFPs are gathered at all. Although this seems not very intuitive, this decision is made because gathering of NTFPs usually has a positive impact on the state of a forest (since generally less deforestation/forest decline takes place in a forest that is rich in NTFPs). Since the interest of this research is investigating the factors correlated with Environmental attitudes and behaviour as a proxy for forest decline, it was chosen to give a higher value when less NTFPs are gathered, since it is worse for the forest.

That said, the low value for NTFP collection (1.36, 1.28 without outliers) indicates that NTFPs are gathered in a large frequency. Standard deviations are relatively low, which means that in almost all villages inhabitants collect a lot of NTFPs.

Amongst the types of NTFPs that are gathered most are palm kernel, bush yam, thatch, ratten, mushrooms and medicine. As can be seen in Table 5, there are slight differences between men and women.

TABLE 5: MOST IMPORTANT NTFPS, AS LISTED BY MEN AND WOMEN.

Most important NTFPs (Men)		**Most important NTFPs (women)**	
NTFP	*Frequency*	*NTFP*	*Frequency*
Palm kernel (Tuwi)	37	Bush Yam (Ngawei)	42
Thatch (Njasei)	31	Palm kernel (Tuwi)	30
Bush Yam (Ngawui)	29	Bush Yam (Mbo)	20
Ratten (Balue)	24	Mushroom (Falii)	15
Bush Yam (Mbo)	16	Medicine (Mbahii)	10

The frequency shows the amount of villages that listed this NTFP as one of the 3 most important NTFPs.

During interviews, participants confirmed to gather NTFPs at a large scale. The products people said to gather most frequently are to a large extent in line with those listed in Table 5. Rattan is often gathered for making chairs, thatch is gathered for the roofs of houses, palm kernel is gathered to make palm oil (which, in turn, is used to cook), and all sorts of fruits and (bush) yams are gathered to be eaten. Women often gather medicines in the forest for a wide variety of diseases, but demand was highest for medicines for treating fever or malaria.

A product that does not come back in Table 5, but was often mentioned in the interviews, is fish. Almost all villages engage in fishing in the many streams and rivers that can be found in the forests. The purpose of fishing is food provision. Until recently, fishing happened through poisoning of a certain stream, but all interview participants indicated that this method is no longer practiced since it is no longer allowed. Nowadays, fishing generally happens with small nets.

The NTFPs are primarily collected for subsistence use, but they are also sold in the market, albeit on a small scale. People mainly sell palm oil (sold by people in 70% of the villages in the 2013 village survey), fruits and vegetables (sold by people in 57% of the villages), medicinal plants, herbs and spices (sold by people in 28% of the villages) and rattan (sold by people in 26% of the villages).

NTFPs were not only gathered in the community forest, but also inside the GRNP (which is allowed for FEC inhabitants by the GRNP organisation). Most participants gather NTFPs in the GRNP occasionally, some do it on a more regular basis. In general, people initially turn to their community forest for their NTFPs (since it is easier to access and generally closer), they only turn to the GRNP for products that cannot be found in the community forest. These are usually medicines or fish.

5.2.4 AGRICULTURAL LAND

Variable Y_4 is the only variable for which the values are interpretable by themselves. In this research, the focus is on the share of agricultural land, in order to control for variation in agricultural land resulting from natural variation in village size. On average, the share of agricultural land is 61% of all village land. The remainder is used for village land (bare soil), water or forestland. The standard deviation (0.12) is small, which indicates little variation. The average (absolute) amount of cultivated land was calculated as well: On average, the total amount of cultivated land in a village was 565.3 acres. However, this variable includes quite some extreme values. Therefore, the average value of variable Y_4 was also calculated without outliers (those values that are lower than *Q1 – 1.5 iqr* or higher than *Q3 + 1.5 iqr*). After excluding the outliers, the average value is 315.2 acres. The exclusion of these 10 extreme values thus has a large impact on the average value and standard deviation.

The most cultivated crops is rice. It is almost purely used for subsistence purposes. Excess harvest, if any, is sometimes sold in the market. However, situations of surplus harvest are rare, since almost all participants indicated that households deal with hunger gaps every year. A hunger gap (also known as the hungry season) is the period between consumption of last year's harvest and the new harvest, in which households have to buy rice in the market. Besides rice, many farmers have a small vegetable garden or plantation, on which they grow limited amounts of cash crops, such as pepper, palm oil, cocoa or groundnuts. These are more often sold in the market. Transactions costs of selling those products are, however, high, since most communities are far away from vehicle roads or markets. With low access to cars or motorbikes, products often have to be transported by foot, which is costly in terms of time and energy.

Yet, many farmers have the wish to increase production so they can sell (more) in the market. Decisions on the amount of land that is to be brushed in a certain year are mainly limited by people's means to buy agricultural inputs (especially labour). Multiple respondents (7 out of 21) indicated to have decreased or increased the size of their farm (as compared to last year) based on their capacity to hire farm workers. This effect was expected to be in place for other inputs (such as fertilizer and pesticides) as well, but none of the participants made use of those inputs due to financial constraints.

Depending on the community, decisions on the amount of cultivated land are not only made by the people themselves. In many villages, chiefs and village elders have the last word in assigning land and setting the fallow period of the land. The role of the chief was particularly large in the villages where the villagers indicated that land scarcity was a problem and that there was not enough land for everyone.

In conclusion, the activities taking place in the community forests are numerous. People report to have very positive attitudes towards conservation. Yet those attitudes do not always translate back into their behaviour, even though many bylaws and structures are in place to regulate forest use. Agricultural activities, hunting and NTFP collection are common practices in community forests. Logging and, to a lower extent, mining are also practiced. These are all activities that negatively influence the (state of the) forest, so the scope at which these activities take place are not in line with the positive attitudes people reported to have towards conservation. The gap between attitudes and behaviour can be caused by a social desirability bias, which means that people give social desirable answers according to whatever they believe the interviewer wants to hear. However, it is also possible that people actually attach importance to conservation, but do not see any chance of changing their behaviour because of the extreme poverty many of the communities suffer from. In the next section, an assessment of the factors that correlate with these attitudes and behaviours will follow, in order to improve insight in the underlying processes that are in place. Also, the correlation between the dependent variables themselves will be assessed.

5.3 Assessment of the factors correlated with Environmental Attitudes and Behaviour

This section presents results for RQ2: *Which factors correlate with environmental attitudes and behaviour in the context of GNRP and its surrounding community forests?*. RQ2 is answered by estimating five models, using an Ordinairy Least Squares (OLS) regression technique. The section presents and discusses these regression results and links them to qualitative interview results, in order to assess to what extent the interview data can explain, confirm or reject the correlation results.

5.3.1 Main Analysis

This section discusses the results of five regressions. The first regression is the regression of the composite indicator *Environmental Attitudes and Behaviour*, which serves as a proxy for forest decline, on the set of independent variables. Thereafter, four separate regressions are done one each of the components of the independent variable: Y_1 (Conservation Attitudes), Y_2 (Activities in Community Forest), Y_3 (NTFP Collection) and Y_4 (Share of Agricultural Land). For each regression, I first discuss the results of the correlation between the dependent and the independent variables separately. Afterwards, the estimation results of the model as a whole are discussed.

After estimation, all results were checked for multicollinearity. No serious multicollinearity occurred. Furthermore, the assumption of normally distributed residuals, and the linearity condition are met for all regressions.

ENVIRONMENTAL ATTITUDES AND BEHAVIOUR

Table 6 presents the results of regressing the composite independent variable, Environmental Attitudes and Behaviour, on the set of independent variables ($Z_1 - Z_8$) and a set of control variables in order to assess the correlations between those. In order to minimize the limitation in sample size resulting from missing data, the dependent variable is first regressed on the independent variables separately, after which the model is estimated as a whole.

The variable *Environmental Attitudes and Behaviour* is defined in such a way that it takes a high value when attitudes and behaviour are negative for the forest (which indicates a higher risk of forest decline), it takes a low value when attitudes and behaviour are positive for the condition of the forest (and the chances of forest decline to occur are lower).

Table 6 shows both positive and negative correlations between the independent variables and Environmental Attitudes and Behaviour. The results of regressing the dependent variable on each independent variable separately (as presented in columns (1) – (8)) are discussed first. Afterwards, the regression results of the full model (as presented in columns (9) and (10)) are discussed.

The variables of which the correlation coefficients are significantly different from zero are *Distance to the nearest road*, *Forest abundance* and *Shocks* (which are all negatively correlated with Environmental Attitudes and Behaviour) and *Population* (which is positively correlated with Environmental Attitudes and Behaviour).

Distance to the nearest major town is negatively correlated with Environmental Attitudes and Behaviour ($P < 0.1$), which means that villages closer to a major town had attitudes and behaviours that are more positive for the forest. This can be explained by looking at forest dependency. Communities closer to towns (potentially) have alternative income opportunities besides the forest, which makes them less dependent on the forest. A similar explanation applies for the variable *Distance to the nearest road.* The coefficient is insignificant, but still has a negative sign, which means that villages closer to roads showed more positive attitudes and behaviours. The presence of a (nearby) road enables people to travel to towns faster and cheaper, which opens up a window for alternate income opportunities. However, it should be noted that the correlations for both variables are weak, since both coefficients are small.

Distance to the GRNP has a positive (yet insignificant) correlation coefficient. The size of the coefficient is 0.102 standard deviations, which means that villages further from the forest had, on average, attitudes and behaviours that are more negative for the forest. A village is less dependent on the forest when it is further away from it, which can explain why attitudes are more negative and more activities that impact the forest are done; the interests of sustainable forest use are simply not as large.

Also, it is possible that villages closer to the GRNP want to engage in more activities, but are unable to do so since they are more limited in the directions in which they can expand their activities (since it is not allowed to go into the GRNP for agriculture, hunting, logging or mining).

