



UNIVERSITY OF GOTHENBURG

Department of Earth Sciences

Tropical deforestation in Sri Lanka

A Minor Field Study investigating the impact of small scale farmers



Photos: Lindström, 2011

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Abstract

This paper is about the relationship between rural people and the tropical forests of Sri Lanka, about the linkages between forests and human needs. The country has a large and dense population with millions of people living in poverty and forests have been shrinking rapidly the last 100 years. The study analyzes small scale farmers impact on the natural forest cover extent in the Kanneliya Forest Reserve and Knuckles Conservation Forest, by focusing on the farmers land use practices since the end of the 1980's. Some of the methods used for the analysis are structured and semi-structured interviews carried out in Sri Lanka, and remote sensing followed by mappings in GIS.

The study confirms that many rural people are dependent upon several recourses provided by surrounding natural forests, primarily for subsistence reasons. Agriculture is the most common source of income in both study areas and there is a clear link between local land use and diminishing forests on the island. Profit-bringing crops of high demand on the domestic and international market are most frequently grown among farmers and have caused the biggest threat to the forests.

Over the last two decades the Kanneliya Forest Reserve has been badly affected by deforestation, particularly due to expanding tea plantations. The case of Knuckles Conservation Forest on the other hand demonstrates an overall increase in forest cover. This can partly be explained by the fact that cardamom, a widely cultivated profit-bringing crop in the area only leads to forest degradation rather than a complete clearance of forest. Further, governmental tree plantations, a ban of shifting cultivation and emigration from the area followed by natural forest regeneration are factors used to explain the situation in the Knuckles.

Legislations and clear demarcations around the reserves have proved successful in the conservation of remaining forests on the island. However, as long as root causes such as poverty in combination with a shortage of land is ignored by stakeholders, people are likely to continue to put pressure on the natural forests of Sri Lanka.

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1. Introduction

1.1 Why care about tropical forests?

2011 has by the United Nations been declared the International Year of Forests. This is to raise global awareness of the value of these large ecosystems because as a matter of fact our forests are vital to the survival and well being of life everywhere on the planet. They provide us with important ecosystem services easily taken for granted but that are contributing to sustain a balance in nature that we are virtually dependent upon. To mention a few, forests have the ability to regulate regional climate, prevent landslides and floods and absorb air pollution. Tropical forests also store a massive amount of the greenhouse gas carbon dioxide, which helps keeping the global climate in balance. They contain a remarkable variety of life and provide home to billions of different plant and animal species. Many more species are yet to be found and scientists believe they might hold the key to treatments of fatal diseases such as HIV and cancer in the future (FAO, 2011a; De Blij et al, 2004, p 212-213; NASA Earth Observatory, 2011).

On top of this, an estimated 25 percent of the global human population, about 1.6 billion people, directly or indirectly rely on the many resources provided by the same forests; clean water, food, clothing, medicines and fuel wood etc. Approximately 75 percent of these people live in extreme poverty (FAO, 2006, p. 1; p. 21)

Until the turn of the 19th century the small tropical island nation of Sri Lanka was almost entirely covered by tropical forests. Today only a fraction of these original old-growth forests remains. Deforestation is considered one of the most severe environmental issues in the country that threatens both humans and biodiversity and between 1990 and 2005, Sri Lanka was among the countries with the highest deforestation rates of primary forests in the world (Conservation International, 2011; Alagan, 2009b; FAO 2010a, p 256-260).

Sri Lanka has a large and dense human population with millions of people living under the poverty line, many trying to earn a living mainly from agriculture and who are dependent upon surrounding forests (CIA World Fact Book, 2011; Senaratne et al, 2003). Thus, a continued deforestation may seriously threaten the livelihoods of these already poor and vulnerable people.

At the same time it is important to be aware of the fact that these people living near the remaining forests not only are victims, but in many cases also contributors to the dilemma themselves. The human relationship to the forest, together with a range of social and political factors in the country have given rise to some harmful activities based on short-term thinking among rural people that have contributed to the deforestation in recent years, which in turn tend to cause the same people problems in the long run (IUCN, 2010). Rural people's actions hence add to a complex dilemma partly driven by poverty - a root cause that has to be addressed if Sri Lanka is to win the battle for its remaining forests.

1.2 Objectives of the study

This Minor Field Study aims to investigate how the activities of small scale farmers have affected the extent of the natural forest cover in two different regions in Sri Lanka during the last 20 years. It will examine what role the forest has to nearby-living people and analyze the historical and current extent of the forest cover.

The aim is to answer the following questions:

- What relationship do people living in the buffer zones have to nearby forests?
- What is the current extent of the natural forest cover in inhabited buffer zones compared to 20 years ago in the two different study areas?
- How have land use practices performed by small scale farmers affected the extent of surrounding natural forests?

1.3 Definitions of key terms

There are a few key terms used throughout this paper that are worth being defined in this early stage to avoid confusion and to clarify what is being conferred.

Forest

According to The Food and Agriculture Organization of the United Nations (FAO) a land area is considered a forest when it is larger than 0,5 hectares with trees higher than 5 meters and with a crown cover exceeding 10 percent. It does not include land that is used primarily for human development or agricultural activities (FAO, 2004). However, Sri Lanka has chosen a different definition and since 2010 this nation define a forest as “a minimum land area of 0.05 hectares with a minimum tree canopy cover of 20% and a canopy height of 3 m” (Chokkalingam & Vanniarachchy, 2011, p 7).

Primary forest

A primary forest is by the FAO (2010a, p 211) defined in as a “Naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed”. This type of forest is still considered as primary when collection of non-timber forest products (NTFP) occurs, given it is performed under careful circumstances where the human impact is minimal (FAO, 2004).

Primary forests are sometimes also identified as “old-growth forests” due to the fact that they have developed over a long period of time and therefore reached a very high age. Many trees are several hundred years old with trunks of very large sizes. These forests are usually characterized by many snags and other dead wood material on the ground that provides a diversified environment for its rich biodiversity. Among all terrestrial ecosystems, primary forests, especially in moist and tropical regions, contain among the highest number of different plant- and animal species in the world, and

are thus of substantially high biological value (Minnesota Department of Natural Resources, 2011; FAO, 2010a, p 20).

Secondary forest

A secondary forest is what once used to be a primary forest. It has regenerated mainly through natural processes after the original vegetation has been removed or in other ways heavily disturbed of natural causes, such as fires, or human interventions, such as logging. Compared to primary forests they display a major difference in forest structure and species composition with generally lower biodiversity and unstable vegetation that represent successional stages. They also store a smaller amount of carbon than old-growth forests. Without further disturbance over a long time a secondary forest can be capable of slowly reverting into a primary forest (FAO, 2011b).

Natural forests

Another term used a few times in this report is “natural forest”. With that I refer to any forest (as defined above) that is *not* established by humans, contrary to for example a plantation. It is an area that used to be a forest before humans inhabited the site (if they did). The forest might after that point have been cut down but is still considered a natural forest as long as it has been *naturally* regenerated. Another prerequisite is that the forest is composed of indigenous species with natural ecosystem functions. Thus, this term can include both primary and secondary forests (Nissanka, pers. comment, 2011; Convention on Biological Diversity, 2011).

Home garden

The appearance of a home garden is similar to that of natural forests and can thus be difficult to distinguish from the air. The difference is that home gardens are privately owned and commonly found around the owners’ houses. The owners are commonly small-scale farmers that grow different crops within their home garden. Due to its resemblance to a natural forest, home gardens may still constitute important habitats for plants as well as vital feeding and nestling grounds for animals. Home gardens can also provide an important alternative source for the supply of timber and NTFPs (Forest Department, 2009b, p 13; FAO, 2009, p 12).

Non-timber forest products (NTFP)

According to FAO, non-timber forest products are “products of biological origin other than wood derived from forests, other wooded land and trees outside forests”. It can thus include all biological products that are not timber, such as fruits, mushroom, twigs, braches and medicinal plants. Non-timber forest products are commonly collected by the rural poor, living close to forests and can help meeting their subsistence needs as they are used as fuel-wood, building material and food etc. NTFPs can also provide an important extra source of cash income. When the extraction of NTFPs gets too intensified, it can lead to forest degradation followed by biodiversity loss (see definition below). (British Columbia, 2011)

Forest buffer-zone

A forest buffer zone is the physical, biological and social buffer area, directly outside the forest boundary. Hence, the outer border of the reserve is the inner border of the buffer zone. The width of what is considered the forest buffer zone in Sri Lanka is slightly unclear due to the lack of a legally defined outer border of the buffer zone, but in this thesis it is set at 0 – 1000 meter away from the border of the reserves (Bandaratillake, 2003 p 142; Knuckles Management Plan 2009 p 37).

Deforestation

Deforestation refers to when a forest is removed by the conversion of the land to another land use, e.g. agriculture or pastureland, resulting in a tree crown cover of less than 10 percent (Naturvårdsverket, 2009; FAO, 2000).

Forest degradation

Forest degradation refers to changes within the forest, often caused by human interference such as selective logging, which have a negative impact on the site and lower its production capacity, but without changing the land use. Normally, forest degradation appears as a gradual reduction of biomass rather than a clear decrease in the area of woody vegetation. Soil erosion and changes in species composition are common consequences (FAO, 2000).

2. Background

2.1 Sri Lanka

The Democratic Socialist Republic of Sri Lanka is an island nation with a total land area of 65,610 km², located in the Indian Ocean just off the southeastern tip of India, as shown in Figure 1. The country got independent from the British in 1948 after a long history of colonial rule (Department of Census and Statistics, 2011a; Atkinson, 2009).

2.1.1 Natural conditions

Due to a location near the equator the climate can be described as tropical and warm without any major seasonal changes. The southwestern parts receive most rainfall, especially between May and October when the south-west monsoon strikes the island. The north region and most of the eastern part comprise the dry zone. Apart from a mountainous region in the south-central part of Sri Lanka - the majority of the island consists of lowland with an average annual temperature of 27°C. Due to the elevation, the central hill country is on average about 10°C colder than the lowland. The highest point, Mt Pidurutalagala, reaches 2 524 meters above sea level. A network of several hundred major rivers and streams originate in the central highlands before being discharged in the Indian Ocean. Most of Sri Lanka falls within one of the world's 34 biological hotspots – a place on earth with extraordinary high concentration of biodiversity and exceptional levels of endemism (Nationalencyklopedin, 2011; Alagan, 2009; Conservation International, 2011).

2.1.2 Population

Since independence in 1948 the human population in Sri Lanka has tripled from 7 million to about 20.7 million in 2010. It is one of the most densely populated countries in the world with a population density of about 330 persons per km², which is like placing the entire population of Australia in Tasmania. The population is unequally distributed over the island with much higher concentrations in the south-west, particularly around the capital city of Colombo, while the northern as well as eastern parts are less densely populated (UNDP, 2011b; UNDP, 2011a, p 9; Nationalencyklopedin, 2011). In recent years the population growth rate has fallen and was in 2010 down at about 0.9 percent, which is lower than in most neighboring countries. In contrast to many other developing countries there has not been any substantial migration between countryside and city in Sri Lanka. An estimated 72 percent of the population remains rural, often because of family and continued land ownership (CIA World Fact Book, 2011; Atkinson, 2009, p 40; Chokkalingam & Vanniarachchy, 2011). Between 1990

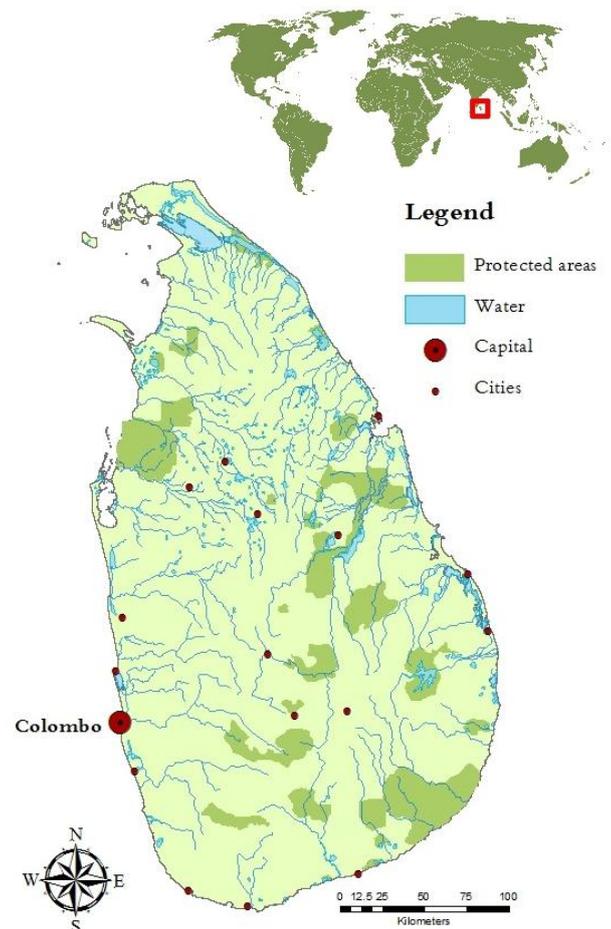


Figure 1: Shows the location of Sri Lanka (above) and an enlargement of the island (below) (Lindström, 2011).

and 2002 the amount of people living under the poverty line was fluctuating closely around 25 percent, in 2010 the same figure was down at 9 percent. However, great differences exist between the many districts. The current official poverty line is set on a monthly salary of less than at Rs. 3321 (about US\$30). About 90 percent of the poor live in rural areas where agriculture is the most important source of income (Department of Census and Statistics, 2011b; Department of Census and Statistics, 2011a; Centre for Poverty Analysis, 2011).

The people in Sri Lanka are divided into two major ethnical groups. The majority (74 percent) is the Sinhalese with origins in the north of India whose presence on the island dates back more than 2500 years. Sinhalese people speak Sinhalese and are predominantly Buddhist. Tamils make up for 18 percent of the population, speak Tamil and are primary Hindus. Some of them have been living in the north of the island for over 2000 years while some other Tamils belong to those who arrived during the 19th century as labor for the British rulers. Apart from Buddhists and Hindus there are two smaller groups of Muslims and Christians on the island (Atkinson, 2009, p. 41-42).

After the British left, the Sinhalese majority got the power in Sri Lanka. They experienced that the Tamil people had been favored and benefited by the British during the colonial era and wanted to change that order by depriving the Tamils their political influence and other basic rights. These events triggered a serious ethnical conflict which in 1983 turned into a 26 year long civil war between the Sri Lankan government and the Liberation Tigers of Tamil Eelam (LTTE). Tens of thousands have died and millions have been displaced in this war that officially ended as recently as in 2009, but the ethnical tensions remain (Atkinson, 2009, p. 30-37).

2.1.3 Economy and administration

Sri Lanka is divided into a number of provinces which are further divided into several districts. A district is then divided into different Divisional Secretariat (DS) divisions that are finally separated into a number of Grama Niladhari (GN) divisions, which basically operate on a village level and is considered the lowest level of administration in Sri Lanka (Schubert, 2004).

Capital and commercial center of Sri Lanka is Colombo, located on the west coast of the island (see Figure 1, above). Important export commodities include textiles and apparel, tea and spices, rubber, coconut, and gems. By the end of the war in 2009 Sri Lanka experienced a GDP growth rate of 3.5 percent. In 2010 the figure was 6.9 percent and the trend is likely to continue. The agricultural sector employs about one third of the population and contributes 12.6 percent to the economy. Most important to the Sri Lankan economy are tourism, the export of tea and textiles and the production of rice. Remittances from family members working abroad constitute another important part of the country's revenue (CIA World Fact Book, 2011; Trading Economics, 2011).

