



**Profiling Socio-Economic, Environment and
Natural Resources Baseline Conditions of
Selected Tea Landscapes in Haputale/ Lipton's
Seat, Uva Province, Sri Lanka**

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Table of Contents

1. Introduction	1
2. Study Objectives	3
3. Data sources and methods of collection	4
3.1. Primary Data	4
3.2. Secondary data	5
3.3. Limitations.....	5
4. Study Area and land use pattern	6
4.1. Geographical Location and Size	6
4.2. Current Land Use	8
4.3. Land Ownership and Tenure.....	10
5. Climate	11
5.1. Rainfall	11
5.2. Temperature	12
5.3. Wind speed and direction.....	12
5.4. Geo Hazards	13
Landslides.....	13
Soil Erosion.....	15
5.5. Environmental Hazards	18
6. Soils, Geology and Hydrology	21
6.1. Topography, Drainage and Hydrology	21
6.2. Geology, Geomorphology & Soils	22
7. Ecosystems and Habitats	23
7.1. Agro ecological Zones	24
7.2. Protected areas.....	25
7.3. Forests.....	26
7.4. Forest Plantations	28
7.5. Patana Grasslands.....	29
7.6. Biological Diversity.....	30
7.6.1. Flora	30
7.6.2. Fauna.....	33
7.7. Invasive Species	37

7.8.	Endangered and Endemic Species	39
7.9.	Ethno botanical uses	40
7.10.	Human wildlife conflict	40
8.	Water resources.....	41
8.1.	Ground Water	41
8.2.	Surface Water	41
9.	Mineral resources	42
10.	Social Setting.....	43
10.1.	Population and Demographic Patterns.....	43
10.2.	Ethnic composition	44
10.3.	Settlement Patterns	46
10.4.	Households by Tenure	47
10.5.	Housing (quality and Materials).....	48
10.6.	Energy (including lighting)	49
10.7.	Drinking Water	50
10.8.	Health and Sanitation	52
10.9.	Poverty Status	52
10.10.	Employment and unemployment	53
11.	Tourism, Trade and Industry.....	53
12.	Public transport and Road Network	54
13.	Waste generation and management	54
14.	Commercial Agriculture/Plantations	56
14.1.	Large tea plantations	56
14.2.	Smallholder tea plantations.....	64
14.3.	Vegetable Cultivations	69
15.	Stakeholder Consultation & Stakeholder Participation in NRM	70
16.	Policy, Legal and Institutional Framework for NRM	71
16.1.	Provincial and District Administrative Structures and coordination mechanisms	71
17.	Conclusions	71

Table of figures

Figure 1: Rainfall pattern in the Bandarawela weathering point	11
Figure 2: Soil erosion in tea plantations under different conditions	16
Figure 3: The estimates on annual soil erosion in different land uses	17
Figure 4: Population of the project area by sex and per square km.....	44
Figure 5: Total population in the project area by gender	44
Figure 6: Population in the project area by ethnicity	45
Figure 7: Ethnic composition of the population in the project area.....	46
Figure 8: Settlement pattern in the project area.....	47
Figure 9: Households by sources of drinking water in project area	51
Figure 10: Households by principal method of waste disposal in project area.....	55
Figure 11: Tea small holding distribution by ownership in Sri Lanka	67
Figure 12: Productivity per hectare per year	67

List of Tables

Table 1: Number of GN divisions and area covered by the project.....	7
Table 2: variation of temperature C° per year over last 50 years.....	12
Table 3: Agro Ecological Zones in project landscape	24
Table 4: Tree species found in the project area and their conservation status	31
Table 5: Scrub forest species found in the project area and their conservation status	32
Table 6: Herb species found in the project area and their conservation status.....	32
Table 7: Vines species found in the project area and their conservation status.....	33
Table 8: Bird species found in the project area and their conservation status	33
Table 9: Mammal species found in the project area and their conservation status	34
Table 10: Reptile species found in the project area and their conservation status	35
Table 11: Amphibian species found in the project area and their conservation status	35
Table 12: Insects species found in the project area and their conservation status	36
Table 13: Distribution of Invasive Alien Flora Species in the Lipton's Seat landscape	37
Table 14: Invasive Alien Fauna Species recorded in Lipton's Seat landscape	38
Table 15: Total number of floral and faunal species found in project area.....	40
Table 16: Population of the Project Area by Ethnicity.....	45
Table 17: Settlement Pattern in the Study Area	46
Table 18: Households by tenure	47
Table 19: Housing units by principal material used to construct the floor	48
Table 20: Housing units by principal material used in the construction of the roof	48
Table 21: Housing units by principal material used in the construction of walls	48
Table 22: Housing units by principal type of cooking fuel	50
Table 23: Households by principal type of lighting.....	50
Table 24: Households by type of toilet	52
Table 25: Sector wise employment and unemployment status of the project area	53
Table 26: Households by principal method of waste disposal.....	55
Table 27: Land use patterns in large tea plantations.....	57