Population is significantly correlated to environmental attitudes and behaviours at the 1% level, and the coefficient is relatively large: 0.466 standard deviations, implying a strong correlation. Villages with more inhabitants had attitudes and behaviours that influenced the forest way more negatively than villages with fewer inhabitants. The explanation for this is intuitive and is much in line with the interview results that were previously discussed: a larger population means more mouths to feed, which demands a higher harvest and more income. For that reason, people's engagement in agriculture, mining, hunting and logging is likely to be higher. This correlation is especially interesting, since the population pressure in the FECs is very high[4], which brings the risk that the pressure on the forest is only going to increase the coming years (Statistics Sierra Leone (SLL) en ICF International 2014).

The next variable that has a coefficient significantly different from zero (at the 1% level) is *Forest abundance*. The negative coefficient shows that villages with a higher share of forestland had attitudes and behaviour that were more positive to the forest. The explanation for this is not straightforward, since an endogeneity problem is in place here: Possibly, the negative correlation exists because the proximity of (a lot of) forest shows people the importance of sustainable forest management. Also, when forestland is in abundance, it is easier to manage it sustainably, since certain plots of land can be restricted from any activities taking place, and fallow periods can be increased. However, the underlying explanation can also be the other way around: it is also possible that the forest share higher is *because* attitudes and behaviour are more positive for the forest. Seemingly both processes are in place. Unfortunately, given the available data, it is not possible to conclude which in direction this correlation is strongest.

Both the variables *Economic value of the forest* and *Institutions* seem not to be of importance in explaining the variation in environmental attitudes and behaviour. Besides not being statistically significant, the coefficients are very small (both smaller than 0.1 standard deviations). The values of $R^2_{Adjusted}$ are negligibly small as well, for which reason they will not further be discussed in this section.

A negative correlation is found between agricultural S*hocks* and environmental attitudes and behaviour ($P < 0.1$). The coefficient is -0.102 standard deviations. This implies that the occurrence of shocks relieved the pressure on the forest. This is contrary to expectations, since it was expected that shocks would make people turn to the forest as a safety net (to find substitutionary food and income). A possible explanation concerns the occurrence of high yield shocks. In the villages that experienced such a shock it is intuitive why the pressure on the forest was lower; there simply was lower need for additional food and income. However, only 2.2% of all villages in the sample indicated to have experienced very high yields, which makes the influence of high yields negligible.

Interview results are more helpful in speculating about the process in place. Interview results match regression results here in the sense that many participants indicated that they did not increase activities like hunting during the hungry season, when stocks of last year's harvests are depleted and people are

[4] [4] In 2013, the average fertility rate in Sierra Leone was 4.9 births per women, which is amongst the top 20 of the world. In rural areas (such as the areas where the FECs are situated), fertility rates exceed this national average with a value of 5.9.

forced to buy additional food in the market. The reason people gave for this is that they were busy working on their farms (trying to ensure a good new harvest the coming season). Although the hungry season and an agricultural shock/crop failure are not one-to-one comparable, these results might still partially explain why the pressure on the forest was not higher in villages that experienced agricultural shocks.

Column (9) and (10) of Table 6 show the estimation results of regressing Environmental Attitudes and Behaviour on the full set of independent variables. Control variables are excluded in column (9) and excluded in (10). The model is found to be statistically significant at the 1% level ($F = 4.637$). Yet the value for $R^2_{Adjusted}$ is only 0.26, which means that only 26% of the variation in Environmental Attitudes and Behaviour is explained by the model. In this the full model (i.e. all independent variables included), the correlation coefficients of two independent variables are significantly different from 0: *Distance to the nearest major town* and *Forest abundance*. Both these variables are negatively correlated with Environmental Attitudes and Behaviour. The H0 of no correlation is thus rejected. For *Distance to the nearest major town*, this correlation takes the expected direction, but for *Forest Abundance* the direction of the correlation is opposite to what was hypothesized. For all other variables, H0 could not be rejected.

The correlation between *Distance to the nearest major town* and environmental attitudes and behaviour is found to be statistically significant at the 5% level. However, the correlation coefficient is only -0.05 standard deviations, which is small. A stronger correlation is found between *Forest abundance* and Environmental Attitudes and Behaviour: the correlation coefficient is -0.186 standard deviations *($P < 0.01$)*. The (possible) processes in place are already discussed above, and the fact that the coefficients as well as the significance levels do not change much after including the other independent variables and control variables indicates robust results.

Another variable that is worthwhile to mention concerns variable Z_4: *Population*. Although, insignificant, the correlation coefficient takes a value of 0.26 standard deviations. This is informative, since this is the highest correlation coefficient in this model. Even though it cannot be confirmed by statistical tests, this result points towards a positive correlation between population and Environmental Attitudes and Behaviour, which means that the importance of population should not be underestimated.

Finally, it is important to briefly mention the variable *Shocks*. For ambiguous reasons, the occurrence of agricultural shocks was negatively correlated with Environmental Attitudes and Behaviour when regressed separately, but the variable now has a small and insignificant correlation coefficient. This means that the variation in the dependent variable is now explained by all the other variables. As such, a remark has to be made about the robustness of the correlation coefficient as shown column (8): the coefficient needs to be interpreted reluctantly. In the full model, the coefficients of the remaining variables are both small and insignificant, and will therefore not be discussed here.

TABLE 6: OLS RESULTS: ENVIRONMENTAL ATTITUDES AND BEHAVIOUR

	Environmental Attitudes and Behaviour									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Distance to nearest major town	-0.046*								-0.035*	-0.051**
	(0.027)								(0.018)	(0.021)
Distance to GRNP		0.102							0.051	0.017
		(0.070)							(0.081)	(0.086)
Distance to the nearest road			-0.0970						0.007	0.064
			(0.0703)						(0.084)	(0.080)
Population				0.466***					0.206	0.260
				(0.169)					(0.267)	(0.272)
Forest abundance					-0.176***				-0.190***	-0.186***
					(0.036)				(0.051)	(0.049)
Economic value of the forest						-0.023			0.005	0.004
						(0.053)			(0.097)	(0.102)
Institutions							0.027		-0.068	-0.033
							(0.042)		(0.045)	(0.049)
Shocks								-0.102*	-0.011	-0.027
								(0.058)	(0.060)	(0.056)
Chiefdom fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Constant	0.547	0.551*	0.608**	0.832***	0.487*	0.684**	0.664**	0.758***	-0.164	0.407
	(0.341)	(0.280)	(0.255)	(0.270)	(0.253)	(0.273)	(0.267)	(0.260)	(0.146)	(0.325)
N	56	72	72	72	72	72	72	72	56	56
F	1.338	2.056	1.847	2.790	5.039	1.753	1.800	2.369***	3.343***	4.637***
$R^2_{Adjusted}$	0.060	0.104	0.102	0.170	0.286	0.072	0.074	0.120	0.244	0.263

Robust standard errors in parentheses. Significance is based on naive P-values. Control variables include average (village) income, gender and bylaws.
** p < 0.10, ** p < 0.05, *** p < 0.01*

CONSERVATION ATTITUDES

After estimating the composite indicator, the dependent variables (Y_1 - Y_4) were separately regressed on the independent variables in order to assess the correlations in more detail. Table 7, 8, 9 and 10 present the results of these regressions. Again, regression coefficients are standardized and standard errors are robust. The first regression results that will discussed are the OLS results for variable Y_1 (*Conservation attitudes*). These are presented in Table 7.

Table 7 shows that Conservation Attitudes are positively correlated with the *Distance to the nearest road* ($P < 0.01$). The relatively large coefficient of 0.32 standard deviations, and the fact that it significantly differs from zero at the 1% level, show that a strong positive correlation exists between distance to the nearest road and conservation attitudes. On average, villages further away from roads were more positive about conservation. A possible explanation for this correlation is that proximity to a road increases people's access to sources of income other than the forest. When people have alternative income possibilities, forest dependency is lower and people might be more positive towards conserving their community forests, the GRNP, and towards the GRNP organisation in general.

No significant correlation is found between *Population* and *Conservation attitudes*. However, it is still discussed since the size of the coefficient is relatively high (-0.258 standard deviations). This coefficient suggests that larger villages were more negative towards conservation, most likely because larger villages have a higher need for food, income and forest products (and would therefore appreciate more areas they can do this in). It is likely that significance could not be detected due to noise in the sample, as reflected in the large standard error. If the sample size were to be increased, it could be possible to detect whether this correlation is actually statistically significant.

A similar situation applies for *Forest abundance*. The correlation coefficient is 0.146 standard deviations, but it not statistically significant. The result suggests that villages that have higher shares of forestland had more positive Conservation attitudes. The most likely explanation for this, is the idea that attitudes are more positive when there is enough forest for everybody anyway. When villages are not limited in the amount of land they have available for farming and other forest activities, people are more likely to support conservation since conservation of forestland does not impact them as much. However, when land is scarce and people have a hard time producing enough on the land they have, the support for conservation is lower because people wish to expand their activities into the GRNP and fear that parts of their (already scarce) community forest plots will be declared protected areas as well. This explanation is strongly supported by interview data: villages in which people claimed to have enough land to engage in all the activities they wanted to do (including maintaining a sustainable fallow period) had more bylaws on sustainable management of the community forests. These villages also demarcated a plot of their own community forest as protected forest land more often, and seemed to be more positive about sustainable usage of their land. On the other hand, villages that said to have land scarcity in their community forest, were less concerned with conservation and sustainable management because their situation simply did not allow them to do so. However, as in the previous section, there might be endogeneity in place again, in the sense that forest abundance might be higher *because* attitudes are more positive.

Full model results are presented without any controls (column 10), with chiefdom fixed effects (11), with chiefdom fixed effects and control variables (12). The values of $R^2_{Adjusted}$ indicate that the predictive value of the model increased a lot when the controls are included. Nevertheless, all three columns are presented, since some of the differences between the models with and without controls are striking.