2.2 Deforestation in Sri Lanka

About 200 years ago Sri Lanka was almost entirely covered by tropical forests; some figures estimate that the forest cover was as high as 90 percent of the total land surface. By the end phase of the 18th century attitudes and land use practices started to change and the expansive forest cover began to give way to the “colonial landscape”. When the British titled most land on the island as “crown land” in 1840, the rate of deforestation rapidly accelerated. The demand for timber in the west increased and vast tracts of forest were also cleared for the large scale plantations of cash crops like rubber, coconut and coffee. When the cultivation of coffee failed it got replaced by tea plantations that proved very successful on the island (Figure 2). During this era, the “chena” (slash and burn) cultivation also got more widely practiced with devastating results on the forest cover (Chokkalingam & Vanniarachchy, 2011; Forestry Sector Master Plan [FSMP], 1995).

When the British left about 100 years later the forest cover was down at about 50 percent of its former extent. Even long after independence, emphasis on timber production continued as a means to fuel the economic and industrial development of the new nation. The government established ply-wood companies and other timber co-operations that heavily contributed to the continued deforestation through intensive logging, especially in the wet-zone. While the decades that followed, until today, witnessed a threefold population increase, the demand for housing and agricultural land rose drastically. Instead of focusing on making each cultivation plot more productive the overall trend in Sri Lanka has been to increase agricultural production primarily by converting natural forests into farmlands when all other cultivable land has already been used (see Figure 3) (Forestry Sector Master Plan [FSMP], 1995; Alagan, 2009; Interview with Pushpakumara, 2011).

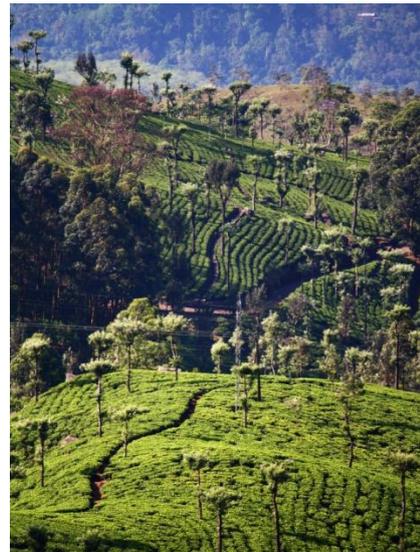


Figure 2. Widespread tea plantations; a common sight in Sri Lanka since the 19th century (Photo: Lindström, 2011).

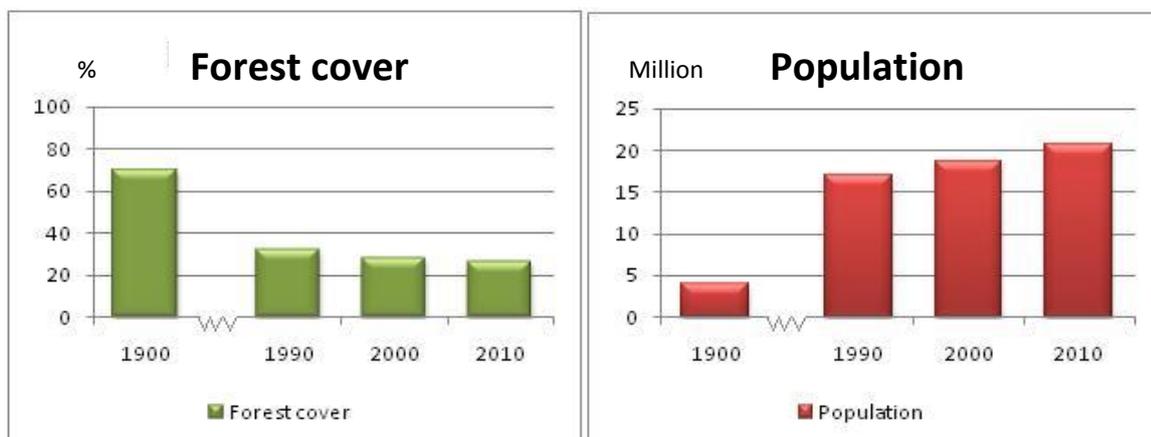


Figure 3 demonstrates the extent of the forest cover in relation to population size in Sri Lanka between 1900 and 2010. Note the time gap between 1900 and 1990 (Forestry Sector Master Plan [FSMP], 1995; CIA World Fact Book, 2011; FAO, 2010b).

In 1969, and the 30 years that followed, a huge development scheme called the Mahaweli project was implemented, with the main objective to irrigate large areas of the dry-zone in the northeast and make these soils more suitable for agriculture, especially the production of rice. This project alone replaced 2 430 km² of forest, equal to about 4 percent of the entire land area of Sri Lanka, mainly as a result of the massive reservoirs that were created (Figure 4 and 5) (Scribd, 2011; FAO, 1997). To meet the new energy requirement of the growing nation the government decided to take advantage of the many rivers of Sri Lanka. Thus, the 1970's and the decade that followed more or less became the "hydro-power era", when high numbers of dams were constructed, particularly in the central and northern areas, resulting in even more forest buried under the water masses. The 26 year long civil war that started in 1983 added further strains to the already fragmented forest cover when much forest was strategically cleared to provide less cover for the enemy (Interview with Pushpakumara, 2011; Mongabay, 2006).



Figure 4. Remnants of a forest in one of many reservoirs created during the Mahaweli project (Photo: Lindström, 2011).



Figure 5. A paddy field in the dry zone, heavily dependent on fresh water from the Mahaweli irrigation system (Photo: Lindström, 2011).

Today one of the most pronounced drivers of deforestation is poverty among Sri Lanka's people. Some provinces are worse affected where the lack of roads, electricity and other infrastructure have brought limited opportunities for rural people to earn an income from anything else than agriculture. The low efficiency characterized by most smallholdings and the practice of shifting cultivation in combination with the recent rapid population increase, have made the demand for new land skyrocket. Driven by poverty, these are all factors that have created incitements for the locals to cut down forest to satisfy more acute needs, as a disadvantage for future generations. This process in turn, seems to be further reinforced by factors including weak governance and a global demand for certain crops that can be grown among farmers for good profit. The pressure on the forest has been most evident in the wet and intermediate climate zones where only fragments of the once widespread natural forest cover are all that remain (IFAD, 2010; FAO, 1997; Atkinson, 2009; Interview with Charith Senanayake, 2011).

2.2.1 Local effects of deforestation

Apart from the direct destruction of habitats of flora and fauna that provide humans with valuable resources, the removal of forest cover put many important natural functions out of order which may lead to a range of additional serious consequences.

The most immediate impacts of deforestation are found on a local level. A forest can be compared to a sponge that absorbs water during heavy rains in the wet season, then filtrates it and gradually releases it, which provides the surroundings with a more even flow of clean freshwater, year-round. Hence, when a forest is cut down the occurrence of floods and droughts are likely to increase which could cause severe damage to downstream villages and cities as well as lower the water quality (Mongabay, 2011).

Deforestation also causes soil erosion. The dense forest vegetation act as a natural shield that decreases splash erosion during intense rainfalls while dispersing the droplet energy and covering the ground in a layer of protective leaf litter. Further, the infiltration of water is enhanced by organic material in the soil which decreases the occurrence of surface runoff. Consequently when the forest cover is lost the soil will be more exposed and prone to erosion. The layer of soil that is typically found in a tropical forest is thin and poor in nutrients which make it even more susceptible to exposure (FSMP p 86). When deforestation occurs on steep slopes, an increase in the number of landslides is another likely result, especially after heavy rains (Mongabay, 2011).

There are also climatic consequences of deforestation. Apart from affecting the global climate, mainly due to the release of greenhouse gases, the clearance of forests leads to an imbalance in the local and regional climate. The process of evaporation in combination with the shady condition in a rainforest has the ability to cool the climate inside the forest, making it a convenient environment for millions of plant and animal species. Also, up to an estimated 80 percent of all rainwater that a tropical forest receives comes from the moisture that has evapotranspired from the vegetation and soil in the same forest. This moisture then condensates into rainclouds and later falls down as new precipitation. The removal of the forest vegetation can thus cause a substantial decline in rainfall, resulting in a much drier local and regional climate. The effect is enhanced by the intense tropical sunshine that will reach down to the ground once the vegetation is removed. Over time this process can transform even the remaining rainforest in the area into an arid scrubland (NASA Earth Observatory, 2011; de Blij, 2005, p 212-213; Mongabay, 2011).

The various rivers and streams originating in the central hill country of Sri Lanka provide millions of farmers with irrigation water far downstream. Without a reliable flow of water from these watersheds far more people than only the ones living in the forest buffer zones would be affected. The massive Mahaweli drainage system relies on these watersheds to be able to make the dry zone soils productive, as well as the national energy sector that heavily depend on hydroelectricity. An additional threat that comes with deforestation is that increased soil erosion can reduce the lifespan of these dams and irrigation systems through downstream siltation (Ministry of Agriculture, 1995, p 86; FAO, 1997).

2.2.2 Legislation and forest management

Ever since the introduction of Buddhism in 246 BC, the protection of nature has had a strong tradition in Sri Lanka. The ancient kings who used to rule the island were also the ruler of the widespread forests and put up a range of restrictions and obligations for the people to avoid any misuse of the royal forestlands. Despite this they never questioned the peasants' right to use the land which left the rural communities with a good amount of self-administration of the area they inhabited (Ministry of Agriculture, 1995, p 34; DeZoysa, 2008 p 29-30). In this way people lived in harmony with their surrounding environment for many hundred years. It was not until the fall of the Sri Lankan Kingdom and the introduction of the British colonial authority in the beginning of the 19th century, that the common property management was starting to break down while being replaced by a centralized governmental management.

Today 17 percent of all land is under some sort of governmental protection, and of all natural forest about 99.5 percent belongs to the government. This leaves little or no forest to private or local community ownership among the 21 million people in the country (FAO, 2009, p 26-27; UNDP, 2011a, p 13).

The management and protection of the natural forests of the Sri Lankan government fall under two governmental ministries; The Forest Department (FD) and the Department of Wildlife Conservation (DWLC).

The FD was established over 120 years ago and is currently responsible for the management of about 54 percent of all natural forests in Sri Lanka. All plantation forest also falls within the purview of the FD. While the production of timber from the plantation forests previously used to be the primary task of the department, environmental conservation has become more of a main focus in recent years. Reforestation, forest research, planning and monitoring, and social forestry are some other important functions. Work at the FD is organized into a hierarchy of administration starting with the "regions", followed by "Divisions", "Ranges" and finally "Beats", down at the lowest level of administration (UNDP, 2011a, p 17; FAO, 2009, p 29-30; DeZoysa, 2008, p 35).

Until the middle of last century, the management of wildlife used to be a part of the FD, but the establishment of the Department of Wildlife Conservation in 1949 officially marked the separation of issues regarding flora and fauna from the FD. Currently the DWLC controls around 44 percent of all forested lands in Sri Lanka.

Most important in the work of the two departments is the Forest Ordinance from 1907, with the overall goal to protect the national forest resources (FAO, 2009, p 29-30). Clearly, the Forest Ordinance has not been able to stop the serious deforestation that has been going on since its establishment. A few amendments have been done and many new legislations and policies have been enacted and added in several attempts to overcome the policy weaknesses. For example, the Forestry Sector Master Plan (FSMP) of 1995 was an ambitious attempt to provide a comprehensive framework for the sustainable development of the forest sector. Together with the FSMP a new National Forest Policy was also created in 1995, which further enhanced the importance of the conservation of forests to protect both natural and social values, as well as the importance of community involvement and the need to increase the productivity and extent of the forest cover. Five years earlier, a complete logging ban was implemented in the wet zone under the Forestry

Sector Development Programme, another important step towards the preservation of the remaining forests (Ministry of Agriculture, 1995, p 4; p 32; p 36; FAO, 2009, p 64).

Still, several weaknesses remain which have been affecting the efficiency of the conservation of the national forests and allowed harmful activities to continue. Forest officers complain about the fact that they are not enough employees to look after all forested land on the island (DeZoysa, 2008, p 28; Interviews with the DFOs in Galle and Kandy, 2011).

2.3 Study areas

The two study sites investigated in this study are both managed and protected by the FD, as a *Forest Reserve* and a *Conservation Forest*. Under the Forest Ordinance a Forest Reserve is defined as an area meant for “conservation and non-destructive uses”, allowing human presence inside the forest to a certain degree. A non-destructive use such as sustainable collection of some NTFPs is legal. A Conservation Forest on the other hand, is “allocated strictly for biodiversity conservation”, meaning no human without a special permission is allowed to enter the forest (FAO, 2010b, p 13).

2.3.1 Kanneliya Forest Reserve

The Kanneliya Forest Reserve is located about 35 kilometers inland from the coastal city of Galle, which is the capital of the Galle District, situated in the Southern Province in the southwest of Sri Lanka (see Figure 6). The population density in the district exceeds 650 people per km², which is about twice the average national population density. The Galle District lies within the wet zone with a hot and humid climate and an average annual rainfall of 3000 mm (Chokkalingam & Vanniarachchy, 2011; Southern Provincial Council, 2011).

The Kanneliya Forest Reserve has a total size of 5305.9 hectares. It is a part of a larger forest complex constituting the three conjoined forests of Kanneliya, Dediyaigala and Nakiyadeniya, the “KDN Complex”. The natural vegetation of the Kanneliya Forest Reserve is wet evergreen forest that harbors a unique collection of flora and fauna with high numbers of endemic species, found nowhere else on earth. This area has a history of intense logging that started in 1940 to provide raw material for plywood mills and other forest industries, a process that continued until 1988 when the government acknowledged the biological value of these wet zone forests and started to develop a management plan of how to protect areas like Kanneliya. It has since been regenerated, mainly naturally. Because of the intensive logging in the past most of the forest in the Kanneliya Reserve is today identified as secondary forest. Despite decades of heavy degradation due to over-exploitation, this forest is considered one of the most extensive surviving blocks of low land rainforest in the country (Gunawardane, 2002, p 7; Bandarathillake, 2008).

Historically, the area around Kanneliya has undergone a rapid population growth. Today, according to Bandarathillake (2003), there are 78 villages surrounding the KDN Forest Complex out of which more than half of the households live below the national poverty line. The rural economy is mainly centered on the small scale cultivation of tea and paddy.

In 2001 the Forest Department started to mark the border of the Kanneliya Forest Reserve that until that point had been slightly unclear to villagers (Interview with the Divisional Forest Officer at the FD, Galle).

2.3.2 Knuckles Conservation Forest

The Knuckles Conservation Forest is located in the central highland of the country (see Figure 6), about 100 kilometers north-east of Kandy - Sri Lanka's second largest city and capital of the Kandy District in the Central Province. Population numbers in the district are high with an approximate density of more than 650 people per km², mainly concentrated around Kandy. Recent studies have identified high levels of poverty in the area with as much as 40 percent receiving governmental aid. Due to the elevation of the area the climate is cooler than in the lowland, with an average temperature of about 20°C (Kandy District Secretariat, 2011; Forest Department, 2009a; Atkinson, 2009). The Knuckles Conservation Forest is situated in the intermediate zone (between the wet zone and the dry zone) which has resulted in a unique and varied climate ranging from extreme wet in the southwest to nearly-arid in the eastern parts. The terrain is very rugged with mountain peaks rising above 1900 meters. These climatic and topographic features have created a unique set of ecosystems that sustain remarkably high levels of biodiversity, including high numbers of species endemic to the area. Within the span of this relatively small area one can find characteristics of all key vegetation types found in the entire country. The five main vegetation types are Semi-evergreen forests, Sub-montane forest, Montane forest, Patana and Savanna grasslands and Riverine forests. The Knuckles forest region provides very important watershed services to lowland populations, especially for the farmers living on the Mahaweli plains, north of Knuckles (Forest Department, 2004; Socio Environmental Foundation Sri Lanka, 2011; Badenoch 2009, p 1).