Table 28: Population and housing in large plantations	58
Table 29: Tea production and certification in large plantations.....	59
Table 30: Total number of tea small holders and extent.....	64
Table 31: Total number of tea small holders in each TI Region.....	65
Table 32: Information on Tea Smallholder Development Societies in GEF Tea project area.....	65

List of Maps

Map 1. GEF-Tea project landscape covering portions of 4 DS Divisions in the Badulla District.....	6
Map 2. List of GN Divisions covered by the project and area of GNDs in Km ²	7
Map 3. Land use classes in 1982 prepared by the Survey Department.....	8
Map 4. Land use classes in 2013 prepared by the Land Use Planning Department (LUPD).....	9
Map 5. Landslide hazard potential created by the National Building Research Organization (NBRO) in 2010.	14
Map 6. Uma Oya multipurpose development project map.....	19
Map 7. Topography, watersheds and major rivers.....	21
Map 8. Hydrology.....	22
Map 9. Major soil types from the Central Environmental Authority (CEA).	23
Map 10. Agro-ecological zones, from Central Environmental Authority (CEA).....	25
Map 11. Environmental sensitive areas identified by the National Building Research Organization (NBRO).	26
Map 12. Large tea plantations within the project landscape.	57

1. Introduction

Scientifically known as *Camellia sinensis L.*, the tea plant was first introduced to Sri Lanka in 1867 as a commercial crop at the Lookandura Estate in Kandy. In 2017, the tea industry is set to celebrate its 150th anniversary. With the introduction of tea, major changes were observed in natural resources availability in the areas where the tea plantations were first established. As a result of clearing large tracts of primary forests and cultivating tea in these areas, the landscape of the central hills region of Sri Lanka changed forever. As a commercial business, tea plantations established on transformed tropical forest lands, were highly successful. However, the resultant changes to ecosystems including forests, grasslands, aquatic ecosystems and their ecosystem services as provisioning, supporting, regulating, and other cultural and spiritual services of the landscape were not evaluated or taken into consideration when decisions to change land use patterns were taken at that time.

Despite the damage not being properly assessed even now, the advent of tea in Sri Lanka caused irreversible damage to ecosystems in the hill country.

Initially, tea plantations were predominantly owned and managed by private individuals and large scale corporate. With the growing demand in international markets for tea, the areas expanded further encroaching into forests and other suitable lands located at both low and high altitudes in high lands and low lands of south western Sri Lanka. The introduction of the 1972 Land Reform Act No. 1 that imposed ceilings on land size in private land ownership and its subsequent Amendment Act No. 39 of 1975 that nationalized companies and distributed land to landless households created pathway for the proliferation of smallholder tea farmers¹. Because of under performance by State owned enterprises, management of these plantations was given to 22 private companies in 1992². The changes in land management in 1972, 1975 and 1992 were key turning points in changes in land use and natural resources management patterns in tea landscapes. During this period, Sri Lanka experienced severe fragmentation of its land, especially with state sponsored felling of forests for timber, encroachment and conversion of forests including important watershed areas into tea, conversion of sustainable home gardens into tea, degradation of cultivable land due to soil erosion, drying of streams and springs, and expansion of vegetable cultivations.