As can be seen in column (12) (and (11)) the only variable that is shown to be significantly correlated with attitudes is the variable *Institutions*. This vairable measures institutional quality, as represented in the quality of leadership. The positive coefficient of 0.228 ($P < 0.05$) implies that people in villages with a higher quality of leadership were more positive towards conservation of the forest. The most likely explanation for this is that people in those villages had more certainty that conservation (by)laws would actually be implemented and enforced in an effective way. Also, they may have had more influence on bylaws and conservation policies for the GRNP (through their chief), which can explain why they are more positive.

The remainder of the variables were not statistically significant. Still, a few things stand out. In the first place, *distance to the GRNP* is not significantly correlated with attitudes anymore when it is included in the full model. The coefficient is slightly lower as well (0.205 instead of 0.322).

Secondly, it is interesting to consider *Population*. None of the coefficients for population are statistically significant. Yet, they are worth mentioning, since two things stand out. The size of the coefficients is very large. Without control variables, the coefficient is 0.99, which is high compared to all other coefficients in this model. Adding Chiefdom fixed effects and control variables yields correlation coefficients of 0.76 and 0.43 respectively. This means the variation across chiefdoms and across differences in control variables accounts for much of the variation that was previously attributed to population. The sign of the correlation coefficients is even more striking: whereas the correlation coefficient resulting from regressing attitudes and population separately was negative, the coefficients showing the correlation coefficients between population and attitudes in the full model are positive (indicating that larger villages had more positive attitudes). Unfortunately, neither the quantitative data not the interview data provide and explanation for this, which means that additional research is required to explain these findings.

Finally, whilst *Forest abundance* is not significant in the model including control variables, it is in the model without. The variation is forest abundance is most likely captured by incorporating Chiefdom fixed effects. Some of the chiefdoms are larger or more remote than others, and villages some of those more remote/land abundant chiefdoms on average have a higher forest abundance than villages in the other chiefdoms, which explains why the variation previously explained by forest abundance is now explained by chiefdom fixed effects.

TABLE 7: OLS RESULTS: CONSERVATION ATTITUDES

	Conservation Attitudes										
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)	(12)
Distance to nearest major town	0.068								0.067	0.075	0.086
	(0.105)								(0.075)	(0.065)	(0.080)
Distance to GRNP		-0.027							0.114	0.0568	0.134
		(0.111)							(0.159)	(0.148)	(0.165)
Distance to the nearest Road			0.322***						0.229	0.265	0.205
			(0.094)						(0.171)	(0.177)	(0.205)
Population				-0.258					0.990	0.759	0.428
				(0.344)					(0.62)	(0.528)	(0.571)
Forest abundance					0.146				0.223**	0.127	0.107
					(0.100)				(0.094)	(0.103)	(0.139)
Economic value of the forest						-0.051			-0.059	0.001	0.112
						(0.137)			(0.202)	(0.188)	(0.175)
Institutions							0.056		0.185	0.205**	0.228**
							(0.086)		(0.112)	(0.100)	(0.109)
Shocks								0.130	0.107	0.151	0.186
								(0.119)	(0.124)	(0.139)	(0.168)
Constant	0.071	0.006	-0.006	-0.106	-0.193	0.065	0.050	-0.019	0.363	-0.081	0.020
	(0.606)	(0.538)	(0.471)	(0.573)	(0.464)	(0.529)	(0.524)	(0.526)	(0.266)	(0.333)	(0.648)
Chiefdom fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
N	66	87	87	88	78	88	88	88	63	63	62
F	6.025	33.06	43.84	19.58	.	20.32	24.43	64.16	2.229**	3.858***	.
r2_a	0.177	0.182	0.291	0.189	0.405	0.179	0.181	0.193	0.065	0.236	0.341

Standard errors in parentheses. Significance is based on naive P-values. Control variables include average income, gender and chief's education level.
** p < 0.10, ** p < 0.05, *** p < 0.01*

ACTIVITIES IN THE COMMUNITY FOREST

The next regression results that will be discussed are the results of the OLS regression of Activities in the Community Forest on the set of independent variables. Regressing the independent variables separately did not yield many interesting results. None of the correlation coefficients are significantly different from 0 and all coefficients are very small, besides the coefficient for *Population* (which is 0.295 standard deviations).

Even though the coefficient for *Population* is not statistically significant, it still points towards a positive correlation between Activities in the community forest and population. This means that, in villages with larger populations, more hunting, logging and mining took place.

Regression of the full model yields more interesting results. The correlation between *Population* and Activities in the Community Forest turns out way stronger when controlled for all other variables. The correlation coefficient is now 1.302, which is very high compared to all other coefficients. Also, the coefficient is now significantly different from zero ($P < 0.05$). The correlation also came back in the interview results. Various participants stated that the rising population in their village (and in one case even in their household) led to a higher demand for houses (and thus for timber as a construction material). Two of the participants indicated a similar relation to be in place between hunting and increased demand for food resulting from a rise in population (as compared to roughly ten years ago). The correlation between population and mining levels was not mentioned by any of the participants.

Table 7 shows one other variable with a significant coefficient: *Distance to the nearest major town*. The correlation is negative, which means that villages further away from a town engaged less in hunting, logging and mining. This can probably be explained by the fact that more remote villages have lower incentives (resulting from higher transactions costs) to sell their forest products in town. However, the coefficient is very small, so the correlation is weak.

A final comment that needs to be made about this model is that it is significant at the 1% level, but the $R^2_{Adjusted}$ is only 0.279.

TABLE 8: OLS RESULTS: ACTIVITIES IN THE COMMUNITY FOREST

	Activities in Community Forest										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Distance to nearest major town	-0.081 (0.059)								-0.095*** (0.031)	-0.074** (0.033)	-0.098* (0.056)
Distance to GRNP		-0.068 (0.154)							-0.065 (0.191)	-0.137 (0.196)	-0.078 (0.199)
Distance to the nearest road			-0.098 (0.089)						0.060 (0.194)	0.169 (0.205)	0.166 (0.200)
Population				0.295 (0.254)					1.223** (0.529)	1.395** (0.639)	1.302** (0.609)
Forest abundance					0.023 (0.091)				0.060 (0.112)	-0.026 (0.100)	-0.029 (0.098)
Economic value of the forest						0.0004 (0.150)			0.187 (0.241)	0.012 (0.242)	-0.053 (0.227)
Institutions							-0.032 (0.086)		-0.046 (0.12)	-0.043 (0.097)	-0.097 (0.118)
Shocks								-0.046 (0.116)	-0.142 (0.128)	0.041 (0.136)	0.070 (0.144)
Constant	-1.101 (0.850)	-0.222 (0.745)	-0.294 (0.733)	-0.124 (0.721)	-0.027 (0.775)	-0.301 (0.714)	-0.282 (0.710)	-0.258 (0.725)	0.409* (0.232)	-0.0256 (0.270)	-0.434 (0.873)
Chiefdom fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
N	60	82	82	83	72	83	83	83	56	56	56
F	12.34	4.610	4.885	4.487	4.984	4.636	4.545	4.584	6.009***	9.241***	6.924***
$R^2_{Adjusted}$	0.264	0.241	0.249	0.252	0.246	0.238	0.239	0.240	0.116	0.275	0.279

Standard errors in parentheses. Significance is based on naive P-values. Control variables include average income, gender and bylaws.
** p < 0.10, ** p < 0.05, *** p < 0.01*

NTFP COLLECTION

The third dependent variable is NTFP Collection. Regression results for this variable are presented in Table 9. In order to make it comparable with the other independent variables, the NTFP variable is defined in such a way that a lower value indicates more NTFP collection. At first instance, this seems counterintuitive, but it is nonetheless done because NTFP collection is perceived as a positive influence on the forest (and the variable must, in the end, be comparable to the other dependent variables). After regressing the independent variables separately, positive correlations were found for distance to the nearest road and forest abundance, while a negative correlation is found for distance to the nearest town.

The correlation between *Distance to the nearest major town* and NTFP collection is negative. This implies that villages closer to a town gather significantly more NTFPs (*P < 0.05*). Although significant, the coefficient is very small (-0.060 standard deviations), so the correlation is not very strong. A possible explanation is the relative proximity of markets when a village is situated closer to a

major town. Proximity of markets provides people with the opportunity to sell NTFPs in the market, which can be an incentive to extract more NTFPs from the forest.

Distance to the nearest road is positively correlated with NTFP collection ($P < 0.1$). The coefficient is 0.496 standard deviations, which is large compared to the other coefficients. Villages closer to roads were found to gather fewer NTFPs. Possibly, because proximity to a road makes it easier for people to engage in alternative income activities, which makes them less dependent on the forest. Also, they can travel to the market in less time, or at fewer costs, so they can more easily buy products they need (instead of gathering them themselves). However, this explanation clashes with the reasoning behind the negative relation with distance to the nearest major town, so it is unclear what process is precisely in place here. There are, however, two indications that point towards the second explanation (proximity to the road making it easier for people to engage in alternative income activities or buy products in the market).

The first indication concerns the correlation coefficients of both variables. The coefficient for distance to the nearest town is much smaller than that for distance to the nearest road, which suggests that the second correlation is stronger than the first. The second indication is derived from interview results. During interviews, a majority of interview participants indicated that the main reason they collected NTFPs was subsistence purposes. People did sell NTFPs in the market, but this happened on a small scale and profits are very little. NTFP collection for commercial purposes thus happens, but only to a limited extent. Thus, since NTFPs were mainly gathered for subsistence purposes, the role of *Distance to the nearest major town* is estimated to be limited.

This information is also useful when looking at the correlation between NTFP collection and *Economic value of the forest*. At first sight, it seems striking that no statistically significant correlation exists between these two variables. However, even though it is not statistically significant, the correlation coefficient of -0.142 is still informative. The coefficient in this regression is much higher than the coefficients for *Economic value of the forest* in all other models. It suggests higher rates of NTFP collection in villages in which the (estimated) economic value of the forest is higher. The high standard error can limit the ability to detect a significant result here. Another reason why the coefficient is smaller than expected is the fact that NTFP collection for commercial sale does not happen on a very large scale.