There are around 80 villages surrounding the Knuckles Conservation Forest. Most of them are very remote and difficult to reach and thus lack access to several social services such as health care and education. This has resulted in the preservation of traditional life with a very simple lifestyle in many villages. The main source of income for most local people is subsistence farming, where the cultivation of paddy and cardamom are two of the most important crops. The cultivation of cardamom has been present in a larger extent since 1965, as the climatic conditions in the Knuckles area have proved highly suitable for this purpose. Cardamom requires shade and the planting process involve total removal of the ground vegetation and partially clearing of the over-storey which over time radically affect the forest structure and lead to soil erosion and forest degradation. Historically this area has also been prone to illegal logging, tea growing and chena (slash and burn) cultivation (Forest Department, 2009b; Forest Department, 2004; Gunatilake 1998, p 277; IUCN, 2010, p 2).

The natural values of the Knuckles area have long been renowned and the area has a conservation history that dates back until 1873 when parts of the area was declared a climatic reserve. In April 2000, about 18,000 hectares of the Knuckles area was declared a Conservation Forest. Similar to the Kanneliya Forest Reserve the boundary of the protected area was not established until 2001. At the time of writing, the Knuckles Conservation area was nominated as an UNESCO World Heritage Site. Both the cultivation of cardamom and the practice of chena cultivation are today banned within the protected area which has caused a clash with the locals' traditional way of life that involves these activities. Some old villages still remain inside the protected area due to their historical linkage to these sites (Forest Department, 2009b; Interview with DFO at the FD, Kandy, 2011; Forest Department 2009a, p 3; Forest Department, 2004).

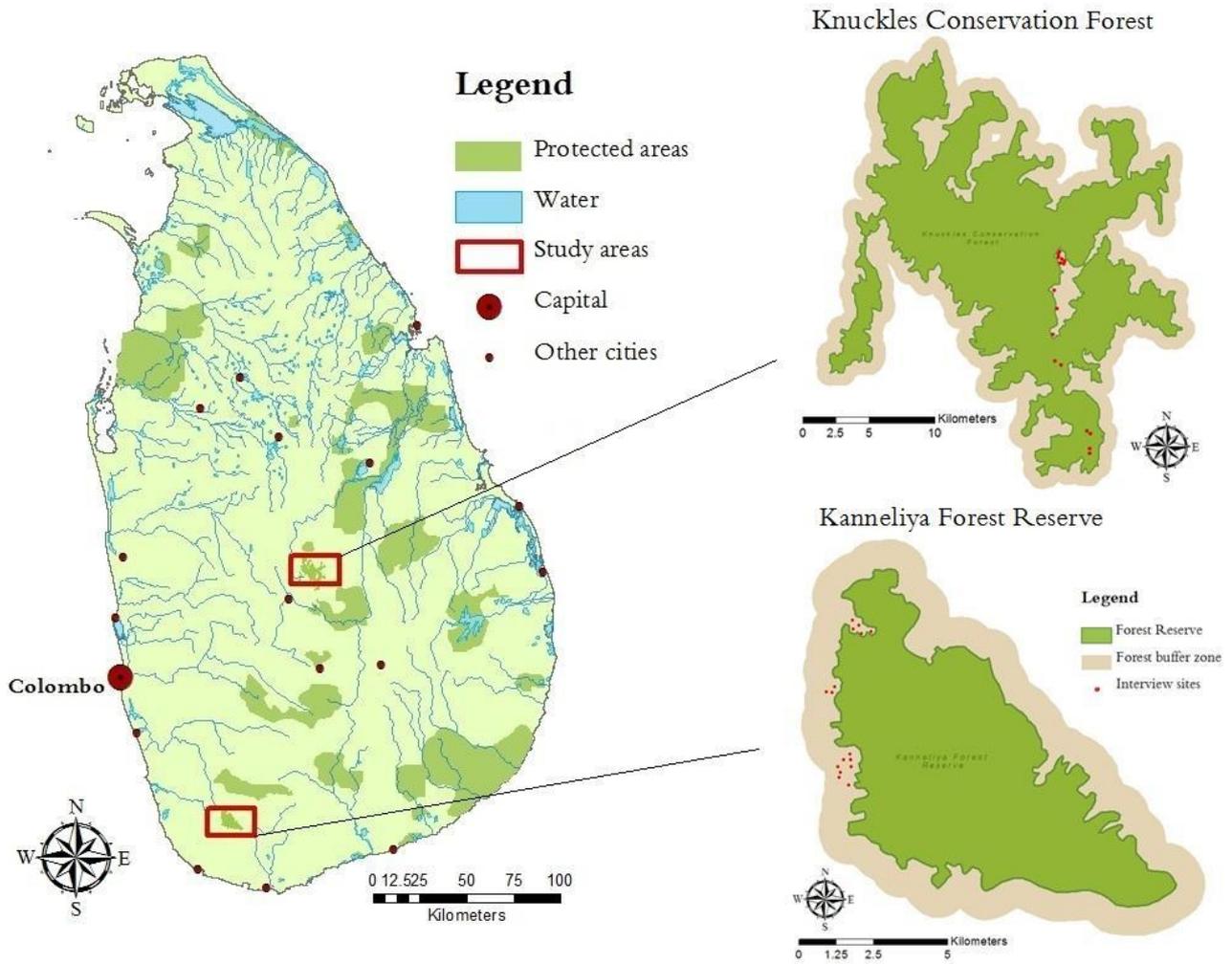


Figure 6 shows the location of the two study areas in Sri Lanka. Note the scale difference in between the Knuckles Conservation Area and the Kanneliya Forest Reserve (Lindström, 2011).

3. Methods

3.1 Selection of study areas

The empirical material in this thesis is based on a field study carried out in Sri Lanka between March and May in 2011. The country was chosen because of its known history of intense deforestation and the fact that relatively few similar studies have been previously made in Sri Lanka. The two different study areas were selected together with the supervisor in field, Dr. S.P. Nissanka (senior lecturer at the Faculty of Agroforestry at the University in Peradeniya), upon the arrival in Sri Lanka.

A few aspects were considered and discussed before the decisions were made. First of all, to make my field visits appropriate I had to select two areas that had been prone to deforestation at least at one point during the last 20 years. Secondly, I wanted to study two areas quite far away from each other to be able to achieve a wider geographical perspective of the dilemma. Lastly, we had to assure that the buffer zones of the chosen forests were inhabited by people whose land use practices and daily activities I could examine. As a result, one area was selected in the south; on the west border of the Kanneliya Forest Reserve, and another in the center of the island a bit further north; the eastern parts of the Knuckles Conservation Forest (Figure 6, above). Partly they were chosen due to my supervisor's contacts with a few relevant people in these areas that were going to be able to help me out with my field work. Below follows a description of the different methodologies used to meet my objectives of this field study.

3.2 Methodological approach

3.2.1 Interviews

An interview is a good method for a researcher looking for an understanding of how individual people experience their own lives as well as the environment and processes operating around them. Contrary to a questionnaire it gives a more diversified response when the answers are not already given by the interviewer. Instead, the respondent can use own words to explain a more complex reality (Valentine, 2005 [Flowerdew] p 110-127).

There are a few different ways of conducting interviews depending on what purpose one wants to achieve with them. In this study, structured and semi-structured interviews have been carried out as a qualitative research method following Berg (1998). The purpose of conducting structured interviews is to ask each candidate the same questions out of a pre-written questionnaire so that valid comparisons of the quality of the responses can be acquired. Semi-structured interviews follow a type of interview schedule with suggested themes, but with more room for the respondents to develop their own answers. The researcher knows what information is important but still lets the respondent openly answer their question (Desai & Potter, 2006; GVC, 2011).

Interviews among small-scale farmers living in the buffer zones of the forest in the two different study areas have been an important method used in the collection of field material for this thesis. Most of these people have been affecting the forest in one way or another. Since many have been living in their villages for years they have also witnessed changes in the forest cover around them

over a long period of time, giving them an insight highly relevant for this study. I chose to conduct structured interviews, with open-ended questions, because I wanted diverse answers and reflections from my respondents but still the possibility to relatively easily be able to compare the answers. Every interview was initiated with a few general questions about personal background etc. as a way of trying to make each respondent more relaxed with the situation.

I was provided with an interpreter for each area of investigation; both students from the Agroforestry section at the University of Peradeniya, with good knowledge in English and Sinhalese, as well as in the field of science. This helped me gather information that would otherwise have been difficult to receive. In addition I also got help from two local guides in each study area with essential knowledge in the villages and the people living there, which saved me a lot of time and further made the whole process smoother. A total of 32 households, equally divided between the two study sites were selected for my research. The interviews in each study site were further divided over a few different villages located within 1 km of the protected forest, some households even situated inside the reserve. The selection was performed rather randomly but always based on my requirements in combination with my guides' knowledge.

In addition, a number of interviews were carried out with a few key informants; one national NGO, two regional representatives (Divisional Forest Officers) from the Forest Department, the Grama Niladhari (GN) division (village headman) for both study areas, as well as two scientific staff members at the Faculty of Agriculture at the University of Peradeniya, to collect different perspectives of the dilemma. This time semi-structured interviews were performed since I was seeking more of an open discussion with the different respondents. Interpretation was only needed during the interviews with the GN.

While conducting the interviews a voice recorder was used as a complement for the notes that were taken, after asking each respondent for the permission to do so.

3.2.2 Geographical Information System

A geographic information system (GIS) is a computerized information system that collects data, stores it, processes it and helps with the analysis and visualization of the results. It makes it easier to analyze spatial connections that otherwise would have been hard to identify. Using GIS in a research project should not be seen as a methodology by itself, but rather as a tool to use in combination with other methods to enhance and emphasize the results (Harrie, 2008; Flowerdew, 2005, p 285).

In this study, GIS was used mainly to clarify the actual forest cover change in the buffer zones of the two different study areas by comparing recent satellite images from Google Earth with land use maps from 1987 (Survey Department, 1987). As mentioned before the width of what is considered the forest buffer zone in Sri Lanka is slightly unclear due to the lack of a legally defined outer border of the buffer zone, but in this thesis I have set it at 0 – 1000 meter away from the border of the reserves. This is based on the assumption that any people living that close to the border are to be considered as highly probable of having a continuous impact on the natural forest cover (Gunatilake, 1998, p 276-279).

The change between the different years of comparison was then analyzed and visualized with the ESRI ArcGIS software.

The GIS-analysis of the forest cover changes and local land use was later compared with the respondent's views of utilization of their lands historically, to find similarities and to acquire a more holistic picture of change. Out in field I carried a GPS with which I marked the coordinates of each household where I conducted the interviews. These coordinates were later added to my maps to show the exact sites of my research.

3.2.3 Field observations

A "participant observation" is a method used to understand people's way of living through an everyday perspective. It helps the researcher to achieve more knowledge about a community, and the routines and activities going on within them, by doing personal observations. According to Cook (2005, p 167-188) participatory methods are especially useful for those who want to identify patterns and behavior that are difficult to identify through an interview. This research method can imply different levels of involvement. The researcher should consider whether he or she should be *participatory* and fully involved by becoming a part of everyday life in the community, or only *observational*, by learning about the environment while simply studying it as an outsider. Thus, a participant observation as a research method can involve anything from living in a community for several months, to taking a one hour stroll through a certain landscape. Most important is to have a clear objective of why one is doing the observation.

While walking through the villages where the interviews were carried out, a few interesting observations were made and documented with a camera. This filled the purpose as a valuable way of complementing the interviews as a research method. Apart from learning about the environments in which my respondents inhabit, the main target by doing these observations was to verify if what I was told by the respondents matched what I actually observed around the interview sites.

3.2.4 Literature review

While doing a research project, it is a good idea to turn to secondary sources to search for relevant background information about the chosen subject. This will give the researcher a notion of what work has already been done in the specific topic so that doing the same job twice can be avoided. It can also help the researcher by complementing his or her project with vital information that would have been too time-consuming to explore through primary research methods (Flowerdew, 2005, p 48-56).

As a secondary source of information I have been using already existing literature, to gain more knowledge about Sri Lanka and the issue of deforestation in the country. This was implemented both as a pre-study prior to my field trip, as well as a complementary method after the field research was completed. Apart from information found in books and on the internet as well as articles provided by my supervisor, I gathered several brochures and information sheets, and made copies of important documents while visiting different departments and organizations in Sri Lanka.

3.3 Method discussion

3.3.1 Interviews with farmers

Without any knowledge in the language of one's respondents when carrying out an interview you will inevitably have to settle with a sort of second hand information channeled through your interpreter. In a situation like this it is important as a researcher to clarify what you want to achieve. To make sure my interpreters understood my objectives we went through the interview guide the day before we entered the study area and discussed what I wanted to get out of each question until we felt we had a mutual understanding. Once in field I always first asked every question in English where after my interpreter translated it into Sinhalese to make myself feel more of a part of the conversation. Still, some interview questions evolved into longer discussions between my interpreter and the respondents ending with only a short summary of what had been said. While this sometimes made me slightly frustrated it was something I had expected to experience. To make sure nothing important had been left out I took some time after every interview to discuss the previous conversation with my interpreters.

Before every interview I told the respondent who I was, about my objectives and made sure that everyone was aware of the fact that the interview was optional. Everyone asked approved to let me go through with my survey. Though, some of the questions asked to the farmers (such as questions no. 7 and 8 – see Appendix 1) seemed to make some of them slightly nervous and it was hence difficult to judge if they were being completely honest. Despite underlining I was only a university student they might have suspected me for having connections to the FD and risking being fined by giving a certain answer and confess an illegal activity. This might have weakened the reliability of some answers (especially questions no. 7 and 8). Although it was difficult to always double check the validity of these answers, the field observations confirmed that dishonesty sometimes was the case (see Results; Field observations).

3.3.2 Validity of GIS-analysis

While doing the visualization of the land use over the two study areas a few issues were faced. First of all the land use in the maps from 1987 seems to have been annoyingly generalized compared to what could be deduced from the satellite images. This is apparent when placing the visualizations from both years next to each other, especially the maps over Kanneliya (see Results; GIS-analysis). Consequently the land use analysis for 1987 inevitably got more generalized. The occurrence of houses which can give a general idea about the population size in 1987 might also have been bigger than it appears. However, the main focus of this study was to examine the change in forest cover after 1987.

All maps acquired from Google Earth from recent years (2003 and 2010) are based on my own interpretations of the ground by studying satellite images. Anyone familiar with Google Earth is likely to know that the surface of the globe is represented by a large set of satellite images of varied resolution, visibility (e.g. due to cloud cover) and date and year the images were taken. This caused some difficulties when trying to analyze the change around the Knuckles Conservation Forest that was covered by two different images from different years; one older version with no clouds but bad resolution, another slightly newer version with perfect resolution but lots of clouds. The

interpretation of forest cover and land use were based on what could be seen in the older image, then the image with better resolution was used to verify these results, but the cloud cover prevented me from doing so in the entire area. This is especially true for the village of Deanstone where the validity of my interpretation should be considered as lower than in other villages.