An extent of four hectares or less is defined as a tea smallholding. Currently, smallholders constitute the largest single group within tea plantations, but of them, a considerable group faces serious problems, including the marginalization of tea land. According to the Ministry of Plantation Industries, marginal tea lands are lands with a yield below the national average of 1,615 kg/ha. Problems faced by Marginal Small Tea farm Holders (MSTH) include low income from the tea sector³, economically unsustainable small tea lands, increasing input costs and low quality inputs etc. There is limited evidence, validating the unsustainability of MSTH land uses. For example, according to Dissanayake⁴ tea bushes in many tea

¹Peiris, G.H. (1978) Land Reform and Agrarian Change in Sri Lanka. *Journal of Modern Asian Studies*, 12, 611-628.

²Jagath S Kularatne and Hiroyuki Takeya 2003, Privatization of the Plantation Sector in Sri Lanka: financial, economic and some environmental aspects, *Journal of the Rubber Research Institute of Sri Lanka*. (2003) 86, 23-31

³Palihakkara, I.R., Mohammed, A.J. and Inoue, M. (2015) Current Livelihood Condition of and Futurity of Tea Farming for Marginal Small Tea Farm Holders (MSTH) of Sri Lanka: Case Study from Badulla and Matara District. *Journal of Environment and Natural Research*, 5, 11-21.

⁴Dissanayake, D.R.R.W., Udugama, J.M.M. and Jayasinghe-Mudalige, U.K. (2013). Development of an Alternative Microfinance Scheme to Finance in the Tea Small Holding Sector: A Success Story. *Journal of Food and Agriculture*, 3, 31-40.

plantations were planted over 40 to 60 years ago, and no new planting has taken place since in a majority of tea estates. The Census taken in 2005 further strengthened this argument by identifying that 7,310 hectares of smallholder plantations were abandoned. In addition to socio-economic drawbacks, this also contributes towards environmental and natural resources degradation and related management issues in the area and in the country.

Sri Lanka is facing a range of environmental issues including irregular rainfall due to climate change, drying up of natural streams, soil erosion and associated loss of soil fertility, deterioration of water quality etc., with these effects being strongly felt in tea producing areas⁵. Therefore, understanding the present reality of marginal tea smallholders is important to address socio-economic as well as environmental consequences of existing tea-based land use systems⁶.

The issues discussed above are not necessarily limited to large tea plantations and smallholders, but also affect other land users within tea producing landscapes. Widespread vegetable cultivations within and bordering tea plantations, smallholdings and other areas also adversely contribute towards environmental and natural resource management related issues in tea landscapes in the hill country region. Overall, unsustainable cultivation practices, exploitation of natural resources, poorly planned and designed development activities have caused social, economic, cultural, environmental, health and natural resources degradation related issues within tea landscapes. Also, traditional tenure systems co-exist with Roman-Dutch law in the country significant factor that has contributed towards poor natural resources management. From the perspective of agriculture, the two most important categories of state lands are, alienated State land and land that is vested in the State through the operation of land reform laws, most notably in the large plantations⁷. Poor land tenure rights have resulted in encroachment of reserve lands, inadequate investment on watershed management, lack of control of soil erosion and other natural resources management issues.

It should be noted that weak institutions, short sighted policies, lack of enforcement of relevant laws have contributed largely towards the failure of environmental and natural resources management in Sri Lanka. This is largely due to the failure of a number of government agencies/authorities mandated with the responsibility for sustainable environmental and natural resources management.

With significant problems faced by the Sri Lankan tea industry, the main export crop and one of the highest foreign income earning export commodities, ecosystems and natural resources in the tea growing regions of Sri Lanka are now in crisis, with rapid degradation of the productive natural resources base and the environment. They are obvious symptoms of unsustainability in current production practices and patterns of resource use in tea agro ecosystems⁸ and other ecosystems in surrounding areas.

⁵Mungal, D. N., Ong, C. K., Kiteme, B., Elkaduwa, W., & Sakthivadivel, R. (2004). Lessons from two long-term hydrological studies in Kenya and Sri Lanka. *Agriculture, Ecosystem and Environment*, 104(1), 135-143. <http://dx.doi.org/10.1016/j.agee.2004.01.011>

⁶FAO. (2012). *Report of the Intercessional Session of the IGG on Tea*. FAO: Colombo.