Variable Z_5, which measures *Forest abundance*, is positively correlated with NTFP collection as well. This means that, where forest abundance is high, fewer NTFPs are gathered. This finding is not in line with expectations (since people were expected to gather more NTFPs when they had more forest available). The underlying process is still ambiguous and can, unfortunately, not be explained by quantitative data nor interview data.

Regressing NTFP collection on all independent variables together only shows two significant correlations: a negative correlation between NTFP collection and *Distance to the nearest major town*, and a positive correlation between *Forest abundance* and NTFP collection. Again, the reasoning behind both correlations is somewhat ambiguous. The predictive value of the model is somewhat higher than that of the previous models. $R^2_{Adjusted}$ is 0.308, which means that about 31% of the variation in NTFP collection is explained by the independent – and control variables.

TABLE 9: OLS RESULTS: NTFP COLLECTION

	NTFP Collection										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Distance to nearest major town	-0.060**								-0.023	-0.035	-0.045*
	(0.025)								(0.014)	(0.022)	(0.026)
Distance to GRNP		-0.122							-0.000	0.162*	0.092
		(0.131)							(0.079)	(0.084)	(0.087)
Distance to the nearest Road			0.496*						0.082	0.038	0.064
			(0.273)						(0.083)	(0.102)	(0.097)
Population				1.166					0.066	0.009	-0.041
				(0.952)					(0.361)	(0.302)	(0.267)
Forest abundance					0.206***				0.159*	0.178**	0.201**
					(0.056)				(0.082)	(0.084)	(0.083)
Economic value of the forest						-0.142			-0.034	0.065	0.113
						(0.312)			(0.062)	(0.059)	(0.080)
Institutions							-0.015		-0.003	0.030	0.077
							(0.109)		(0.058)	(0.059)	(0.066)
Shocks								0.227	0.018	0.057	0.043
								(0.152)	(0.057)	(0.060)	(0.077)
Chiefdom fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Constant	0.377	0.579	0.479	1.167	0.256	0.383	0.474	0.167	-0.139	-0.209*	0.545
	(0.436)	(0.554)	(0.480)	(0.849)	(0.276)	(0.458)	(0.508)	(0.443)	(0.142)	(0.115)	(0.479)
N	66	87	87	88	78	88	88	88	63	63	62
F	1.428	3.500	9.545	1.265	.	3.184	2.275	4.549	1.627	2.453**	.
$R^2_{Adjusted}$	0.189	0.001	0.222	0.209	0.293	0.006	-0.003	0.037	0.081	0.182	0.308

Standard errors in parentheses. Significance is based on naive P-values. Control variables include average income, gender, bylaws and education level of the chief.
** p < 0.10, ** p < 0.05, *** p < 0.01*

SHARE OF AGRICULTURAL LAND

The final model that will be discussed estimates the correlation between the independent variables and the share of agricultural land. Regression results of this correlation are presented in Table 10. Due to the strong correlation between population and agricultural land, population was included as additional control variable. The significance levels as well as the sizes of the correlation coefficients of the population variable show the importance of controlling for population.

Distance to GRNP is positively correlated with the share of agricultural land ($P < 0.05$). The positive correlation shows that villages at larger distance from the GRNP had, on average, higher shares of agricultural land. The correlation is quite strong, given the coefficient of 0.350 standard deviations. A possible (speculative) explanation for this has to do with the availability of land. Villages closer to the GNRP are more restricted in the expansion possibilities for their agricultural lands, since they cannot expand into the GRNP.

Distance to the nearest road is negatively correlated with the amount of cultivated land ($P < 0.1$). The share of agricultural land was lower in villages further away from roads, which might be related to the increased transactions costs of selling agricultural products in the market (leading to lower incentives to trade in this market), once this market is harder to reach over road. Consequently, the incentives for people to produce additional crops for the market are lower. Furthermore, expansion possibilities might play a role here. Villages further away from roads were in general closer to the GRNP. As explained above, proximity to the GNRP might restrain villages in the expansion of agricultural lands, since they are unable to expand into at least one direction (the direction of the GRNP).

Column (4) shows a very strong correlation between *Population* and the share of agricultural land: the correlation coefficient is 1.057 standard deviations ($P < 0.01$). This correlation is intuitive and easy to explain: a larger population comes with a higher demand for food, which requires the amount of land attributed to agricultural purposes to be higher. During interviews, this relation was often mentioned by people, who often spoke about their growing populations and the need to clear more agricultural land every season.

The strongest correlation in Table 10 is the correlation between *Forest abundance* and the share of agricultural land. The correlation coefficient is -0.746 standard deviations, and is statistically significant at the 1% level. This correlation was expected, since it is quite inherent given the way the variables were defined. Naturally, when the share of forestland in a community is higher, the share of agricultural land is inherently likely to be lower. Villages face a trade-off between devoting land to agriculture on the one hand and forestland on the other hand.

Economic value of the forest is negatively correlated with the share of agricultural land ($P < 0.05$), which implies villages in which the economic value of the forest was higher, a smaller share of land was cleared for agriculture. This is because people have higher incentives to maintain their community forest forest, once its value in terms of products that can be gathered there is higher.

The remainder of the variables, *Distance to the nearest major town, Institutions* and *Shocks,* have correlation coefficients that are both small and statistically insignificant, for which reason they will not be discussed here.

Looking at the full model, it is easily detectable that this model's predictive value is the highest of all models. The $R^2_{Adjusted}$ of 0.637 indicates that 63% of the variation in share of agricultural land is explained by the independent variables. Furthermore, the model is significant at the 1% level. However, many correlations that were found after assessing the variables separately do not come back

in the integrated model. The only variable that is still significantly correlated with the share of agricultural land is *Forest abundance*. Presumably, this correlation is so strong, that is accounts for all variation that was previously explained by the other variables. This correlation results from a trade-off villages face between land clearance for agriculture and maintaining forestland.

The absence of statistically significant correlations between the share of agricultural land and all independent variables besides forest abundance stands out even more when comparing regression results with the interview data. Especially when it comes to the role of population, the interview results are not completely in line with the quantitative results. Population pressure is extremely high in the villages in the surroundings of the GRNP, primarily because of excessively high fertility rates (Statistics Sierra Leone (SLL) en ICF International 2014). In slash-and-burn agriculture, new parcels of land are cleared every season, which means that every season again people have to make decisions about the size of their farm. During interviews, population growth (and more specifically the increased demand for food resulting from this growth) was often mentioned as the most important reason patches of (primary) forest were increasingly brushed and made into farm bush, since a larger family means more mouths to feed, which requires higher harvests. In most communities, land scarcity is not a problem yet, although it was often indicated that land is becoming increasingly scarce now that populations are growing.

There are differences between regression results and interview results for two of the other variables as well. Even though multiple participants spoke about constraints for selling harvest in the market (high transactions costs resulting from large distance to town or road/no access to motorbikes), neither distance to the town nor distance to the nearest vehicle road showed up to be significantly correlated to the share of agricultural land in Table 10. This tells us that, even though people experience the transactions costs as a constraint, it apparently does not influence their decisions on how much land to cultivate.

TABLE 10: OLS RESULTS: SHARE OF AGRICULTURAL LAND

	Share of Agricultural Land									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Distance to nearest major town	-0.029								0.002	-0.043
	(0.044)								(0.048)	(0.042)
Distance to GRNP		0.350**							0.107	0.227
		(0.164)							(0.139)	(0.153)
Distance to the nearest road			-0.289*						-0.168	0.087
			(0.164)						(0.117)	(0.119)
Forest abundance					-0.746***				-0.600***	-0.790***
					(0.083)				(0.078)	(0.091)
Economic value of the forest						-0.277**			-0.157	-0.225
						(0.129)			(0.142)	(0.164)
Institutions							0.037		-0.068	-0.050
							(0.109)		(0.086)	(0.089)
Shocks								-0.028	0.015	0.127
								(0.126)	(0.104)	(0.103)
Population	1.259**	0.856**	0.803**	1.057***	0.037	1.170***	1.124**	1.115**	0.177	-0.005
	(0.516)	(0.406)	(0.354)	(0.397)	(0.266)	(0.411)	(0.427)	(0.440)	(0.354)	(0.359)
Constant	1.473**	0.466	0.636	0.137	-0.264	1.138**	0.969*	1.002*	0.221	-0.182
	(0.731)	(0.554)	(0.465)	(0.151)	(0.465)	(0.558)	(0.565)	(0.568)	(0.147)	(0.591)
Chiefdom Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
N	63	81	81	118	81	80	80	80	63	63
F	1.446	4.486	2.653	6.117	17.69	2.617	2.717	2.806	17.72***	16.81***
$R^2_{Adjusted}$	0.041	0.194	0.183	0.201	0.603	0.193	0.146	0.146	0.530	0.637

Robust standard errors in parentheses. Significance is based on naive P-values. In the regressions, there was controlled for population. Other control variables included average income and gender.
** p < 0.10, ** p < 0.05, *** p < 0.01.*

5.3.2 CORRELATIONS BETWEEN THE OUTCOME VARIABLES

After finishing the main analysis, it was checked whether there were any correlations between the dependent variables themselves. The results of these pairwise correlations are presented in Table 11.

When looking at Table 11, one aspect immediately stands out. The amount of statistically significant correlations that are found is considerably lower than previously expected. The only two variables that are significantly correlated (at the 5% level) are NTFP collection and the Share of agricultural land. They are correlated with a correlation coefficient of -0.227 standard deviations, which is large compared to the other correlation coefficients in Table 11. The correlation is negative, which means that villages that have more agricultural land have a lower score for NTFP collection.