Furthermore, some land use types were almost impossible to identify from above due to its nature, such as cardamom and rubber; seen from the air both land use types can easily appear like regenerating/degraded/natural forest to an unpracticed eye. This might have resulted in a few mistakes and a generalization in the interpretation of the forest buffer zone of the Knuckles. I faced the same problem when visualizing home gardens that are also easily mistaken for natural forests. Again I had to generalize but I also based my visualization on general knowledge about what the villages looked like in reality; almost every household I saw in field at the time of research was surrounded by home gardens, therefore that is how they mostly appear in my maps (see Results; GIS-analysis).

4. Results

4.1 Interviews with local farmers

Below the result of the interviews carried out with the local small-scale farmers in each study area is presented.

4.1.1 General

Almost every respondent (15 out of 16 in both study areas) had been living in the area their entire life which exceeded 20 years. They all owned their own land (most commonly inherited from parents), or had the legal right to use it as if it was their own land.

Around the Kanneliya Forest Reserve all farmers count agriculture as their primary source of income and grow crops both for commercial and subsistence reasons, except from one farmer with only commercial purposes. Around the Knuckles Conservation Forest four farmers mentioned only commercial reasons while one farmer only relied on agriculture as a food source, the rest produced for both reasons.

4.1.2 Forest relationship

In the Kanneliya buffer zone 11 out of 16 villagers (about 70 percent) claimed they used the natural forest for various resources (Figure 7), medicinal plants being the most commonly collected one, followed by fruits/food and fuel wood.

In the Knuckles buffer zone another 13 out of 16 villagers (about 80 percent) said they utilized resources from the natural forest, mainly through the collection of fuel wood (Figure 7). The collection of fruits/food for home consumption was the second most common reason to enter the forest, followed by medicinal plants.

In both study areas 60 percent of the respondents claimed that the income they received from agriculture was insufficient to sustain their needs. Out of these, every farmer in the Kanneliya area except from one mentioned another source of income to improve their situation. The same figure for the Knuckles area was 10 farmers out of 16. Half of all farmers admitted they turned to the natural forest to earn this extra income, mainly through the extraction of kitul¹ for the production of different liquids (Figure 8).

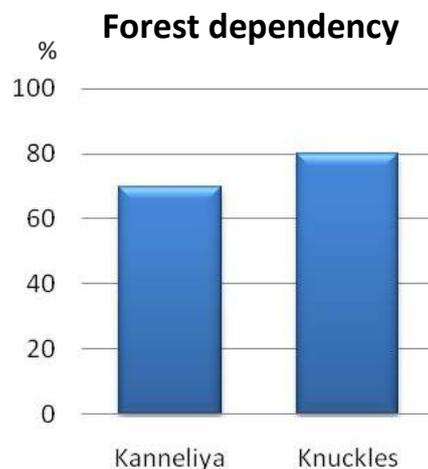


Figure 7 demonstrates the amount of respondents utilizing resources from surrounding natural forests for subsistence reasons (Lindström, 2011).

¹ Kitul is a palm tree species of high economic value. It produces a range of different products that can be processed into toddy, jaggery and treacle that are products of high demand in Sri Lanka (Ministry of Agriculture, 1995, p 245).

When being asked if the forest had any other important function the large majority (above 75 percent) in both areas answered responded positively. The most frequently mentioned factor was water regulation, access to clean drinking water and the prevention of soil erosion. The rest either had no knowledge about it or mentioned negative impacts from the surrounding forest such as wildlife encroachment on their cultivated lands.



Figure 8. Treacle; a profit-bringing product of kitul (Photo: Lindström, 2011).

4.1.3 Land use practices

Every respondent except two persons were having 10 acres² of land or less; 22 out of the total 32 had less than three acres. Overall the lands of the respondents around the Knuckles tended to be bigger.

Around Kanneliya every farmer was growing tea which makes it the most commonly grown crop in the area. It is also the most important source of income according to the respondents' answers who all said they grow tea for profit. The second most commonly grown crop was coconut, followed by pepper which provided 40 percent of the respondents with an income (see Figure 9 and 10).

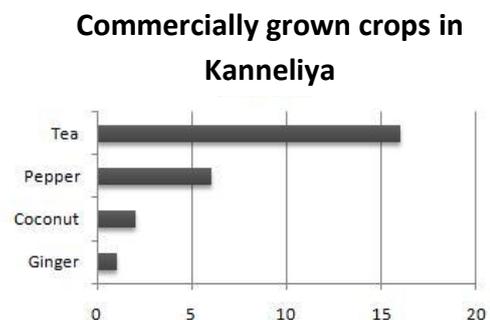
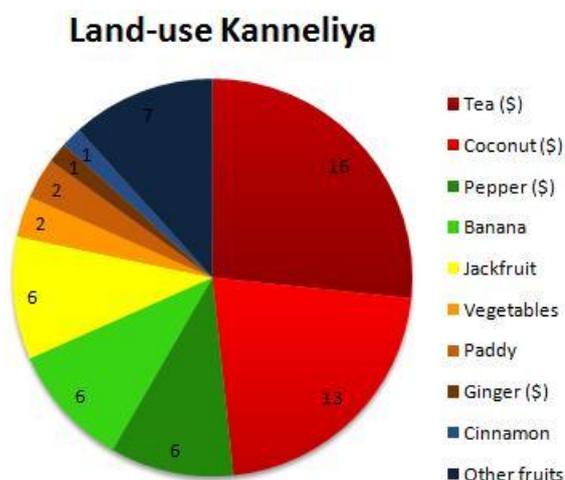


Figure 10 shows the number of respondents growing the different profit bringing crops in the Kanneliya area (Lindström 2011).

Figure 9 shows the number of respondents cultivating the most common crops in the Kanneliya area. "\$" is indicating what crops that are grown for commercial purposes (Lindström, 2011).

Around Knuckles the most common crop was pepper, grown by 70 percent of the interviewees, all doing it for commercial reasons. The second most important profit bringing crop was tea, together with rice and coconut, followed by cardamom (see Figure 11 and 12).

² One acre is equivalent to 4,050 square meters (0,405 hectares)

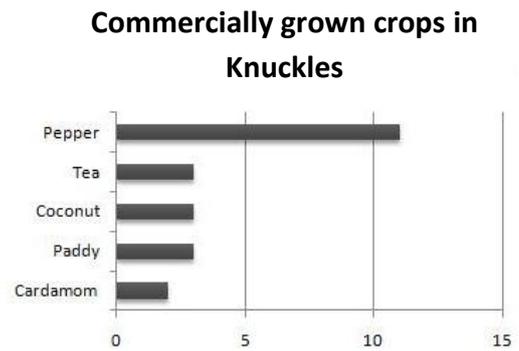
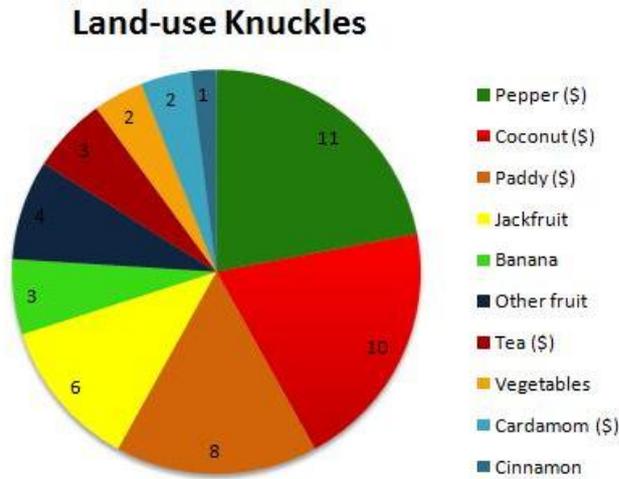


Figure 12 shows the number of respondents growing the different profit bringing crops in the Knuckles area (Lindström, 2011).

Figure 11 shows the number of respondents cultivating the most common crops in the Knuckles area. "\$" is indicating what crops that are grown for commercial purposes (Lindström, 2011).

When being asked if they had been expanding their cultivated land during the past 20 years or had any plans to do so in the future, 70 percent of the respondents around Kanneliya said yes. The rest said they would do so if they were legally allowed to.

Around Knuckles the same question resulted in 20 percent of the interviewees saying they had been expanding their lands while 60 percent claimed no expansion. Four farmers would expand if they had the right to and another three had been experiencing a *decrease* in the amount of cultivated land since parts had been taken back by the FD when declared illegal at the time they established the border. Almost everyone who answered no to the question mentioned the newly marked border for the protected forest in both areas as a reason for no expansion and expressed a fear of getting caught and fined by the FD.

4.1.4 Natural forest cover extent

In Kanneliya 50 percent of the respondents experienced that the natural forest cover had remained the same in most recent years, while about 40 percent said they had seen an increase after the FD marked the reserve border around 2001. Approximately 10 percent claimed they had witnessed a decrease in forest cover around them.

In Knuckles 95 percent said they had seen a clear *increase* in the natural forest cover in most recent years, while only one respondent had experienced an actual decrease. Almost every respondent who had seen an increase mentioned the marking of the boundary and strict legislations against chena cultivation as a contributing factor to the forest expansion. Some also mentioned a recent emigration trend among farmers in the area whose old lands have gotten replaced by forest through natural regeneration. Several farmers expressed some degree of fear for the future and were not sure if they would be able to survive in the area through their traditional way of life in the coming years due to the fact that some of their livelihoods have been practically banned.

Historically though, 20 years back and until the setting of the conservation borders, the majority in both areas had witnessed destructive human activities and experienced a clear decrease in the extent of the natural forest cover. Especially in Kanneliya the respondents talked about severe destruction 10 years ago and back. Most respondents agreed on that the clarified borders have been playing a major role in reducing the rate of deforestation in these areas and that many more villagers respect the rules nowadays. However, a few still knew about illegal forest activities and encroachments happening around them at the time of my visit.

4.2 Other perspectives

Below follows a summary of the results of the semi-structured interviews carried out with the different key informants; two officers at the FD, the Grama Niladhari (village headman) for each study area, the two scientific staff members at the University of Peradeniya as well as the managing director at the NGO “Rainforest Rescue International” (RRI).

4.2.1 Mr. Vasante, Divisional Forest Officer, the Forest Department in Galle (managing the Kanneliya area)

According to Mr. Vasante’s experience the Kanneliya forest was subject to huge encroachments from the villagers in the buffer zone before the demarcation of the boundary in 2001. He blamed the intense population increase followed by rapidly expanding tea cultivations for most of the deforestation in the area. He believed that the establishment of the border of the reserve by the FD has been very successful in decreasing the rate of deforestation. At the time of my visit Mr. Vasante claimed that the size of the forest was rather fixed; that it was not expanding, nor decreasing due to a balance between natural regrowth within the forest (on patches of land that used to be illegally cultivated etc.) and the current, lower rate of deforestation. Though, even if the human impact on the forest has slowed down he did not deny the fact that illegal and destructive activities still happen in Kanneliya.

As a forest officer Mr. Vasante complained about the fact that they are not enough employees at the FD to look after all forested land in the area, and in the country as a whole. With a bigger crew he believed he could do a much better job controlling the activities of people in the buffer zone of Kanneliya and eventually end the deforestation.

4.2.2 Mr. Kanayake, Assistant Divisional Forest Officer, the Forest Department in Kandy (managing the Knuckles area)

Similar to the Divisional Forest Officer in Galle Mr. Kanayake had seen encroachments into the forest before the establishment of the Knuckles Conservation Forest in 2000, mainly due to the highly profitable cultivation of cardamom. He stated that about 15 - 20 years ago shifting cultivation was also a rather big issue in the Knuckles but has since then been gradually reduced after being totally banned in 2000. He believed that the setting of the border of the reserve has been highly efficient and according to his own experience there is no large scale encroachment going on in the area today. Mr. Kanayake claims that the biggest problem that remains is the cardamom cultivation that in a certain extent still exists despite being illegalized. Because of the nature of the current problem and

the fact that the shifting cultivation basically stopped in his opinion there is no real deforestation going on but rather a forest degradation.

Nowadays the FD is trying to increase the forest by planting new trees, according to Mr. Kanayake. There is also a lot of natural regeneration going on, partly due to emigration of people from the area followed by regrowth of trees on their abandoned lands.

4.2.3 The Grama Niladhari, Hiniduma (the Kanneliya area)

This Grama Niladhari had been active in the area for 32 years. When asked about the villagers' relationship to the forest he was saying that before the 1990's about half of the population in the area used the forest in some way which caused a certain degree of forest destruction. Today he meant that only something like 3 percent is using the same forest because of the stricter rules and claims the current relationship to be good and sustainable. At the same time he recognized a problem with population increase in the combination with lack of land during the past 20 years. About 10 – 12 years ago the tea industry encouraged rural people to start producing tea and when no other open land was left they cut down parts of the forest to start to make room for the tea. In his opinion the process has slowed down in recent years but he still knows of people that are involved in illegal logging and other banned activities – still driven by the lack of land, or the lack of resources on their own land. Generally though, he experienced that the rules were being respected today, after clarifying the border. He only wished that the FD would have implemented it earlier to save more forest.

When we were talking about environmental problems in the area he mentioned a lower water table today as well as the occurrence of unusually long droughts, but without being too sure about its relationship to the forest cover extent. After the marking of the border in 2001 he experienced that the problem with the severe droughts has stopped.

4.2.4 The Grama Niladhari, Pusse-Ela (the Knuckles area)

As with the Grama Niladhari near Kanneliya this man had been an active GN in the Knuckles area for 32 years. When we were talking about the local forest relationship he claimed that many villagers in the area are dependent upon the natural forest, mainly for the collection of NTFPs and that this situation never changed after the establishment of the conservation forest. He said that this situation has always been the same during the past 20 years but that the establishment of the conservation forest in 2000 has caused a profound income reduction to many villagers when they are no longer allowed to enter the forest they have always been depended upon. Some people thus enter the forest illegally. In his opinion the villagers use the forest resources rather sustainably, without causing any major destruction to the forest. He was aware of the shifting cultivation that was common in the area 15 - 20 years ago and that it used to cause deforestation but said that at present it was not practiced much.

In recent years he had seen an emigration trend in the area followed by an expanding natural forest cover; partly due to natural regeneration of trees and partly due to plantation activities carried out by the FD. This had made water more abundant and the climate more convenient in his opinion. Therefore he could say that the new conservation rules had been very successful from an environmental point of view but that his people were paying the price while facing difficulties maintaining their livelihoods.

4.2.5 Dr. D.K.N.G. Pushpakumara, Professor, Faculty of Agriculture, University of Peradeniya

When asked what Dr. Pushpakumara himself defined as the main drivers of deforestation in the two study areas he mentioned a range of different contributors through history but claimed that land use is the biggest issue today. Around the Knuckles he mentioned the cultivation of cardamom as one of the most destructive activities, causing severe forest degradation through the removal of ground vegetation (Figure 13). Since this is hard to identify from above he also mentioned that it has been a bit difficult to map the current impact of the cardamom. Further Dr Pushpakumara stated that also the cultivation of tea has caused some deforestation in the area during the last two decades, but not near as much as in the wet zone. Around Kanneliya Forest Reserve he therefore claimed tea as the main cause of deforestation since the beginning of the 90's, especially due to the crop's high profitability and the rapid population growth that has been going on in the area.

Generally he thought of the deforestation as less of a problem today than 20 years ago, but through own experiences and research he knew of illegal activities still going on despite being illegal, such as chena cultivation.