⁷Ranasinghe, T., Munro Faure, P. and Herrera Garibay, A. 2012. Status of Land Tenure in the Dry Zone Livelihood Support and Partnership Programme (DZLiSPP) Districts: Kurunegala, Anuradhapura, Badulla and Moneragala

⁸Prabodh Illukpitiya et al 2004, Tea Agroecosystems in the Uva Highlands of Sri Lanka: An Evaluation of Land Management Activities Mountain Research and Development Vol 24 No 1 Feb 2004: 52–59

This baseline assessment was undertaken with the overall objective of examining the current status and sustainability of natural resources use, with special reference to natural resource management practices as soil, water, forests, grasslands, biodiversity, mineral resources conservation in tea plantation landscapes and to identify the socio–economics factors which affect natural resource management of a selected tea growing GEF-Tea project area of Lipton’s Seat in the Uva highlands of Sri Lanka.

2. Study Objectives

The GEF-Tea project aims to engage key stakeholders in tea-producing landscapes to develop ground-level Integrated Natural Resource Management (INRM) plans. The purpose of these plans is to support INRM and guide investment to reduce land degradation and natural resource conflicts while safeguarding key ecosystem services. These outcomes will help ensure the future viability of tea production and support local and downstream communities.

In order to develop an INRM plan, it is a prerequisite to understand the current status, issues and constraints for sustainable natural resources management in the GEF-Tea project area. The objectives of this baseline assessment are as follows:

- To collect information on issues and challenges in tea production faced by large tea plantations and smallholders.
- To collect spatial data on land use patterns, hydrology, vegetation cover, status of natural resource use and environmental issues using available data sources.
- To assess current status, trends, challenges, issues and conflicts related to natural resources (e.g. soil, water, forests, minerals, biodiversity, and natural hazards and human induced hazards) in the GEF-Tea project in the Lipton’s Seat landscape.
- To assess and analyze key social and economic issues including poverty, housing, infrastructure and other facilities, labour issues and social conflicts in the GEF-Tea project landscapes.
- To identify and analyze trends and challenges related to tea production, including productivity, planting material, soil, pests and diseases, tea quality, and economic viability of the tea industry.
- To identify existing organizations/stakeholders such as government agencies, NGOs etc., and activities as government planning processes, regulations, tea industry initiatives etc., aimed at addressing issues related to natural resource management and increasing tea productivity.
- To identify ideas of stakeholders and priorities for collective action as collaboration among different groups in the landscape to help address key natural resource-related issues.
- To assess and analyze institutions, legislation and policies related to natural resources management in Sri Lanka.
- To identify the impacts of natural resources related issues and conflicts on the tea industry and study the wellbeing of households in the project area.
- To propose solutions to overcome natural resources management related issues which can be used when designing INRM plans to ensure future viability of tea production while also supporting local and downstream communities.

This baseline report will provide necessary data and information to understand the current status of natural resources management in GEF-Tea project landscapes which can be used in preparing an Integrated Natural Resource Management plan for the project landscape. In addition, this baseline report will help government decision and policymakers, planners, natural resource managers, natural

resource users and other stakeholders to identify and prioritize action to seek solutions to issues of natural resources management in the country. We envisage that the report will be useful for decision/policymakers when having to make decisions to address issues in the environment and natural resource sectors.

3. Data sources and methods of collection

The study used data from both primary and secondary sources to cover all major aspects of environmental and natural resource management in the GEF-Tea Lipton's Seat project area in the Badulla District.

3.1. Primary Data

Three methods of primary data collection were employed in this study to identify current status of natural resource use, consequences of natural resources degradation, drivers of natural resource degradation, social, economic, cultural, institutional, legal and policy issues related to natural resource management, and recommendations for sustainable Integrated Natural Resources Management in the GEF-Tea project landscape. They were, stakeholder meetings, focus groups discussions and key informant interviews.

Several stakeholder meetings were undertaken to gather primary information related to natural resources management in the project landscape. The meetings were carried out with relevant staff attached to the District Office of the Department of Forest Conservation, District Office of the Central Environmental Authority, District Office of the Land Use Policy Planning Department, District Office of the Uva Province Road Development Department, Tea Smallholdings Development Authority, National Building Research Organization, multi mixed crop cultivating small holder farmers of Nikapotha (downstream), vegetable cultivators, and management staff of Finlays, Agarapatana and Maskeliya Plantations.