The correlation between Activities in the community forest and the Share of agricultural land has a coefficient of -0.182 standard deviations. The result is not statistically significant, but suggests a negative correlation between the two variables. This means that villages with a larger share of agricultural land engage less in activities in the community forest. The correlation can intuitively be explained: if more land is devoted to agriculture, fewer forestland remains, limiting the potential to engage in activities in the community forest. This seems intuitive, but does provide additional information: Apparently, hunting, mining and logging on a certain plot of forestland do not intensify once forestland shrinks in area.

Especially for the variable Conservation Attitudes the results are striking, since strong correlations were expected for this variable. Based on theory, it was estimated that people's attitudes would influence their behaviour. The lack of any correlation between attitudes and the other activities can mean that people act regardless of their beliefs. Even though they think the forest is important, in the end they may attach more value on the activities they do (and the income it generates) over their attitudes towards the forest. Also, since people were asked about their conservation attitudes, and the activities all take place in the community forest, it is possible that people care way more about the GRNP than they do about their community forest. Another explanation is that there was a reporting bias in the attitudes variable. Since people were asked about their attitudes, it is likely that they gave socially desired answers and reported to be more positive than they actually are.

TABLE 11: INDEPENDENT VARIABLES – PAIRWISE CORRELATIONS

	Y_1: Conservation Attitudes	Y_2: Activities in Community Forest	Y_3: NTFP Collection	Y_4: Share of Agricultural Land
Y_1: Conservation Attitudes	1.000			
Y_2: Activities in Community Forest	-0.066	1.000		
Y_3: NTFP Collection	0.0029	-0.089	1.000	
Y_4: Share of Agricultural Land	-0.050	-0.182	-0.227**	1.000

Correlation coefficients are standardized. Significance is based on naive P-values.
** p<0.10, **p<0.05, *** p<0.01*

Some more interesting results show when assessing the correlations between mining, logging and hunting levels separately. Since the coefficients are positive, it can be concluded that communities that engage more in one of the activities are more likely to engage more the other two as well. Table 12 shows strong correlations between logging and hunting levels (P=0.000). The correlations are about 0.5 standard deviations in size, which is a lot. This means that community that engaged much in

logging generally engaged more in hunting as well. Furthermore, mining activities significantly correlate with hunting activities ($P < 0.1$). No significant correlation is found between mining and logging activities. Yet the positive correlation coefficients suggest that villages with higher mining levels had higher values for logging activities as well.

TABLE 12: ACTIVITIES IN THE COMMUNITY FOREST - PAIRWISE CORRELATIONS

	Y_{2a}: Mining	Y_{2b}: Logging	Y_{2c}: Hunting
Y_{2a}: Mining	1.000		
Y_{2b}: Logging	0.116	1.000	
Y_{2c}: Hunting	0.192*	0.494***	1.000

Correlation coefficients are standardized. Significance is based on naive P-values.
** p<0.10, **p<0.05, *** p<0.01*

Summarizing the results, there are various variables that are significantly correlated with Environmental Attitudes and Behaviour. Analysis of the main model indicated significant correlations between Environmental Attitudes and Behaviour and the distance to the nearest major town and forest abundance. Splitting up results, it is found that Conservation Attitudes are significantly correlated with institutions, Activities in the community forest are significantly correlated with distance to the nearest major town and population, NTFP collection is significantly correlated with distance to the nearest major town and forest abundance and the share of agricultural land is significantly correlated with distance to the nearest major town and forest abundance. Unlike expectations, checking pairwise correlations between the four components of the dependent variable did not show significant correlation between Conservation Attitudes and the other variables. Pairwise correlation coefficients for the three components of variable Y_2 (Activities in the community forest) show that villages more engaged in one of the activities in general engage more in the other activities as well.

6. DISCUSSION AND LIMITATIONS

6.1 CORRELATION, NOT CAUSATION

An important claim has to be made with regard to causality. The study has shown which variables are correlated with each other, but no causal claims can be made based on these correlations whatsoever. Conducting causal research was not feasible in this study given the available data. Consequently, the research is limited to finding correlations.

Being able to make causal claims requires additional research. However, future research on the causes of forest decline is challenging, since research on causality requires randomization and none of the independent variables easily serves itself for this purpose. It is, for example, hard to randomize distance to the road, population, or forest abundance (since it is not feasible to start building roads, control for population or influence forest abundance or shocks). Also, making use of natural variation in certain variables is hard, since it is not possible to keep all other variables constant. The only variable for which causal research might be feasible is *Economic value of the forest*. As this variable is measured based on (reported) prices people receive for their forest products in the market, some sort of treatment can be designed in which treatment villages get the opportunity to sell their products at a higher price. Alternatively, a lab-in-the-field game could be designed in order to assess how people's decisions are influenced by varying prices. However, both of these methods come with a lot of assumptions. Both methods might make people behave differently as they would do in real life.

As mentioned, being unable to make certain claims, this research only focusses on correlations. However, results on these correlations leave much uncertainty about the underlying explanations and processes. Therefore, this research took a mixed-method approach, in order to make the analysis as complete as possible. The next paragraph evaluates the use of these mixed methods.

6.2 USE OF MIXED METHODS

The combinations of methods is one of the unique aspects of this research. Methods were combined according to a sequential explanatory design, in which the emphasis lies on collecting and analysing quantitative data, that are later combined with qualitative data that help explain, or elaborate on, the quantitative results (Cresswell, et al. 2003).

Using mixed methods added much value to this research. The combination of methods was particularly relevant, since the purpose of this research was to both describe and explain the processes that take place in the community forests around GRNP. Using a single method would not provide the sufficient information to reach this goal. Quantitative analysis in this research shows multiple correlations between variables, but since the research cannot make causal claims, the regression results cannot explain these processes take place. Correlations can have multiple underlying explanations and these cannot be revealed in regression analysis. Additional, qualitative data were needed to find these explanations. Methods were thus combined to show which processes are happening and subsequently explain (the mechanisms behind) these processes.

The combination of (quantitative) survey data and (qualitative) interview data allows to gain both depth and breadth. It provides a more complete and comprehensive understanding of the situation. The qualitative data is useful for the interpretation of quantitative regression results because serves as a means of understanding and explaining the correlations found in this analysis. Also, it provides explanations on aspects that were not included in regressions (either because they could not be

included, or because it was not expected that these processes would take place). Interview data proved useful in explaining the size, direction and significance of all correlation coefficients, but especially for those correlations that were not expected beforehand. It happened multiple times that a correlation coefficient had a different direction than previously expected. In these cases, the interview data explained why. Using qualitative data to complement quantitative results was found very relevant, since all these explanations would not have been found when purely focussing on regression results.

On the other hand, the quantitative data provides statistical evidence that the processes indicated in the theoretical framework as well as in the qualitative results actually take place on a larger scale. The fact that the data were statistically analysed increases the reliability of the results. The qualitative sample was small, and was not selected randomly. Only looking at interview results would therefore bring major generalizability issues. These issues are overcome by performing statistical analysis. The quantitative data allows us to make more general conclusions that are applicable to the entire sample. Furthermore, the quantitative data is more objective and the influence of the researcher is minimized in the way data are collected as well as interpreted.

Summarised, combining different methods was an enrichment to the study since the methods added complementary information. Since this is not a causal research, regression results did not provide information on the reason behind the correlations that were found. The mixed methods approach enabled giving these explanations after all. The combination of methods provided all necessary information to answer the research questions.

6.3 USE OF A THEORETICAL FRAMEWORK

The empirical strategy of this research was guided by a theoretical framework. The main reason for using a theoretical framework was embedding the hypotheses and choice of variables in this research in theory.

However, operationalizing the theoretical framework into an empirical strategy led to some deviations from the framework. These deviations were made for various reasons. In the first place, "Technological Factors" were left out of the analysis. Furthermore, attitudes were chosen to be a dependent variable (instead of an independent) and some variables were omitted for endogeneity reasons.

However, deviating from the framework was done for motivated reasons. In general, the framework was mainly used as a base upon which the empirical strategy of the research was based and the study did not aim at a 1:1 replication of the model, for which reason the deviation from the framework is not considered problematic. More specifically, technological factors were left out because of lacking data on this factor but this is not perceived problematic, since technological factors are shown to be primarily of influence in the situation of capital-driven forest use, whereas forest use in the context of GRNP is mainly poverty-driven. Endogenous variables were left out of the analysis since the their correlations would be so endogenous that they would only provide very ambiguous information. Finally, Conservation attitudes were chosen as dependent variable. According to the model, attitudes are in the category of cultural factors and should be a dependent variable. However, this research had to make use of a proxy variable for forest decline, which had to consist of factors that were perceived to be an important (direct) predictor of this, for which reason Conservation attitudes was chosen as one of the dependent variables. The results in Table 11 justify the decision to take Conservation attitudes as dependent variable, since the variable is not correlated to any of the other variables.

Overall, using a theoretical framework was useful, since it provided a solid theoretical base to the research and it embedded the research and its results in a broader perspective. However, it is interesting to note that multiple variables are differently correlated than hypothesized based on the model as well as other literature. It was hypothesized for each variable whether it was positively or negatively correlated with environmental attitudes and behaviour, but the direction of the correlation coefficients found here often differs from this prediction. For example, *Forest Abundance* was found to be negatively correlated with Environmental attitudes and behaviour, while it was hypothesized to be positively correlated. This can have various reasons, such as the existence of context-specific factors, large variation in the data and a small sample size (low power), the way the variables are composed or the absence of some aspects mentioned in the framework. Additional research including more villages and more precise variables is required to solidify and confirm the robustness of the results found in this study.