In national terms he partly blamed the policies and weak governance for nourishing the deforestation issue in the country, mainly by not giving rural people enough incentives to protect the forest and act more sustainably. He also recognizes the problem with the difficulties of linking the forest policy with the desired national development.



Figure 13. A farmer demonstrating his cardamom hidden away in the shade under the tree canopy where the natural ground vegetation once was cleared to make room for this cash crop (Photo: Lindström, 2011).

4.2.6 Dr. L.H.P. Gunaratne, Senior Lecturer, Faculty of Agriculture, University of Peradeniya

Dr. Gunaratne did not see the deforestation as a very serious problem in Sri Lanka at the moment, compared to a few decades ago. Yet, he identified a range of harmful activities and land use practices among rural people still going on, especially in the wet zone, and victimized these people. The most prominent destructive form of land use that he had been witnessing around Kanneliya during the last 20 years was the conversion of forests into tea cultivations, driven by the crop's high profitability.

He pointed at the intense population pressure in combination with lack of land that had been creating a demand for small-scale farmers to illegally encroach into the forest. In his opinion the government should release more land to the people since he believes that private ownership would create much better incentives among these rural people to protect and look after their lands, including the forest.

4.2.7 Mr. Charith Senanayake, Managing Director, Rainforest Rescue International (RRI)

RRI is an NGO that has been working for the protection of the remaining rainforests and other vulnerable environments in Sri Lanka since 2002, partly through ecosystem restoration and development of sustainable livelihoods. RRI is based in the city of Galle and therefore mainly operate in the southern parts of the island. At the time of my visit they had an ongoing project based in Hiniduma, a village in the buffer zone of the Kanneliya Forest Reserve.

Charith Senanayake agreed with the other actors above when identifying land use and the production of tea as the most important driver of deforestation around the Kanneliya Forest Reserve, currently and during the past two decades. He claims that the cultivation of tea has caused forest clearance ever since its introduction long ago due to its profitability.

From his experience the rate of deforestation has slowed down in recent years and he thought that the marking of the boundary has helped since “a clear demarcation is necessary to clarify who owns what”. But at the same time he believes that the boundary can only be successful in the long run if the group of people on the other side has enough resources to live happily on their own land. Also, he stated that when a cash crop such as tea is still on the market with a growing demand, it encourages poor rural people to grow more of it.

When it comes to the Knuckles Conservation Forest he claimed he had seen a fragmentation of the forest edge and a conversion of primary forest through anthropogenic activities such as livestock and resource extraction. He mentioned the presence of poor and marginalized communities in close proximity of the forest as one of the drivers of the buffer zone degradation in this area.

Senanayake also pointed at current conservation policies and governance when talking about underlying causes of deforestation and the behavior of rural people; He mentioned how the government in the strive towards national development seems to transmit a sort of mindset to the people to make their lands productive, even though it involves the clearance of forest. Lack of enforcement, particularly in remote areas, is another issue that still needs to be addressed by the FD according to Senanayake. Thus, he is not so optimistic about the sustainability and long term success of the rules and actions of the FD.

4.3 GIS-analysis

Below follows the results from the GIS visualization and analysis of land use practices around the interview sites in both study areas. Due to differences in the access to satellite images for the two areas the year of comparison for the Knuckles Conservation Forest is 2003, while the year for the Kanneliya Forest Reserve is 2010.

4.3.1 Changes in land use in the buffer zone of the Kanneliya Forest Reserve

Around the Kanneliya Forest Reserve the interviews were conducted in three different villages located in the forest buffer zone (see Figure 14). The land use change between the two years will be presented one village at the time below.

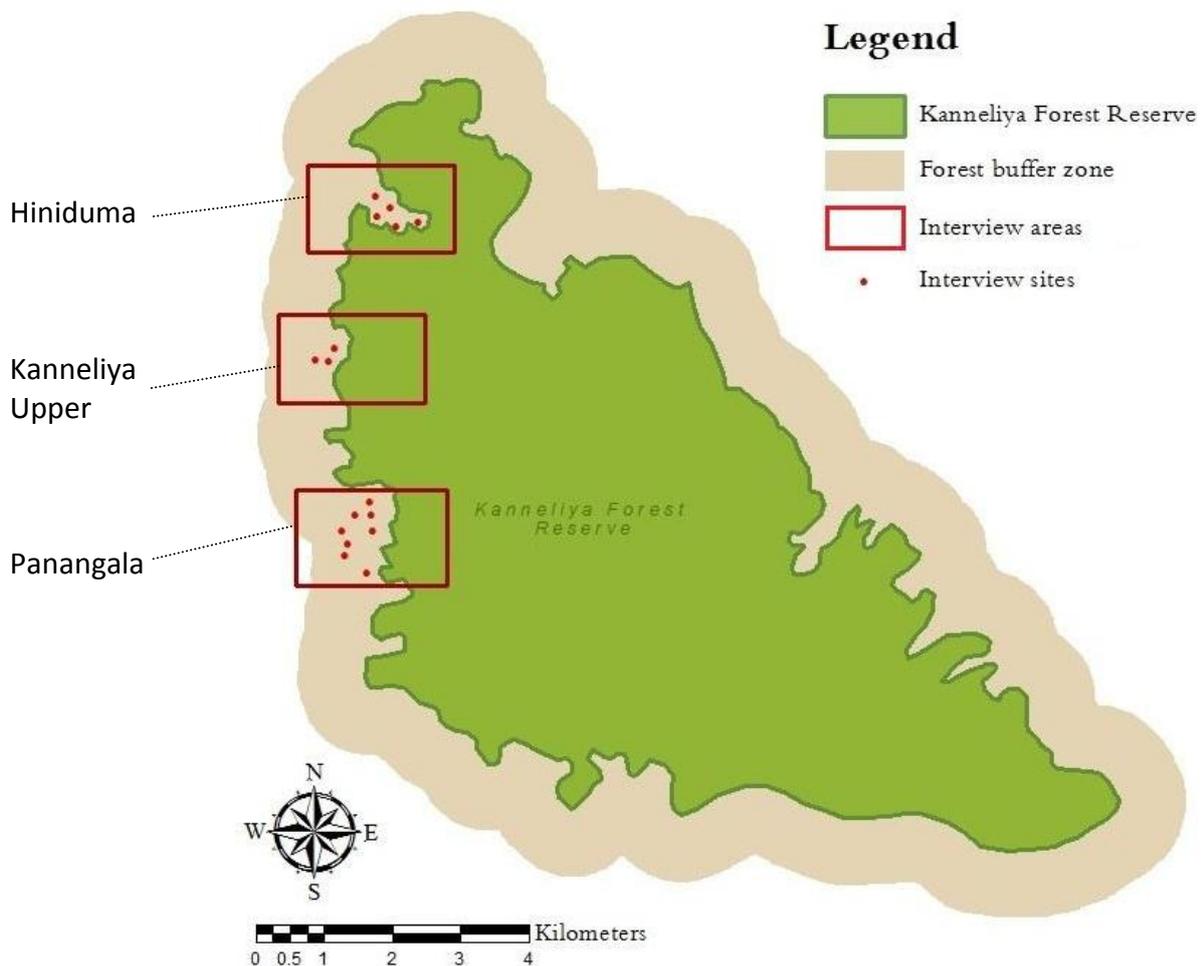


Figure 14 shows the Kanneliya Forest Reserve and the location of the interview sites, situated in three different buffer zone villages (Lindström, 2011; based on map from the FD, Galle, Sri Lanka).

The illustration of Hiniduma in 1987 indicates that the area was relatively undeveloped with no visible roads or houses (Figure 15). A rather large amount of land was under some sort of cultivation but almost entirely surrounded by natural forest. When compared with the situation in 2010 (Figure 16), it is apparent that the population has increased and that especially the cultivation of tea has become widespread in the village. Tea is the most common crop found in direct proximity to the forest in 2010. In 1987 the amount of natural forest was about 78 percent, while the same figure for 2010 was about 58 percent (see Figure 21).

Hiniduma 1987

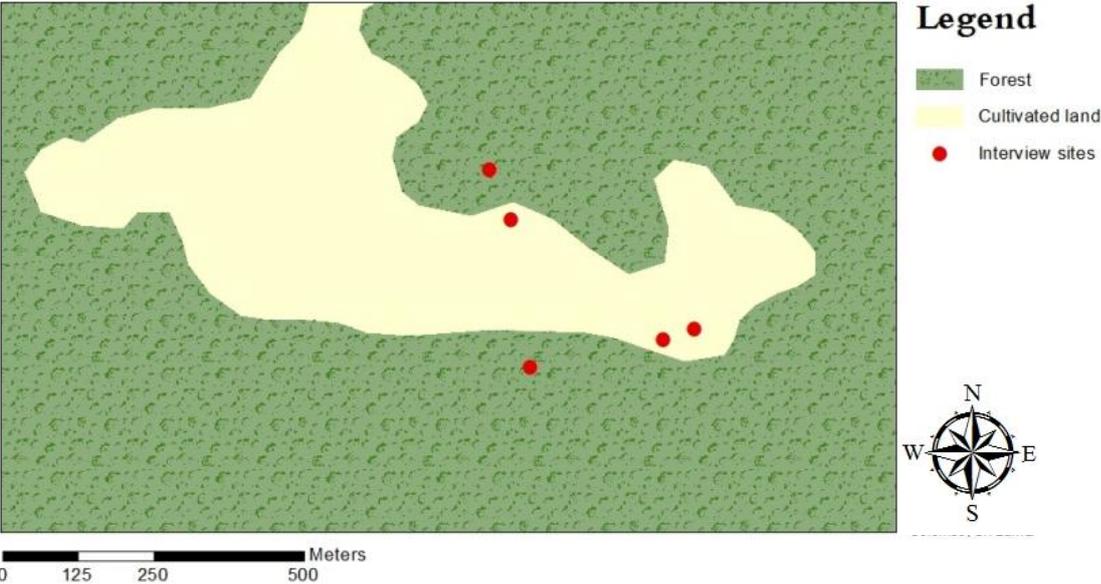


Figure 15. Forest cover extent and land use in Hiniduma for 1987 (Lindström, 2011; illustrations based on maps from the Survey Department in Colombo).

Hiniduma 2010



Figure 16. Forest cover extent and land use in Hiniduma for 2010 (Lindström, 2011; illustrations based on satellite images from Google Earth).

In Kanneliya Upper a few houses appeared in 1987 (Figure 17) but as with Hiniduma a large population increase until 2010 is very evident (Figure 18). Parts of what used to be dense forest in 1987 seem to have degraded down into scrublands (centre of illustration) and the cultivation of tea appears closer to the natural forest. While the amount of forest in this area was 38 percent in 1987 it was down at 25 percent in 2010 (Figure 21).

Kanneliya Upper 1987

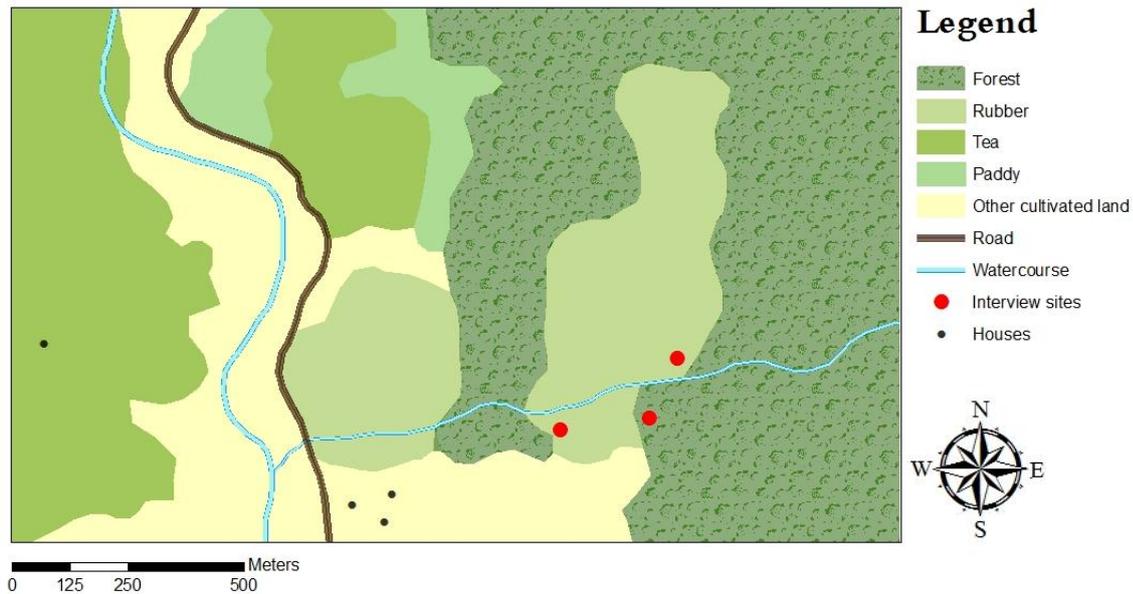


Figure 17. Forest cover extent and land use in Kanneliya Upper for 1987 (Lindström, 2011; illustrations based on maps from the Survey Department in Colombo).

Kanneliya Upper 2010



Figure 18. Forest cover extent and land use in Kanneliya Upper for 2010 (Lindström, 2011; illustrations based on satellite images from Google Earth).

The same trend as for the two other villages in the buffer zone of the Kanneliya Forest Reserve can be seen in Panangala; a steady population increase and an overall development in the area. It is also clear that the production of tea has become commonly practiced by 2010 (Figure 19 and 20). Between the two years the natural forest cover has decreased from 57 percent to 47 percent (Figure 21). In addition, what used to be scrublands in 1987 has more or less been entirely replaced by land under cultivation by 2010.

Panangala 1987

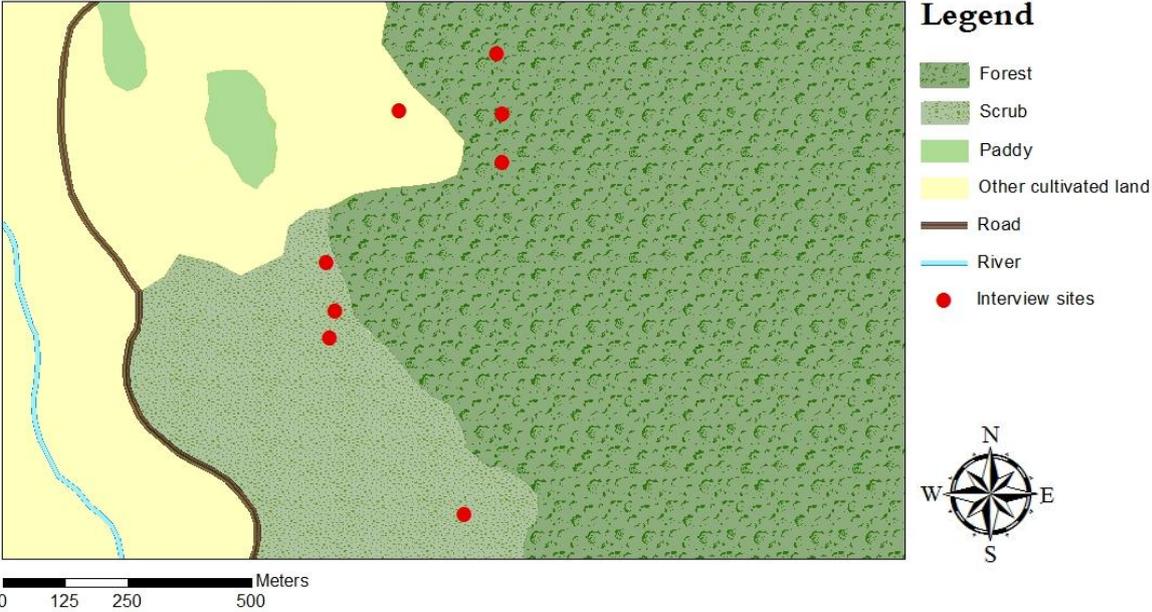


Figure 19. Forest cover extent and land use in Panangala for 1987 (Lindström, 2011; illustrations based on maps from the Survey Department in Colombo).