Nineteen (19) focus group discussion were conducted in the GEF-Tea project area with the participation of Tea Smallholder Development Society members. There were 399 participants representing 18 TSDs. Several members of these societies are involved in vegetable cultivations, in addition to tea. Socio-economic information and policy related to tea and vegetable cultivations and information on overall natural resources management of forests, soil, water, minerals etc., drivers of natural resource degradation and their proposals for Sustainable Integrated Natural Resources Management in the project landscape were collected during these discussions.

Several Key Informant Interviews were carried out to supplement the data and information gathered. Divisional Secretaries in Bandarawela, Haputale, Ella and Hali-Ela, regional managers of Agarapatana, Maskeliya, Finlays, Hupugastenna Plantations and the manager of the Thotalagala Plantation (Bio Tea Pvt. Ltd.) were also interviewed.

A set of pre-developed standard questions were used in gathering primary data and information from stakeholders. They are as follows:

- What is your relationship with the landscape and role/mandate in natural resources management?

- What in your view are the most pressing threats to the environment and the livelihoods of communities within the landscape/your estate/area covers by the TSDS?
- What do you see are the major social, economic, environmental or political factors that enable or add to the persistence of these threats you have identified?
- What do you see are the major opportunities to help mitigate these threats you have identified?
- Are you involved in any stakeholder initiatives that focus on designing and implementing sustainable land management activities within your estate, if yes, describe these initiatives and your specific involvement?
- Are you interested in engaging in a new multi-stakeholder planning process to address some of the threats and root causes you have identified above?
- If yes, how would you see yourself engaging and what capacity and expertise would you bring to such a collaborative landscape planning process in your estate?

The outcome of the above exercise is presented under Chapter 18 - Stakeholder Consultation & Stakeholder Participation in NRM.

3.2. Secondary data

Data for the biodiversity assessment, socio economic assessment, natural resource status, quality and drivers of degradation assessments, spatial data (maps) etc., were gathered from a number of secondary sources. Published data from different sources including official data from the Department of Census and Statistics, resources profiles maintained by Divisional Secretariat Offices in the project area and data and information recorded by plantation companies in the project area were also used. In addition, published literature, research and assessment reports and articles by individuals and organizations, monographs, laws, acts, regulations and policy documents, development plans and development project documents etc., were used.

Spatial data, particularly GIS maps and related information were gathered from the Land Use Policy Planning Department, Sri Lanka Survey Department (SLSD) and Central Environmental Authority in Colombo.