6.4 Sample Size, Power and Validity

An important limitation of this research concerns the sample size. Surveys included different amounts of villages, but the smallest study sample contained information on 92 FECs, which is why the study sample of this research is 92. However, the sample size was severely lower in some of the regressions, due to missing data. The missing data problem was, one the one hand, caused by missing data within the surveys (e.g. because of unanswered questions) and, on the other hand, caused by the fact that the villages included in the various surveys did not overlap 100%. In order to limit the bias from the reduction in sample size, variables that had many missing values were substituted by alternatives where possible. Also, rough correlations between each of the dependent and independent variables were estimated (since these correlations usually included more variables). However, even though these measures limited the reduction in sample size, regressing the full model, in most cases, still included only about two thirds of the total sample. The reduction in sample size influences the power of the research. Statistical power is the likelihood to detect a correlation when there is one. A larger sample size increases the power, since it reduces noise in the sample and correlations (even if they are small) are easier to detect when noise is lower. Consequently, missing data, and the reduction in sample size resulting from it, is one of the most important limitations of this research due to its negative effect on power.

Furthermore, the sample size may have limited the power to detect statistically significant correlations. For multiple variables (but specifically for the variable *Population*), a strong correlation is estimated, but the large standard errors (resulting from large variation in the sample) disable us to detect a statistically significant correlation. An increase of the sample size could reduce the noise in the sample, improving our ability to detect smaller correlations as well.

It is important to address validity of this research. Internal validity was ensured in two ways. In the first place, the main instruments used for measurement of variables were solid, elaborate surveys that were designed according to international standards. Survey questions were asked in a standardized way, in order to minimize measurement bias. Secondly, the full analysis strategy is stored in a do-file, so that the results can easily be replicated.

The external validity was ensured as well. Since participating villages were randomly selected from the study sample, the results can be generalized for all Forest Edge Communities surrounding the GNRP. Generalization to other, similar cases, can be done to a limited extent. The capacity to generalize is increased by using a theoretical model, since the thesis looks at factors predetermined in the model. Across the world's tropical forest belt, there are many cases that have similarity to this one,

since the forests are under pressure an poverty often plays a large role. To a certain extent, the results of this results might thus be applicable to these other forests. However, context always plays a role, and since some cultural, historical and contextual factors are specific to the communities surrounding the GRNP, testing the model in other similar cases of tropical forests is recommended improve the external validity of this research.

6.5 Variable Composition

This research uses many composite variables and proxy variables. All these variables are created and used based on the assumption that they are perfect measures for the variables they represent. They are created to the best ability, given available data, but in the absence of alternative variables, their robustness cannot be verified. It is therefore important to bear in mind that some of the variables might not fully represent the things they are supposed to measure.

Besides the composition of variables, a remark has to be made about the quality of data. The datasets that are used are very valuable in terms of extensiveness, but some variables suffer from a lot of noise. Extreme values were widely present, and some variables had extremely large standard deviations. This might be caused by the fact that the majority of people living in FECs are poorly educated, and might have a hard time estimating the answers to certain questions. This is illustrated by the large variation in the data, and the seemingly unrealistic answers people gave to some of the questions. For the variables that are easily interpretable extreme values can easily be detected. It is, for example, not very realistic that multiple people living in a Forest Edge Community are over 100 years old, live 99 kilometres away from the nearest major town, or earn over USD 10.000 a year. For variables that are not as intuitively interpretable, it is harder to detect the presence of surrealistic values. The large variation in data is not estimated to structurally bias the results of this research, since communities as well as individuals in these communities were randomly selected into the study sample. So, the bias was on average predicted to be the same in every village. However, it needs to be kept in mind that the presence of so much noise may have decreased the ability to detect statistically significant correlations for some variables.

A final note has to be made with regard to the robustness of the results. Robustness checks showed that the results tend to change resulting from small changes in the set of variables, which indicates uncertainty on the coefficients.

6.6 Qualitative Research Methods

The qualitative data were gathered through structured interviews. Interviews were structured for logistical reasons, mainly because various translators were used and translators needed to see the questions beforehand. However, additional questions were asked at any time this was considered relevant during an interview. Translators translated these questions on the spot when this was the case. The structured character of the interviews had both advantages and drawbacks. On the one hand, it limited the risk that answers are framed by the order and way questions were asked. This was particularly relevant since different translators were used and the way they translated certain terms or questions was beyond the control of the researcher. On the other hand, it may also have lead the results into certain directions, since the focus was mainly on the questions that were created before. It was, however, tried to minimize this effect, by making sure additional questions were asked every time the researcher considered this relevant, giving the interviews a more semi-structured character.

The interviews were set up as neutral as possible. Initially, it was feared that people would be reluctant to participate or truthfully answer when they heard the research was related to the GRNP organisation. However, people were eager to participate in the interviews and large numbers of people volunteered to take part. Social desirability bias was limited by emphasizing that, although this research is done in collaboration with the GRNP organisation, the final report will be written independently from the organisation. This was successful, since answers did not seem to be socially desirable. Some topics, especially the topic of hunting, were more sensitive than others. Indeed, some participants were initially somewhat reluctant to go into depth about these topics, but most people eventually opened up and shared a lot of information. However, even though the influence of social desirability was limited, it is still important to bear in mind that social desirability might play a (small) role in the answers people gave.

There is, one more serious issue that needs to be mentioned with regard to the interviews. In order to ensure anonymity, it was always tried to isolate participants when they were being interviewed. In practice, this turned out to be challenging due to large interest from the other community members, who kept approaching the interview location hoping to catch some of the conversation. If possible, we politely asked adults to leave the interview location and explained them this was done to ensure of anonymity. For practical reasons, we allowed children, who were usually curious and present in large numbers, to stay since they were expected not to influence the results that much. In most cases people answered our requests, but in two villages people kept coming back. In one of these villages the town chief was amongst the people listening. In order to limit the influence of the presence of the town chief, the interview was then moved to the house of the participant. In the other village, attending people were asked not to interfere and the interview proceeded as normal.

6.7 Relevance for Current Policy

Finally, it has to be noted that data were collected in the period 2011 – 2013. Based on the assumption that the processes that were in place then, are still in place now, the moment of data collection is not expected to influence the results for RQ2 (assessing the factors correlated with Environmental attitudes and behaviour). This research question assessed correlations at a certain point in time and the processes underlying these correlations are not expected to change drastically in the time span of 5 years.

However, the moment data were collected does need to be taken in mind when reading the results for RQ1, which describes the levels of Environmental attitudes and behaviour. These results might be slightly outdated, especially since the GRNP organisation started a large-scale REDD project after the data were collected. However, interview data gathered for the purpose of this thesis did not indicate any major differences. This is in line with the fact that behaviour generally takes a long time to change. As such, results are not expected to have changed a lot. Yet, in order to be completely sure whether there are any major differences in behaviour occurred between the moment the data were collected and now, a repetition of the survey is required, so that within-village changes over time can be assessed.

7. CONCLUSION AND RECOMMENDATIONS

The aim of this research was describing environmental attitudes and behaviour in the community forests surrounding GRNP and assessing the factors that correlate with these attitudes and behaviour. The results of the research improve context-specific knowledge on the community forests surrounding GRNP, add to scientific literature on socio-ecological interactions and give important policy insights. The research questions were answered using a mixed methods approach: quantitative (survey) data are supplemented with qualitative (interview) data.

The first part of the research focussed on describing environmental attitudes and behaviour. The activities in the community forests are numerous. The most widespread activity is shifting cultivation agriculture. Rice farming is practiced most frequently, though many people engage in vegetable farming additionally. Land is primarily cultivated for subsistence purposes. Due to increasing demand for food from within the population, many villages experience annual expansion of the amount of cultivated land (or a decrease in the fallow period of land).

Bushmeat hunting and NTFP collection are also widely practiced. People hunt for all sorts of (protected as well as unprotected) animals, but mainly greater cane rat (cutting grass), brush-tailed porcupine and bushbuck. People primarily engage in hunting with the purpose of adding meat (protein) to their diets, but also to prevent animals from damaging crops on their farms. Hunting mostly happens through trap setting, yet people also use guns. When it comes to NTFP collection, the products that are gathered most frequently are palm kernel (palm oil), bush yam, rattan, thatch, mushrooms, medicines and fish. NTFPs were originally mainly gathered for subsistence use, but are increasingly gathered with the purpose of selling in the market as well. NTFPs are collected in the community forest. Products that cannot be found in the community forest are gathered in the GRNP.

Furthermore, people engage in logging and, to a lower extent, mining. Logging primarily happens for construction purposes. Logging for commercial purposes once formed a source of income for many communities, but nowadays this has been cut back due to decreased availability of mature trees suited for timber logging. Mining by villagers happens on a considerably lower scale. This has to do with the presence of mining areas, as well as the effort it takes to engage in mining and ambiguity about (by)laws and permits. Commercial mining companies are active in the area as well. They often receive permission at the chiefdom headquarters.

Besides asking people about their activities, questions about conservation attitudes were also asked. Conservation attitudes are generally positive. The clear majority of people states to be in favour of forest protection. In most communities, these positive attitudes are translated into many bylaws and structures that regulate forest use. The gap between people's (stated) conservation attitudes and behaviour stands out here. On the one hand, people state to value conservation highly, yet those attitudes do not always translate back to their behaviour. The gap between attitudes and behaviour has three explanations. The first is a social desirability bias in answering. Secondly, people do value conservation, but seem unable to change their behaviour given the poverty they suffer from. Finally, people find it hard to estimate the benefits of conservation and do not see future benefits for their personal situation.

The activities taking place in the community forest are numerous. After describing what environmental attitudes and behaviour were like, regression analysis was done in order to find the correlating factors. Multivariate regression analysis shows various correlations between environmental attitudes and behaviour and the set of predictor variables. Analysis of the main model indicates

significant negative correlations between environmental attitudes and behaviour and the *Distance to the nearest major town* and *Forest abundance*. This means that remote villages with a larger share of forest on average put a higher pressure on the forest. This most likely results from higher dependency. Of these two factors, forest abundance is correlated strongest. Other variables do not seem to be correlated with environmental attitudes and behaviour, since the correlation coefficients are all very small. As standard errors are also small, the absence of any statistically significant correlations is not likely to be the result of noise in the data. An exception to this is the variable population, which has a large standard error. Since the coefficient for population is large as well, increasing the sample size (which reduces noise) could show the presence of a correlation. The model is statistically significant at the 1% level, but its predictive value is not high.