Panangala 2010

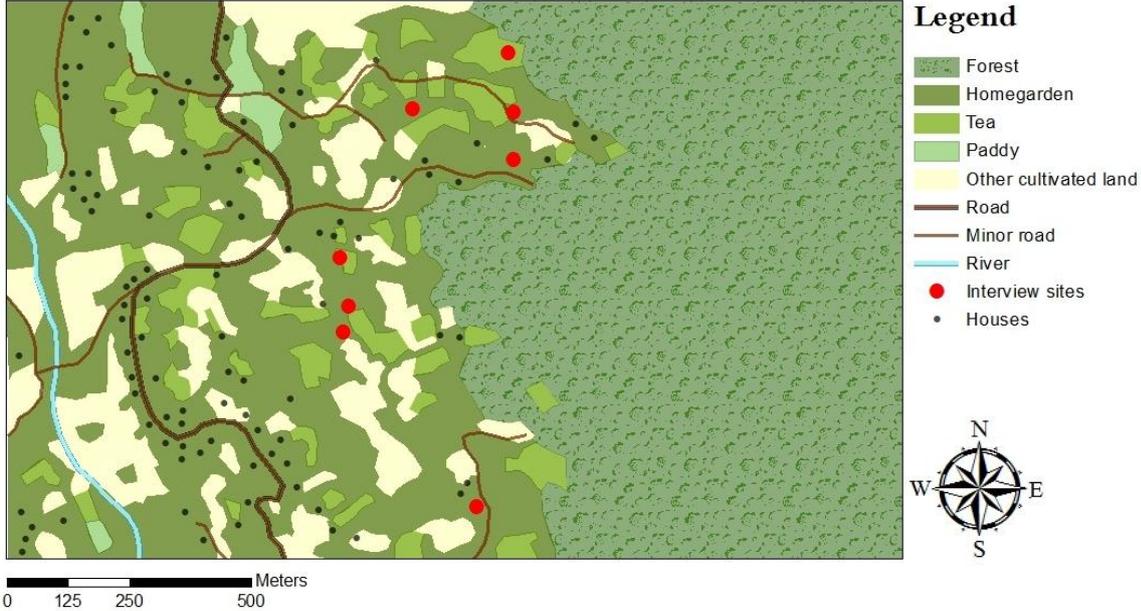


Figure 20. Forest cover extent and land use in Panangala for 2010 (Lindström, 2011; illustrations based on satellite images from Google Earth).

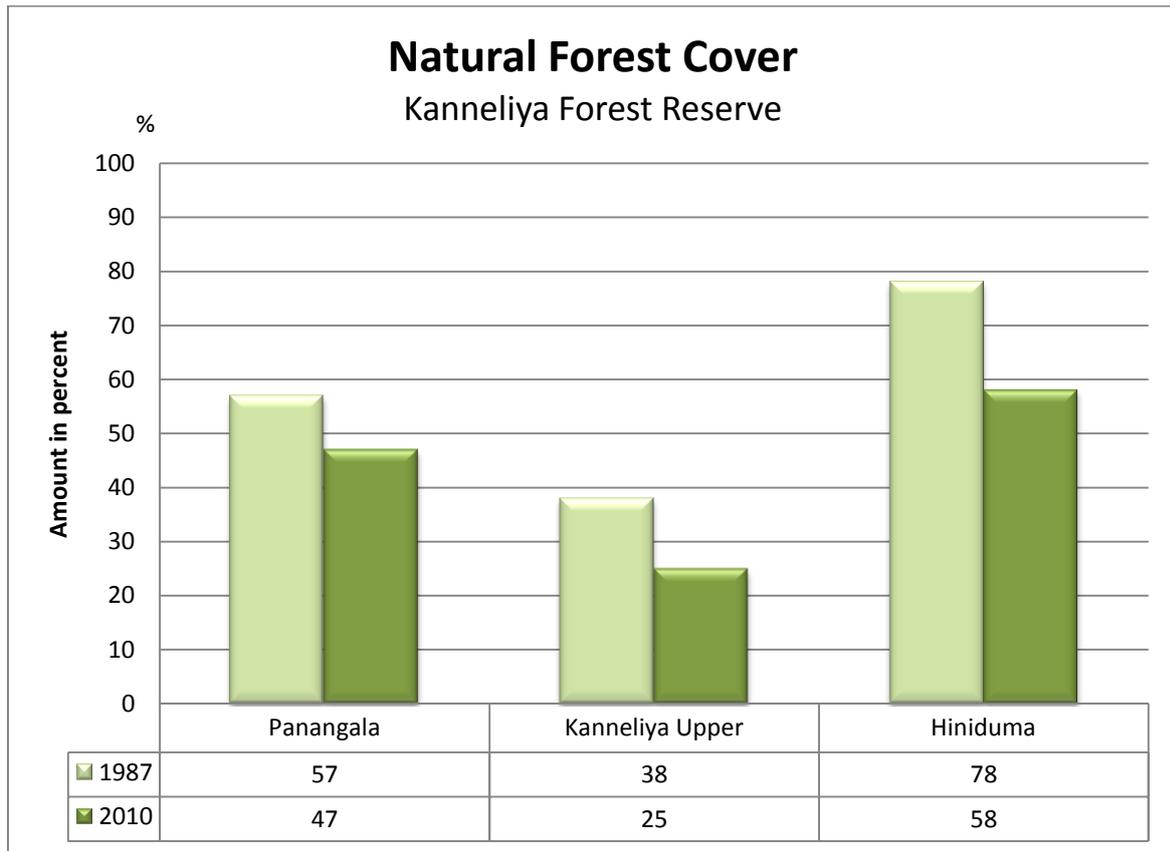


Figure 21 illustrates the amount of natural forest found in the three buffer zone villages of Kanneliya in 1987 and 2010, based on GIS-analysis (Lindström, 2011).

4.3.2 Changes in land use in the buffer zone of the Knuckles Conservation Forest

Around the Knuckles Conservation Forest the interviews were conducted in four different villages located in the forest buffer zone, and a few even inside the forest (see Figure 22). As with Kanneliya the land use change between the two years will be presented one village at the time below.

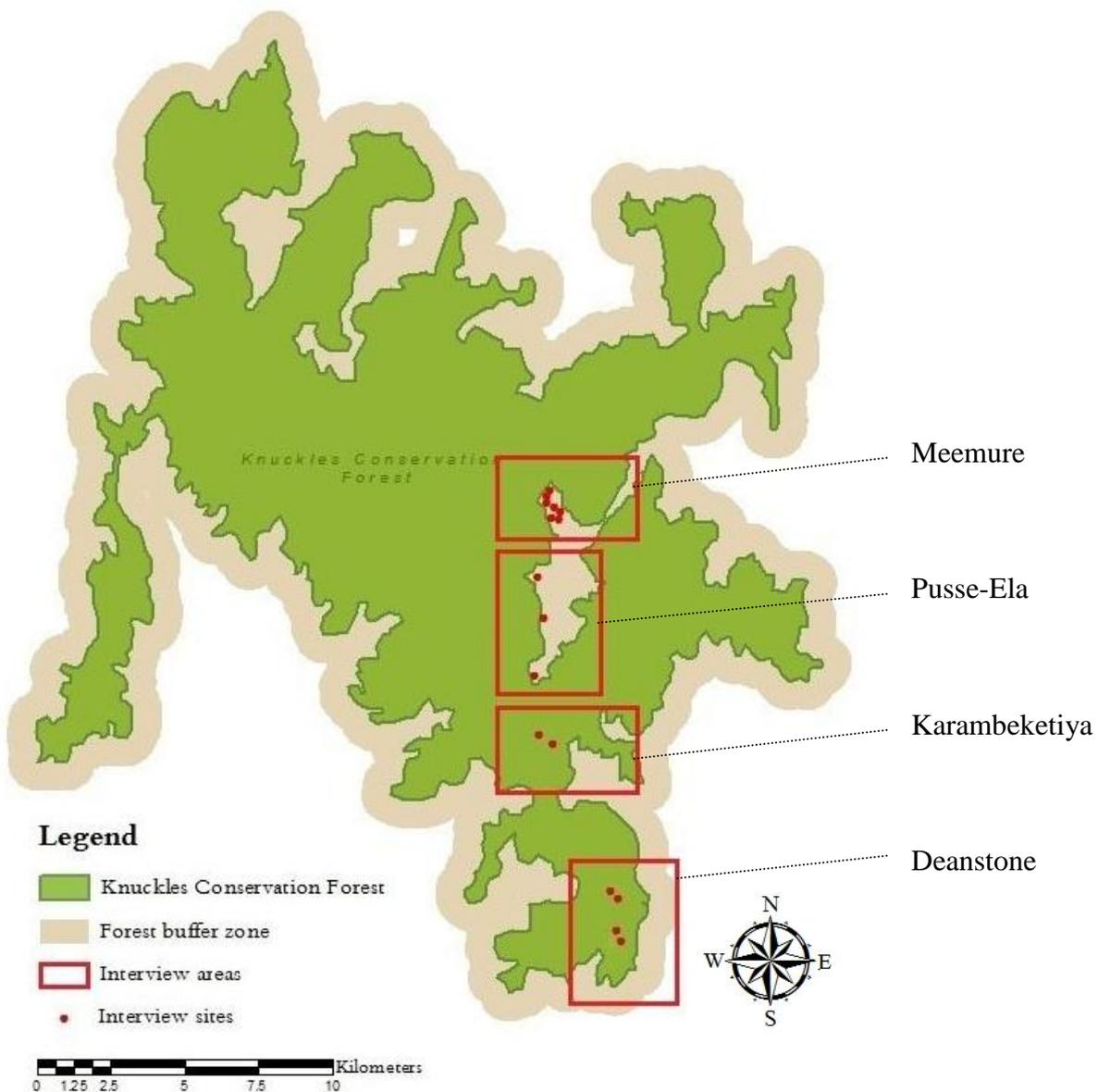


Figure 22 shows the Knuckles Conservation Forest and the location of the interview sites, situated in four different buffer zone villages (Lindström, 2011; based on map from the FD, Kandy, Sri Lanka).

Meemure was the most remote and inaccessible village that I visited during my field trip. The amount of houses has seemingly increased and what used to be only a foot path in 1987 was in 2003 a smaller road which indicates some development (Figure 23 and 24). However, apart from the fact that the location of a few paddy fields in 1987 differ from the location in 2003 and have become slightly more concentrated around the core of the village, and the fact that some patches of scrubland seem to have been replaced by forest, the land use remains relatively unchanged in 2003. The natural forest cover was about 84 percent in 1987 and around 83 percent in 2003 (see Figure 31).

Meemure 1987

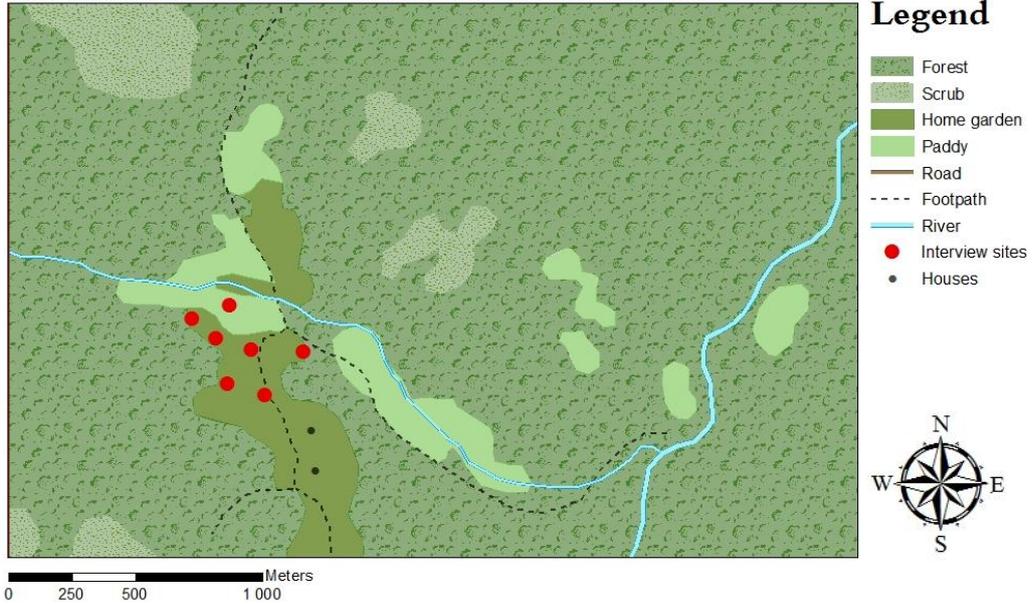


Figure 23. Forest cover extent and land use in Meemure for 1987 (Lindström, 2011; illustrations based on maps from the Survey Department in Colombo).

Meemure 2003

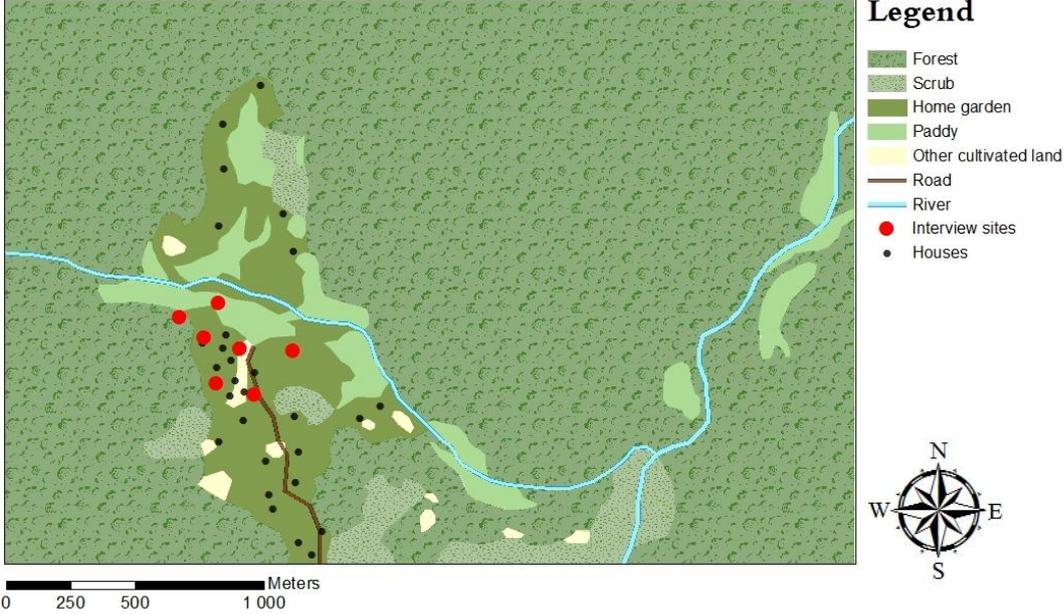


Figure 24. Forest cover extent and land use in Meemure for 2003 (Lindström, 2011; illustrations based on satellite images from Google Earth).