3.3. Limitations

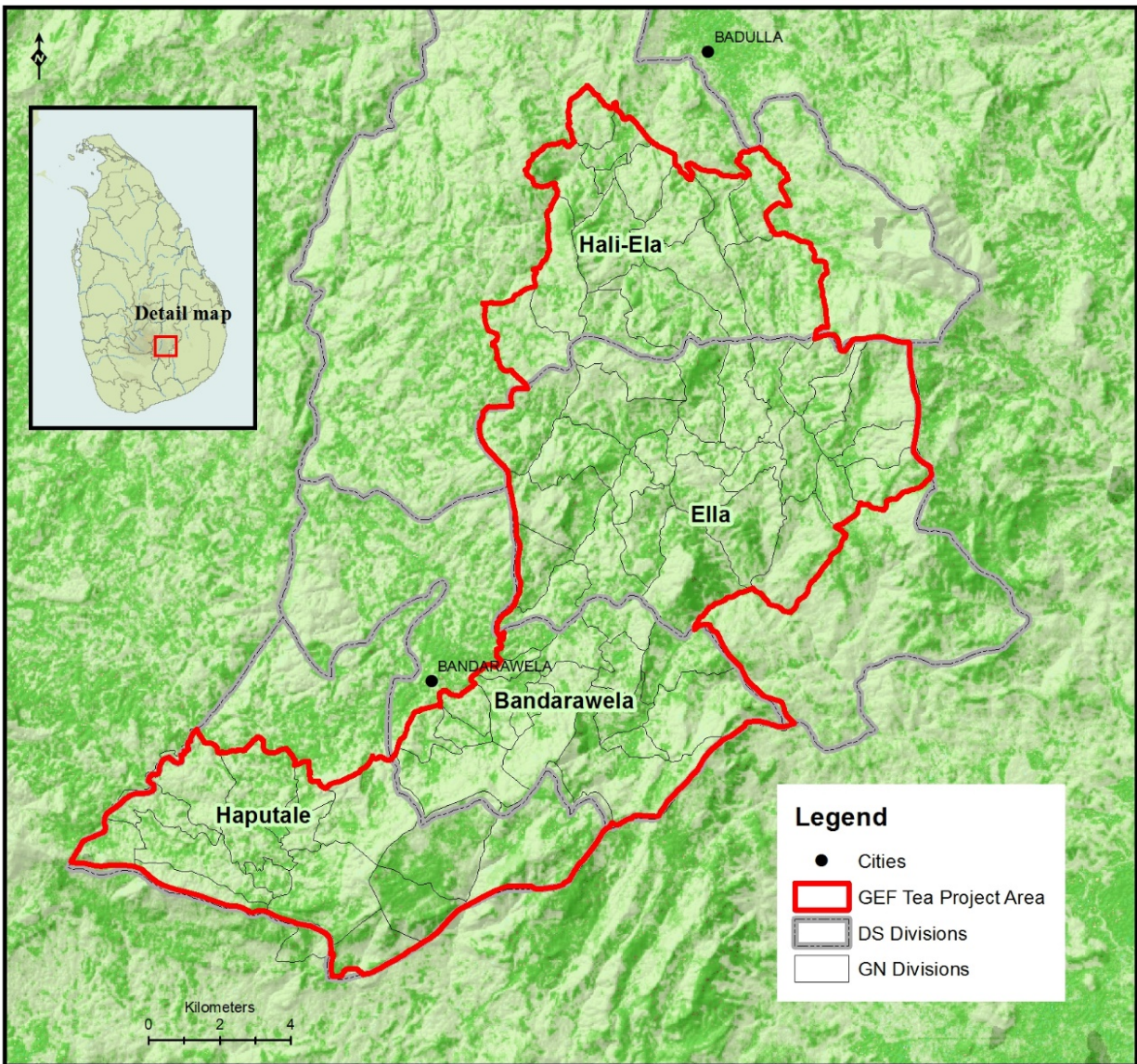
The main limitation of this study is regarding relevant data and information. Lack of data for research purposes and poor management of databases was identified. Reluctance of government agencies to share data available within their systems with other organizations and researchers was a major limitation to gather data necessary for this assessment. This assessment depended on data available at Divisional Secretariat Divisions, Land Use Policy and Planning Department (LUPPD), CEA, Department of Survey, TSHDA and RPCs. However, the data available at these different places are in different formats, in different units of measure, and at different levels of segregation. Therefore, analysis and comparison is difficult. Available GIS maps at the Department of Survey are old, predictions are not accurate, boundaries of DSDs and GNDs in the project area were also not up-to-date.

4. Study Area and land use pattern

4.1. Geographical Location and Size

The GEF-Tea project area in Sri Lanka is located in the Badulla District on longitude 81° 01' 33.25"E and latitude 6° 58' 30.43"N from North and Longitude 80° 57' 40.01"E and Latitude 6° 44' 49.65"N from the South. It comes under four Administrative Divisions - Divisional Secretariat Divisions (DSDs) in Haputale, Bandarawela, Ella and Hali-Ela. There are 67 *Grama Niladhari* Divisions (GNDs) within these four DSDs. The area is bordered by Haldummulla DS Division from the South, Passara, Badulla, Soranathota and Kandaketiya DSDs from the North, the Moneragala District from the East and the Welimada DS Division from the North West.