Narrowing down the results, it is found that Conservation attitudes are positively correlated with *Institutions* (with a correlation coefficient of 0.228 standard deviations). Thus, villages with stronger institutions had more positive conservation attitudes. People are more positive about conservation when leadership is strong, most likely because they have more certainty that conservation (by)laws are actually implemented and enforced effectively. Also, they might have had more influence on bylaws and conservation policies (through their chief). The correlation coefficient between *Population* and Conservation attitudes is large as well (0.428 standard deviations). Yet this coefficient is not statistically significant due to the large standard error that results from noise in the sample. An increase in sample size is recommended to be able to detect a significant result.

Activities in the community forest are significantly correlated with distance to the nearest major town (negative correlation) and population (strong, positive correlation), which means that larger villages closer to towns engage more in hunting, logging and mining. Population increases the demand for food and income. Proximity to the nearest major town decreases the barriers and transactions costs of selling in the market. NTFP collection is negatively correlated with distance to the nearest major town and positively with forest abundance. Again, the coefficient for *Forest abundance* (0.201 standard deviations) is considerably higher than that of *Distance to the nearest town* (-0.0448 standard deviations).

Finally, the share of agricultural land is also significantly correlated with *Forest abundance*. The strong, negative relation can be explained by a trade-off: communities that attributed a larger share of their land to agricultural land automatically have a smaller share of forestland. This trade-off can, for example, be between agricultural production and conservation, or between agricultural production and commercialisation of NTFPs. However, this trade-off is not necessarily made rationally, as people are in some cases just forced to increase their agricultural land because of their population numbers. No significant correlation is found between *Population* and the share of agricultural land due to the high standard error for the population variable. However, significant correlations are found when regressing population on agricultural land separately, and when including population as a control variable. Furthermore, increasing population was often mentioned in interviews as one of the main reasons for expanding land. It is thus likely that a correlation would be found, should the sample size be increased. A final thing that stands out about the model estimating the correlation between share of agricultural land and the independent variables is its predictive value. Whereas the previous models had low predictive values ($R^2_{Adjusted}$ ranged between 0.263 and 0.308), the predictive value of the model on Share of Agricultural Land was much higher. About 64% of the variation in the share of agricultural land is explained by the independent variables.

Unlike expectations, checking pairwise correlations between the four components of the dependent variable did not show any significant correlation between Conservation Attitudes and the other variables. Pairwise correlation coefficients for the three components of variable Y_2 (Activities in the community forest) showed that in general, villages that were more engaged in one of the activities, engaged more in the other activities as well.

Summarised, this research identifies multiple factors that correlate environmental attitudes and behaviour. The factors that often come back are distance to the nearest major town, population and forest abundance. These results demonstrate that forest dependency is key in understanding the interactions between people and the forest. Villages that are far from towns (and thus markets), and have high shares of forestland are typically more dependent on the forest and therefore show attitudes and behaviour that put more pressure on the forest. These results improve insight in the situation surrounding GRNP and are therefore valuable for policymakers. The results also add to the academic literature on the factors correlated with land use change forest decline. However, some processes and relations are still unknown, for which reason further research is recommended.

The most important suggestion for further research is research on causality. Research on causality is, however, challenging in terms of logistics, since manipulation or randomization of most of the variables of interest is not feasible. To overcome logistical barriers, it is recommended to use experiments to conduct causal research where possible.

Furthermore, a follow-up study using the same survey and study sample, would allow for a within-villages comparison between now and 5 years ago. It is hereby important to make sure that the exact same sample and questionnaire are used as in this study, so that data are comparable over time.

Another suggestion for follow-up research is a change of dependent variable. This study makes use of land cover data at one point in time. It would, however, be particularly interesting to use land cover data that covers multiple time periods so that actual changes in land cover can be assessed. This variable can then serve as dependent variable and overcomes the need of using a proxy for forest decline. Follow-up research can also be done in order the questions there were left unanswered in this research, such as the explanations for some of the correlations that were found, and the gap between attitudes and behaviour.

Finally, an increase in sample size is recommended, to improve the quality and predictive capacity of this study. The variation in the sample was large which was especially problematic for the population variable, so extra care collecting this variable is required. A reduction of noise in the data (resulting from a larger sample size) will increase the power to detect correlations, even if they are small. Furthermore, data on some of the factors of the theoretical framework lacked and proxies had to be used for others. For future research, it is therefore recommended that data on these factors were to be collected as well.

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APPENDIX 1: INTERVIEW PARTICIPANTS

Participant 1	Male, 37 years old, Gaura Chiefdom
Participant 2	Female, 35 years old, Gaura Chiefdom
Participant 3	Female, 50 years old, Gaura Chiefdom
Participant 4	Male, 19 years old, Gaura Chiefdom
Participant 5	Male, 50 years old, Malema Chiefdom
Participant 6	Female, 45 years old, Malema Chiefdom
Participant 7	Female, approximately 30-35 years old, Malema Chiefdom
Participant 8	Female, 37 years old, Malema Chiefdom
Participant 9	Male, 64 years old, Malema Chiefdom
Participant 10	Female, 45 years old, Tunkia Chiefdom
Participant 11	Female, 40 years old, Tunkia Chiefdom
Participant 12	Male, 30 years old, Tunkia Chiefdom
Participant 13	Female, 40 years old, Tunkia Chiefdom
Participant 14	Male, 55 years old, Tunkia Chiefdom
Participant 15	Female, 40 years old, Tunkia Chiefdom
Participant 16	Female, 37 years old, Tunkia Chiefdom
Participant 17	Male, 35 years old, Tunkia Chiefdom
Participant 18	Female, 30 years old, Tunkia Chiefdom
Participant 19	Male, 47 years old, Tunkia Chiefdom
Participant 20	Female, 46 years old, Tunkia Chiefdom
Participant 21	Male, 65 years old, Tunkia Chiefdom

APPENDIX 2: VILLAGES IN WHICH INTERVIEWS WERE CONDUCTED

Villages are listed in random order.

Tunkia Chiefdom:	*(n = 12)*
Bikoma	(n = 2)
Congo	(n = 2)
Naimaguama	(n = 2)
Gjunction	(n = 2)
Njiagboima	(n = 2)
Gobaru	(n = 2)
Malema Chiefdom:	*(n = 5)*
Takpoima	(n = 3)
Teyama	(n = 1)
Madina	(n = 1)
Gaura Chiefdom:	*(n = 4)*
Gomo	(n = 1)
Bo	(n = 1)
Njala	(n = 1)
Niawama	(n = 1)

APPENDIX 3: COMPOSITION OF DEPENDENT VARIABLES

Y: Environmental Attitudes and Behaviour	
Composition of variable:	$Y = \frac{\Sigma\ (Standardized\ values\ of\ (1-Y_1)\ Y_2\ Y_3\ Y_4)}{4}$

Y_1: Conservation Attitudes				
Composition of variable:		$\frac{\Sigma\ Q80 - Q90}{n}$		
Survey	**Question**	**Question**	**Level**	**Type**
2013 Household Survey	Q80	We should have a conservation association in our village	HH	Dummy variable (Value 1 if person strongly agrees)
2013 Household Survey	Q81	A healthy community forest makes me better off	HH	Dummy variable (Value 1 if person strongly agrees)
2013 Household Survey	Q82	A healthy GRNP (Forest) makes me better off	HH	Dummy variable (Value 1 if person strongly agrees)
2013 Household Survey	Q83	Do you like the GRNP Programme?	HH	Dummy variable (Value 1 if person strongly agrees)
2013 Household Survey	Q84	To support the GNRP Programme, I would be willing to provide info to the GRNP if they knew of any illegal activities taking place	HH	Dummy variable (Value 1 if person is willing to provide information about everyone)
2013 Household Survey	Q85	To support the GNRP Programme, I would be willing to contribute to the rehabilitation of mining areas inside the GRNP	HH	Dummy variable (value 1 if individual is willing to participate)
2013 Household Survey	Q86	To support the GNRP Programme, I would be willing to help protect the GRNP through joint patrols with GRNP rangers	HH	Dummy variable (value 1 if individual is willing to participate)
2013 Household Survey	Q87	To support the GNRP Programme, I would be willing to create bylaws to protect the GRNP	HH	Dummy variable (value 1 if individual is willing to create bylaws)
2013 Household Survey	Q88	Do you support the GRNP organisation?	HH	Dummy variable (value 1 if individual agrees)

2013 Household Survey	Q89	The GRNP organization is welcome in my village	HH	Dummy variable (value 1 if individual agrees)
2013 Household Survey	Q90	Do you expect that the GRNP Programme will do future development projects in your village?	HH	Dummy variable (value 1 if individual agrees)

Y_2: Activities done in the community forest

Composition of variable: $\frac{\Sigma(Logging, Mining, Hunting)}{3}$

Y_{2a}: Mining

Composition of variable: $\frac{\Sigma(Q_{70}\ Q_{71}\ Q_{211}\ Q_{212})}{4}$

Survey	Question	Question	Level	Type
2013 Household Survey	Q70	In the past year, Have households in your village mined in the community forest?	HH	Dummy variable (value 1 if yes)
2013 Household Survey	Q71	Did your village in the past year allow miners to access your community forest?	HH	Dummy variable (value 1 if yes)
2013 Community Survey	Q211	Do people in your community engage in mining in the community forest?	COM	Dummy variable (value 1 if yes)
2013 Community Survey	Q212	Has your community been approached by miners and asked for permission to mine close to your community?	COM	Dummy variable (value 1 if yes)