The illustrations of Pusse-Ela indicates that the population has increased between the two years and parts of what used to be a large area of cardamom cultivation in 1987 had turned into scrub or grasslands in 2003 (Figure 25 and 26).

It appears as if paddy fields have become a more common element in the landscape, as well as the non-agricultural land type of grasslands that clearly has spread. The overall forest cover remains nearly the same; it covered about 59 percent in 1987 and 54 percent in 2003 (Figure 31).

Pusse-Ela 1987

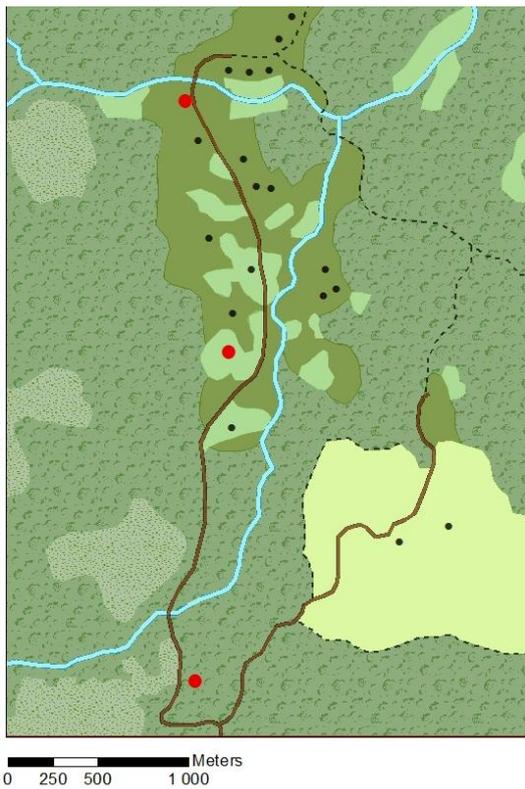


Figure 25. Forest cover extent and land use in Meemure for 1987 (Lindström, 2011; illustrations based on maps from the Survey Department in Colombo).

Pusse-Ela 2003

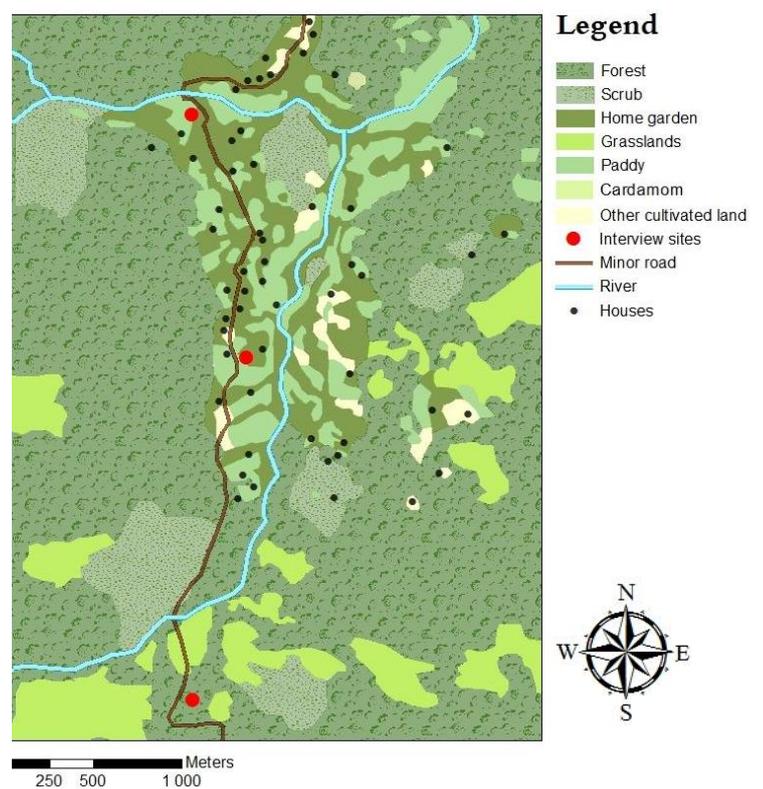


Figure 26. Forest cover extent and land use in Meemure for 2003 (Lindström, 2011; illustrations based on satellite images from Google Earth).

In Karambeketiya a slight population increase is visible. Parts of what used to be scrub in 1987 was in 2003 under some form of cultivation at the same time as some of the former cultivated land has been replaced by plantation forest (see Figure 27 and 28). The production of tea has decreased. Overall there has been an increase in the forest cover extent that was about 45 percent in 1987 and 61 percent in 2003 (see Figure 31).

Karambeketiya 1987

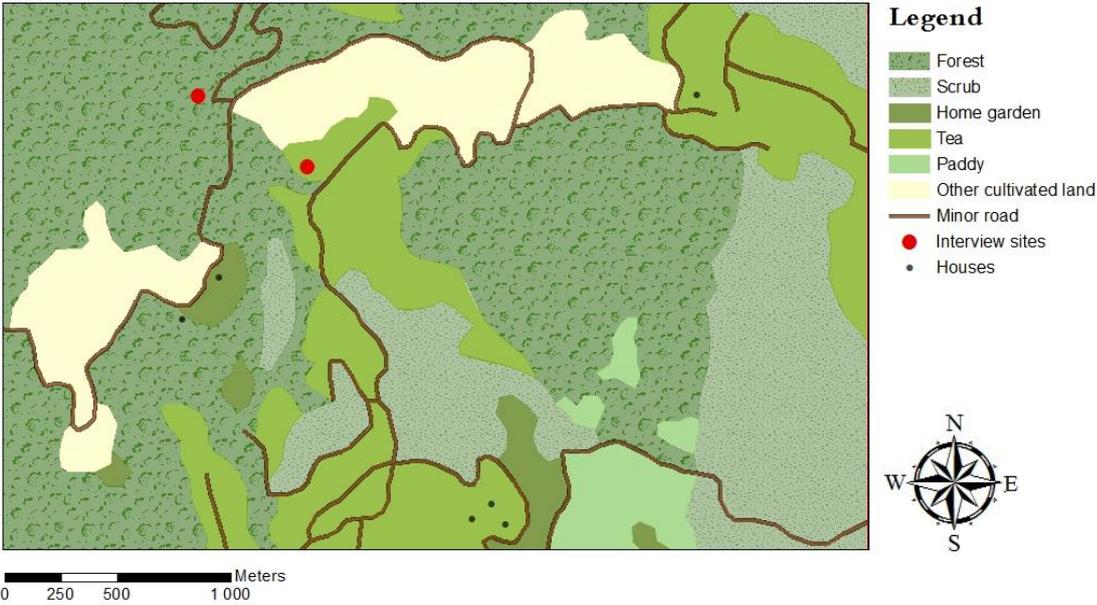


Figure 27. Forest cover extent and land use in Karambeketiya for 1987 (Lindström, 2011; illustrations based on maps from the Survey Department in Colombo).

Karambeketiya 2003

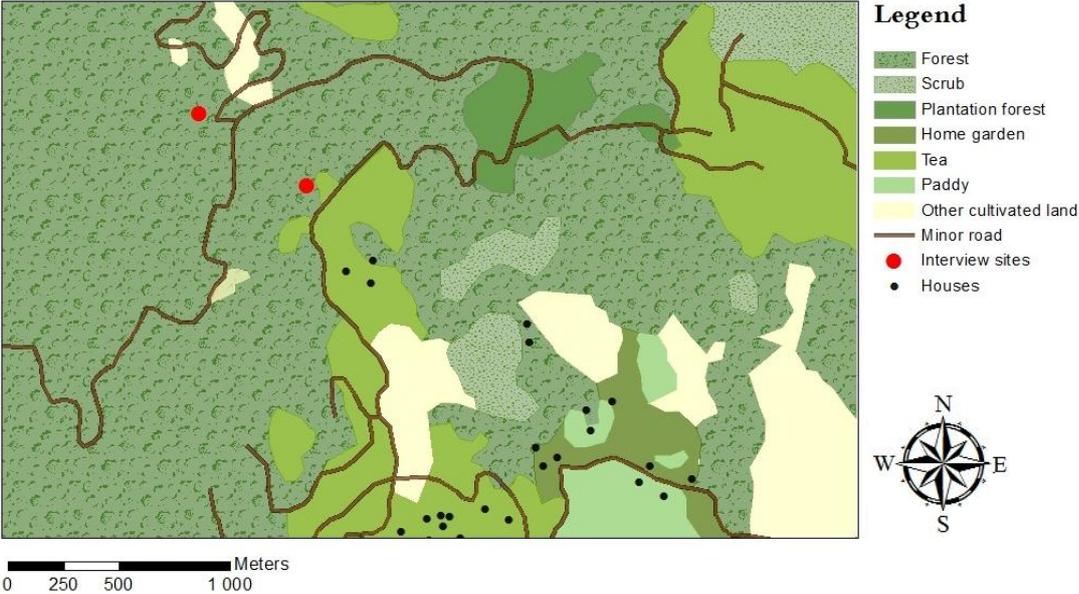


Figure 28. Forest cover extent and land use in Karambeketiya for 2003 (Lindström, 2011; illustrations based on satellite images from Google Earth).

As with all other villages the population in Deanstone seems to have increased between 1987 and 2003. At the same time the cultivation of tea has gone down and parts of what used to be cardamom in 1987 have turned into scrub (see Figure 29 and 30). Also, a very large amount of the former scrublands have turned into forest by 2003. The total forest cover was 22 percent in 1987 and 62 percent in 2003 (see Figure 31).

Deanstone 1987

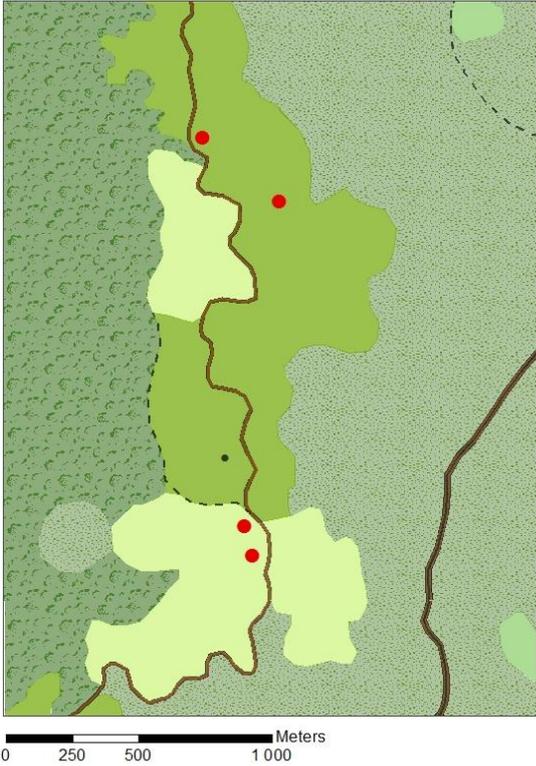
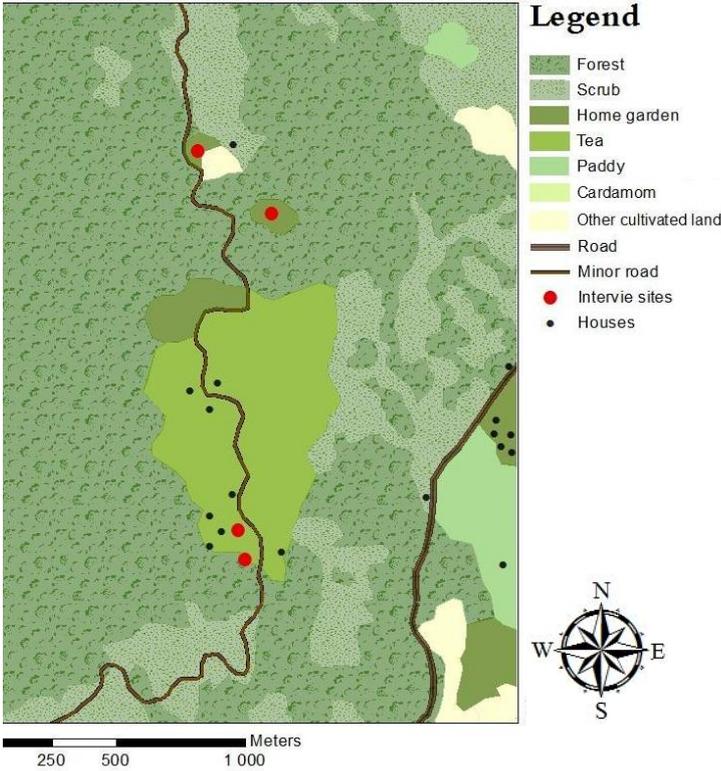


Figure 29. Forest cover extent and land use in Deanstone for 1987 (Lindström, 2011; illustrations based on maps from the Survey Department in Colombo).

Deanstone 2003



Legend

- Forest
- Scrub
- Home garden
- Tea
- Paddy
- Cardamom
- Other cultivated land
- Road
- Minor road
- Interview sites
- Houses

Figure 30. Forest cover extent and land use in Deanstone for 2003 (Lindström, 2011; illustrations based on satellite images from Google Earth).

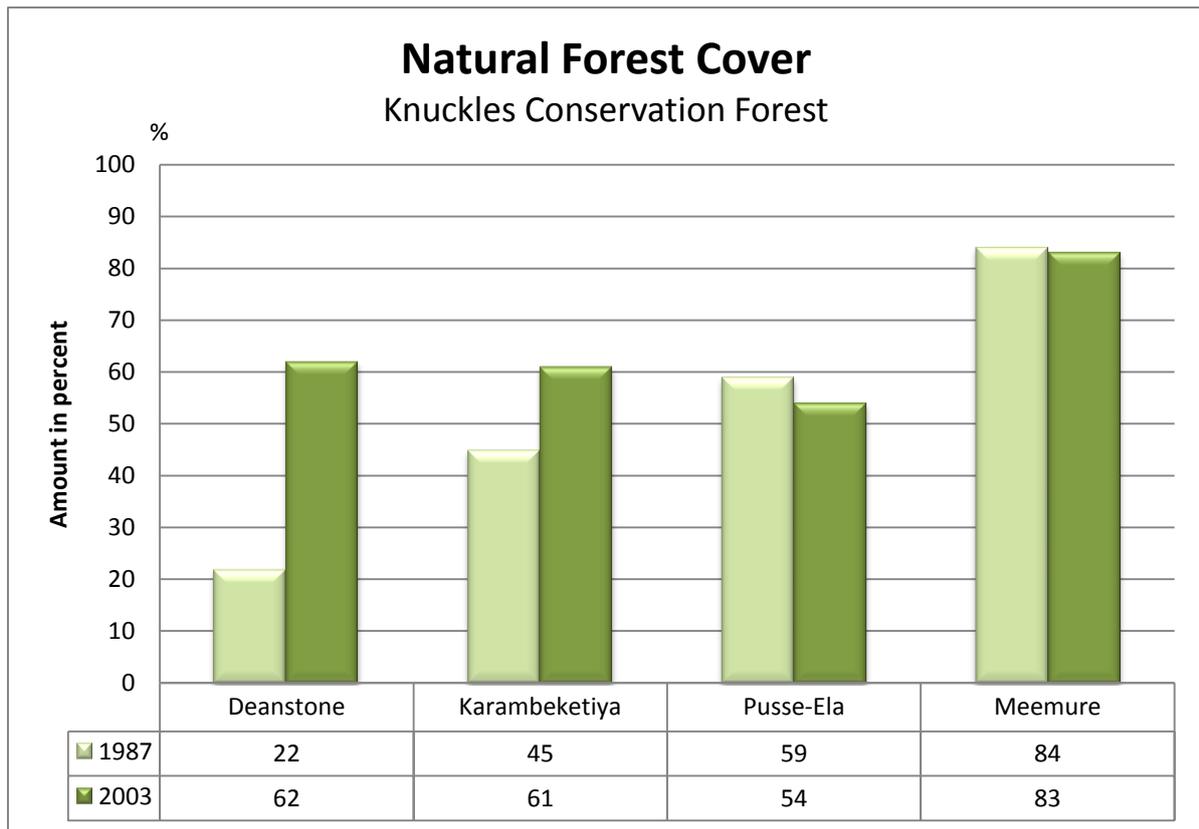


Figure 31 illustrates the amount of natural forest found in the four buffer zone villages of Knuckles in 1987 and 2003, based on GIS-analysis (Lindström, 2011).

4.4 Field observations

Some general conclusions that can be drawn from walking around the villages where the respondents were living were that the income-bringing crops were the ones that claimed most land. Therefore tea was the dominating land use, especially around the Kanneliya Forest Reserve. Pepper was also a common element among the households in and around the Knuckles Conservation Forest (see Figure 32). Several land plots where the vegetation had been cleared and removed were passed; almost in every case as a preparation for an expanded cultivation of tea (see Figure 33). Most farmers claimed this expansion was taking place within their own land and hence did not encroach into the natural forest.

It got clear that even though all farmers agreed to answer all questions they were not always being completely honest; particularly (and understandably) when an honest answer basically meant they would point their own actions out as illegal. A quick look around every respondent's land could thus tell another story which in a few cases involved apparent illegal encroachments into the reserve, especially in Kanneliya (see Figure 34).

Most other observations corresponded with what the small-scale farmers had told during the interviews. A common sight in both study sites was people carrying around on large piles of fuel wood which highlighted a widespread dependency on NTFP.



Figure 32. Land used for the cultivation of pepper in the Knuckles forest buffer zone (Photo: Lindström, 2011).



Figure 33. Land cleared and prepared for tea cultivation in the Kanneliya forest buffer zone (Photo: Lindström, 2011).



Figure 34. Tea bushes in one of my respondents' backyard in Kanneliya Upper. The yellow post marks the border of the Kanneliya Forest Reserve; everything growing above has involved illegal forest felling (Photo: Lindström, 2011).

5. Discussion

5.1 Answers to the objectives

5.1.1 Relationship between small-scale farmers and forest

The result shows that many small-scale farmers are dependent upon the remaining natural forests on the island. There is a clear connection between economical constraints and the utilization of forest resources. Many farmers claimed they lack the money to sustain their daily needs and thus seek an income outside agricultural activities where the natural forest seems to be the most important alternative resource base. In both study areas NTFPs such as fuel wood, food/fruits (particularly kitul) and medicinal plants were commonly extracted.

In the Knuckles, where villagers are not allowed to enter the forest since the establishment of the conservation area in 2000 the unchanged dependency upon the forest has caused a severe income reduction among several small-scale farmers. As they struggle to survive some people are faced with no other option than to enter the forest illegally while hoping not to get caught. However, according to the GN in the Knuckles area the extraction of resources is not causing any major harm to the local forest.

Even though a few farmers highlighted negative impacts from surrounding forests (such as wildlife encroachment) most respondents in both study areas were aware of the important ecosystem services that the forests provide in terms of water regulation, access to clean drinking water and the prevention of soil erosion. Therefore, it is evident that there is a general knowledge about the need to conserve remaining forests but that farmers still, mainly due to low incomes, continue to cause potential harm by entering and extracting resources from the forest.

5.1.2 Changes in the natural forest cover extent and its relationship to land use among small scale farmers

All farmers that were interviewed owned the lands they were cultivating and living on, including home gardens, and utilized it for commercial as well as self-subsistence reasons. Tea, coconut, pepper and fruits were the most frequently grown crops in Kanneliya. In Knuckles pepper, coconut, paddy and fruits were most common. However, the profit-bringing crops were the ones that claimed most land and thus the plantations of in particular tea, but also pepper, were widespread around the respondents' households.

According to the GIS-analysis, all three investigated villages in Kanneliya seem to have suffered from forest loss since 1987 (Figure 21). In Knuckles on the other hand, there has been a rather clear *increase* in forest cover since 1987 in two out of four analyzed villages (Figure 31). The other two villages had undergone only a slight decrease in forest cover. This corresponds with what several key informants claimed during the semi-structured interviews, and most small scale farmers agreed; historically deforestation has been more of a problem in the wet zone (including Kanneliya) compared to the intermediate zone (the location of Knuckles). At the time of research the situation

remained the same with more pressure on the wet zone forests, even though several informants claimed the deforestation rate has slowed down until today. The overall opinion was that the current size of the Kanneliya forest was rather fixed, mainly due to a general respect for the establishment of the border of the reserve ten years ago, while the forest in Knuckles was still expanding. However, several respondents, both farmers and key informants, mentioned that they knew of people that still were involved in illegal logging and other prohibited activities. This was also partly confirmed during the field observations.

The results point at a clear linkage between land use among small scale farmers and deforestation. In Kanneliya 70 percent of the respondents had been expanding the lands they cultivated since 1987 (or had plans to do so) while only 20 percent in Knuckles had been doing the same. The GIS-analysis demonstrates that in particular the cultivation of tea in Kanneliya has claimed land where natural forest was present two decades ago which is underlined by several key informants who blamed tea for much of the deforestation that has happened in the area.

The trend with expanding forests in Knuckles can partly be explained with the plantation of trees by the FD and the emigration of people from the area in recent years, resulting in abandoned agricultural lands that have been reclaimed by the forest through natural regeneration.

The biggest forest related land use issue in the Knuckles area during the past 20 years has been the cultivation of cardamom, which causes forest degradation rather than deforestation. Because of its nature the impact from cardamom is not highly visible on the GIS maps more than as a potential cause of turning some former cardamom plantations into scrub and grasslands until 2003 (Figure 25 and 26 as well as 29 and 30). Shifting cultivation used to be a major problem before but appears to be almost entirely gone in the area after the ban that came with the demarcation of the conservation forest in 2001. This is in line with the findings from the interviews, where a majority of the respondents claimed that deforestation was more intense in Knuckles before 2001.

However, the GIS-analysis in this study only considers changes from 1987-2010 for Kanneliya and 1987-2003 for Knuckles and it is likely that the forest cover loss was even greater from 1987 until the forest boundary was demarcated in 2001. From the interviews of local farmers and key informants it is evident that illegal logging activities and encroaching of forest land have decreased since the border of the forest demarcation lines were enforced. A thorough GIS-analysis investigating the impact on land use and forest cover extent before and after the demarcation of the forest boundary lines until today, would give more quantitative information on historical and recent changes in land use and forest cover. A possibility for further work would be to use high resolution satellite imagery to more accurately estimate these changes.

5.2 Underlying drivers of deforestation in Sri Lanka

5.2.1 Poverty, population growth and lack of land

The web of factors contributing to deforestation around the globe is complex, but as in the case of Sri Lanka one of the main drivers historically and currently has been poverty among its people. However, poverty would not necessarily be a threat to the forests on the island if it was not for the limitation in access to more cultivable land; An intense population increase during the last century has driven Sri Lanka's primarily rural population to claim more and more pieces of the once widespread forest cover to gain new land for agriculture that for long has been the most important source of income (Figure 3). From 1900 until today the forest cover has dwindled from about 70 percent of the total land area to below 25 percent while the population during the same time has risen from 4 to 21 million people. Deforestation in relation to population growth is in particular evident around the heavily fragmented study area of Kanneliya Forest Reserve, situated in a part of the country where the population growth has been most extreme.

As mentioned before, the buffer zone of the Knuckles Conservation Forest has seen a decrease in population in recent years due to an emigration trend in the area. The emigration is said to be caused by the government's failure in providing these people and villages with basic services such as health care and infrastructure, and as opposed to Kanneliya the forest cover in Knuckles has increased during the past two decades. It emphasizes that less inhabitants tend to be good for forest and biodiversity. The overall falling population growth rate that has been documented in Sri Lanka lately might thus instill some hope for the future of the remaining forests in the country.

5.2.2 Forest management and institutional weaknesses

As all natural forest surrounding the study sites was under the management of the FD the locals were not allowed to cause any harm inside these forests by cutting down trees or causing degradation etc. In the case of Knuckles they were not even allowed to enter. New legislations and clarified boundaries around the reserves seem to have halted the destruction of natural forests in recent years which has been a great success for the FD and a huge environmental benefit. However, the price is to be paid by poor local farmers by jeopardizing their livelihoods, and of this reason the present study made it rather clear that the rules were not always respected.

According to the Divisional Forest Officer in Galle, the FD lacks the workforce to fully control the buffer zone area of the protected forest. He believed that the deforestation issue could eventually be solved if this was to change. But even though he might be right, one can wonder if this would not be a way of ignoring the actual root of the problem. The establishment and enforcement of many rules tend to focus too much on the symptoms of the dilemma without addressing the actual root cause of deforestation. As long as there will be poverty in the villages surrounding these natural forests, in the combination with a shortage of land, there is a big possibility that people will continue with the destructive activities as long as possible. More control would certainly be great for the heavily stressed environment but devastating for millions of rural people.

To be able to pursue successful forest conservation work the need to mitigate poverty should be taken into consideration. Policymakers could probably use a little more knowledge about local livelihoods to understand the economic dependency of the communities on forest resources. Furthermore, there should be a compromise between what natural resources to protect and what the local inhabitants must be allowed to utilize to sustain their daily needs.

Another issue, highlighted by Dr. L.H.P. Gunaratne, is that people do not give the impression to care as much about the forest as if it would have been their own. What is the point to a single farmer of trying to conserve a piece of land that his neighbor might be encroaching tomorrow anyway? Governmental ownership can create short term thinking among local people where it seems better to simply grab and run today (or use the forest in whatever other way you can) than to actually preserve it to gain more in the future. Current forest management is spread among different government agencies, which has led to many and often conflicting interests that have contributed to further inefficiencies in the attempt to conserve the forests. In Gunaratne's opinion the solution could be for the FD to release more land for private ownership among the rural people, or at least increase the degree of involvement of local communities in the forest management. History indicates that when villagers had the responsibility to manage their local forest they took good care of it and lived in harmony with the surrounding environment for centuries (DeZoysa, 2008).

5.2.3 Global demand

If taking a few steps back and looking at the picture with a wider perspective it is possible to find root causes of deforestation far outside of the actual borders of Sri Lanka. As mentioned above it is the profit-bringing crops grown among small scale farmers that have contributed to much of the conversion of former forest into new plantations in the country. No respondent denied that tea has been among the biggest tree killers on the island during the last 20 years, especially in the wet zone. In Knuckles, cardamom has caused most harm to the forest during the same period of time. What these two crops have in common is that they both are on high demand on the national as well as international and global market, and as stated by Mr. Senanayake this is profoundly encouraging poor rural people to grow more of it.

It is important to remember that Sri Lanka is a developing country that only recently attained peace after almost three decades of civil war. The country is now recovering and striving towards raising its standard of living which requires energy and resources, as well as attractive products for export to be able to raise national revenues. Therefore, global demand might be capable of solving some financial issues but the whole process of national development may simultaneously put more forest at risk which again underlines the complexity of this dilemma.

However, this study indicates that by further developing a well functioning participatory forest management and by acknowledging the needs of local people in the forest buffers zones, Sri Lanka would take one big step for the overall wellbeing of forests, livelihoods and biodiversity.

6. Conclusions

- Rural people are dependent upon several recourses provided by surrounding natural forests for subsistence reasons.
- The most common source of income among villagers in the buffer zones of the two study areas is agriculture, but the profits it generates are in general insufficient to sustain their needs. The most common alternative source of income is achieved through resources extracted from the forest.
- Profit-bringing crops of high demand on the domestic and international market are most frequently grown among farmers and claim most land.
- Over the last 20 years the natural forest cover has decreased in the study area of Kanneliya due to population pressure and expansion of tea plantations whereas the forest cover has undergone a general *increased* in the study area of Knuckles due to emigration, tree plantations and a ban of chena cultivation.
- The forest boundary lines established in 2001 have had a positive effect on forest cover through declined encroaching and illegal felling of timber in forests in both study areas, but have simultaneously threatened the livelihoods of many local people in the forest buffer zone.
- As long as there will be poverty in the villages surrounding natural forests, in combination with a shortage of land, people are likely to continue with the destructive activities.

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Appendices

Appendix 1: Interview guide (for individually interviewed farmers)

Name of village:

GPS-waypoint:

Date and time:

Personal information

Gender:

Name:

Age:

Occupation:

Number of people in household:

Level of education:

Land use and income

- 1.) How long have you been living on this land?
- 2.) How much land do you have today? (Hectares/Acres?)
 - Did you always have the same amount of land?
- 3.) Do you own the land yourself?
 - What user rights do you have?
- 4.) What crops are you growing on this land?
 - Purpose? (Commercial/self-sufficiency?)
 - Does the yield sustain your needs as an income/for food?
- 5.) Do you have any other source of income?
 - If yes; what source?
- 6.) What is your annual income?

7.) Have you been expanding your cultivation since you started living here/the past 20 years?

- If yes; of what reason? (Most important crop etc.?)
Can you show me where?
What was here before?
- If not; any plans to do so in the future? (Of what reason?)

Forest relationship

8.) Do you use the surrounding forest to collect any resource(s)?

- If yes; what do you collect?

9.) Does the forest have any (other) important function to you? (Water regulation, prevent soil erosion, shade etc.?)

10.) Have you experienced any changes in your right to use the forest since you moved here/ in the past 20 years? (Legislation? Regulations?)

11.) Have you seen any changes in the extent of the forest cover around you since you moved here/in the past 20 years?

- If yes; has this affected your life in some way? (Made living more difficult etc.?)

Future

12.) What do you think will happen to this area and your land in the future?

- Are you concerned about your future situation?
- What would you do if the forest disappeared..? Would you be able to keep on living here?

Appendix 2: Topics discussed during the interviews with key informants

Topics discussed with the DFOs at the Forest Department

- The work of the FD in the area
- Historical and current drivers of deforestation around Kanneliya Forest Reserve/Knuckles Conservation Area
- Impacts of small scale farmers; forest dependency and land-use practices during last two decades in forest buffer zone

Topics discussed with the staff at the University of Peradeniya

- History of deforestation in Sri Lanka
- Historical and current drivers of deforestation around Kanneliya Forest Reserve and Knuckles Conservation Area
- Impacts of small scale farmers; forest dependency and land-use practices during last two decades in the two forest buffer zones

Topics discussed with the GN-Divisions

- Relationship between villagers and forest (dependency?)
- Land-use practices among villagers – impact on deforestation
- Changes in forest cover extent during the last two decades
- Environmental problems in the area (landslides, floods, droughts, water quality etc.)

Topics discussed with Charith Senanayake at Rainforest Rescue International (RRI)

- The work of RRI
- Historical and current drivers of deforestation around the Kanneliya Forest Reserve and the Knuckles Conservation Area
- Impacts of small scale farmers; forest dependency and land-use practices during the last two decades in the forest buffer zones
- Governmental actions against deforestation (effectiveness, failures etc.)