Y_{2b}: Logging

Composition of variable $\frac{\Sigma(Q_{188}\ Q_{189}\ Q_{73})}{3}$

Survey	Question	Question	Level	Type
2013 Community Survey	Q188	Do people in your community cut trees close to your community for commercial sale?	COM	Dummy variable (value 1 if yes)
2013 Community Survey	Q189	Has your community been approached by a logger and asked for permission to cut down trees close to your community?	COM	Dummy variable (value 1 if yes)
2013 Household Survey	Q73	Did your village last year allow loggers to access your community forest?	HH	Dummy variable (value 1 if yes)

Y_{2c}: Hunting

Composition of variable $\frac{\Sigma((\frac{Q_{63}Q_{64}Q_{65}}{3})\ Q_{62}\ Q_{67}\ Q_{74}\ Q_{196}Q_{197}Q_{204})}{7}$

Survey	Question	Question	Level	Type
2013 Household Survey	Q62	Is the food you hunt/gather from the community forest important for your nutrition?	HH	Dummy variable (value 1 if yes)
2013 Household Survey	Q63	In the past month, what part of your food consumption came from hunting/gathering in the community forest?	HH	Continuous variable (0 if none, 0.25 if some, 0.5 if half, 0.75 if most and 1 if all)
2013 Household Survey	Q64	In the past dry season, what part of your food consumption came from hunting/gathering in the community forest?	HH	Continuous variable (0 if none, 0.25 if some, 0.5 if half, 0.75 if most and 1 if all)
2013 Household Survey	Q65	In the past hungry season, what part of your food consumption came from hunting/gathering in the community forest?	HH	Continuous variable (0 if none, 0.25 if some, 0.5 if half, 0.75 if most and 1 if all)
2013 Household Survey	Q67	In the past dry season, did you sell anything from what you hunted/gathered in the community forest?	HH	Dummy variable (value 1 if yes)
2013 Household Survey	Q74	Did your village in the past year allow hunters to access your community forest?	COM	Dummy variable (value 1 if yes)
2013 Community Survey	Q196	Do people in your community hunt close to your community for commercial sale?	COM	Dummy variable (value 1 if yes)
2013 Community Survey	Q197	Do people in your community hunt in the community forest?	COM	Dummy variable (value 1 if yes)
2013 Community Survey	Q204	Has your community been approached by a hunter and asked for permission to hunt animals in the community forest?	COM	Dummy variable (value 1 if yes)

Y_3: NTFP Collection

Composition of variable $\frac{\Sigma(NTFPs\ collected\ by\ men) + \Sigma(NTFPs\ collected\ by\ women)}{2}$

Survey	Question	Question	Level	Type
NTFP Survey	Important NTFP list, Question C	Ask the women in the village: HH in village who extract the NTFP?	COM	Continuous variable (value 1 if all, value 2 if most, value 3 if some, value 0 if none)
NTFP Survey	Important NTFP list, Question C	Ask the men in the village: HH in village who extract the NTFP?	COM	Continuous variable (value 1 if all, value 2 if most, value 3 if some, value 0 if none)

Y_4: Share of Agricultural Land

Composition of variable $\frac{Area\ covered\ with\ non-forest\ vegeation}{Total\ village\ land}$

Survey	Question	Variable	Level	Type
Land cover data	n/a	Non-forest vegetation	COM	Continuous

APPENDIX 4: COMPOSITION OF INDEPENDENT VARIABLES

Z_1: Distance to the nearest major town				
Composition of variable		1.609344 * $Q_{4.1.2}$		
Survey	**Question**	**Variable**	**Level**	**Type**
2011 Village level survey	Q 4.1.2	Distance to nearest major town (miles)	COM	Continuous variable, transformed to km

Z_2: Distance to GRNP				
Composition of variable		Single variable, no composition		
Survey	**Question**	**Variable**	**Level**	**Type**
Land cover data	n/a	Distance to GRNP (m)	COM	Continuous variable

Z_3: Distance to the nearest road				
Composition of variable		Single variable, no composition		
Survey	**Question**	**Variable**	**Level**	**Type**
Land cover data	n/a	Distance to road (m)	COM	Continuous variable

Z_4: Population (amount of households)				
Composition of variable		Imputed variable		
Survey	**Question**	**Question**	**Level**	**Type**
2011 Village level survey	Q 1.1.2	Total adult population	COM	Continuous variable
2011 Village level survey	Q 1.1.4	Number of houses	COM	Continuous variable

Z_5: Forest abundance				
Composition of variable		$\frac{Amount\ of\ forestland}{Total\ village\ land}$		
Survey	**Question**	**Variable**	**Level**	**Type**
Land cover data	n/a	Forest land (ha)	COM	Continuous variable
Land cover data	n/a	Total village land (ha)	COM	Continuous variable

Z_6: Economic value of the forest Proxy variable: value of the NTFPs found near the village				
Composition of variable		$\frac{NTFP\ Value\ Men + NTFP\ Value\ Women}{2}$		
Survey	**Question**	**Question**	**Level**	**Type**
NTFP Survey	NTFP Survey MEN, Question J	NTFP Price in the market	COM	Σ Market prices of all NTFPs that were mentioned
NTFP Survey	NTFP Survey WOMEN, Question J	NTFP Price in the market	COM	Σ Market prices of all NTFPs that were mentioned

Z_7: Institutions				
Measured as: Quality of Leadership				
Composition of variable		$\frac{\Sigma(Q_{46}\ Q_{47}\ Q_{48}\ Q_{49}\ Q_{50} Q_{51}\ Q_{52})}{7}$		
Survey	**Question**	**Question**	**Level**	**Type**
2013 Household Survey	Q46	Is your chief open about how much money he gets from the village?	HH	Dummy variable (1 if yes)
2013 Household Survey	Q47	Is your chief a good chief?	HH	Dummy variable (1 if yes)
2013 Household Survey	Q48	Do you trust your chief?	HH	Dummy variable (1 if yes)
2013 Household Survey	Q49	Could someone in your household stand for village chief?	HH	Dummy variable (1 if yes)
2013 Household Survey	Q50	Do you wish you could be chief in your village?	HH	Dummy variable (1 if yes)
2013 Household Survey	Q51	How many times did you ask your chief for help?	HH	Dummy variable (1 if individual asked chief for help at least once)
2013 Household Survey	Q52	How many times have you complained to the chief?	HH	Dummy variable (1 if individual complained to the chief at least once)

Z_8: Shocks				
Composition of variable		$\frac{\Sigma(Q_{22}\ Q_{23}\ Q_{24} Q_{25}\ Q_{26}\ Q_{27})}{6}$		
Survey	**Question**	**Question**	**Level**	**Type**
2013	Q22-27	Did you experience any of the following	COM	

Village Survey		shocks?		
2013 Village Survey	Q22	Much rain	COM	Dummy variable (1 if yes)
2013 Village Survey	Q23	Little rain	COM	Dummy variable (1 if yes)
2013 Village Survey	Q24	Draught	COM	Dummy variable (1 if yes)
2013 Village Survey	Q25	Crop disease	COM	Dummy variable (1 if yes)
2013 Village Survey	Q26	Low yields	COM	Dummy variable (1 if yes)
2013 Village Survey	Q27	High yields	COM	Dummy variable (1 if yes)

APPENDIX 5: COMPOSITION OF CONTROL VARIABLES

Control variable 1: Average income				
Composition of variable		Income of individual was calculated according to: $\Sigma(Q_{13}\ Q_{14}\ Q_{15}\ Q_{17}\ Q_{18}\ )$ Data were then collapsed at village level.		
Survey	**Question**	**Question**	**Level**	**Type**
2013 HH	Q13	How much did you earn last year from labour on someone else's farm?	HH	Continuous
2013 HH	Q14	How much did you earn last year from selling farm products (palm oil, groundnuts, etc.)?	HH	Continuous
2013 HH	Q15	How much did you earn last year from remittances (money gifts sent back by family from outside village)?	HH	Continuous
2013 HH	Q17, Q18	Have you any other type big income? How much did you earn from that?	HH	Continuous

Control variable 2: Gender				
Collapsed at village level: the proportion of men that participated in the survey as compared to women				
Composition of variable		Collapsed at village level		
Survey	**Question**	**Question**	**Level**	**Type**
2013 Household Survey	Q4	What is your gender?	HH	Dummy (0 if male, 1 if female)

Control variable 3: Bylaws				
Composition of variable				
Survey	**Question**	**Question**	**Level**	**Type**
2013 Village	Q156	Do you have any bylaws telling you how to use forest land around your village?	COM	Dummy variable (1 if yes)
2013 Village	Q 157	How many bylaws about forest land around your village do you have?	COM	Dummy variable (1 if yes)
2013 Village	Q164	Do you have a bylaw prohibiting sawing/logging in your community forest?	COM	Dummy variable (1 if yes)
2013 Village	Q165	Do you have a bylaw prohibiting hunting in your community forest?	COM	Dummy variable (1 if yes)
2013 Village	Q166	Do you have a bylaws prohibiting mining in your community forest?	COM	Dummy variable (1 if yes)
2013 Village	Q171	What happens if a person in your village violates a bylaw?	COM	Dummy variable (0 if nothing happens, 1 if there are consequences)

APPENDIX 6: INFORMED CONSENT FORM

Dear Sir, Madam,

My name is Esther Smits and I am a student from Wageningen University & Research, the Netherlands. You are about to take part in a questionnaire that is part of a master's thesis research. The research is about land use in community forests. The study is done in collaboration with the GRNP organisation, but your answers will not be shared with GRNP. The interview answers will be analysed by the researcher only; although final reports will be shared with the GRNP organisation.

I would like to emphasize that participation is completely voluntary. All answers are confidential and anonymous. The interview will take approximately 40 minutes. Should you want to stop the interview, you are free to do so at any time without any consequences.

In case you have any questions, you can ask them now. Should you have any questions later, you can always contact Esther Smits:
Phone: 079 53 42 14
E-mail: esther.smits@wur.nl