Map 1. GEF-Tea project landscape covering portions of 4 DS Divisions in the Badulla District



Relevant DSDs, total number of GNDs, number of GNDs covered by the project and total geographical area in km²

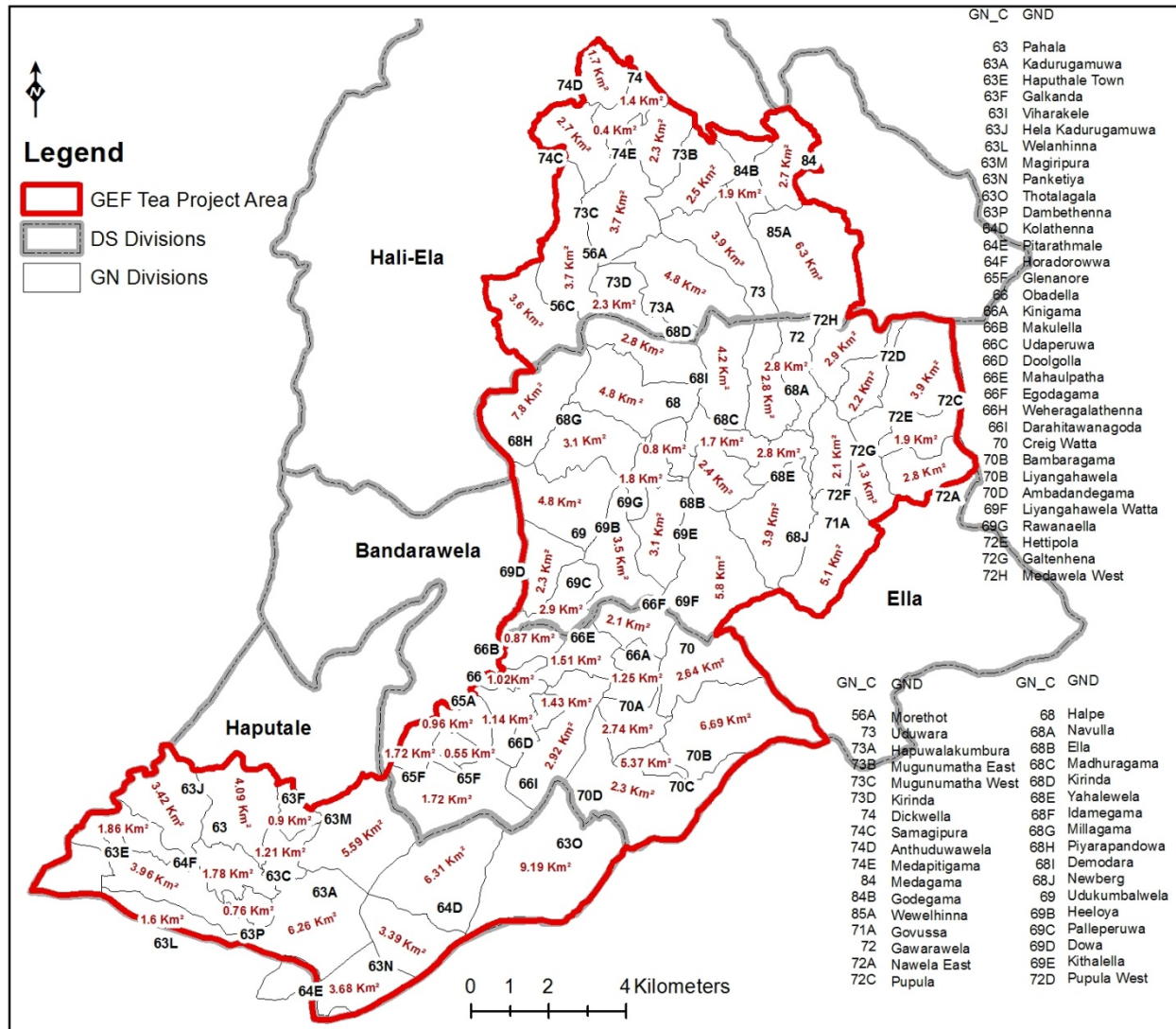
Table 1: Number of GN divisions and area covered by the project

DS Division	Geographical Area Km ²	Total Number of GN Divisions	Number of GN divisions covered by the study	Geographical Area Km ² covered by the study
Haputale	60	26	14	52.22
Bandarawela	70	35	14	28.85
Ella	111	32	26	85.00
Hali-Ela	170	57	13	39.90
Total	411	150	67	205.97

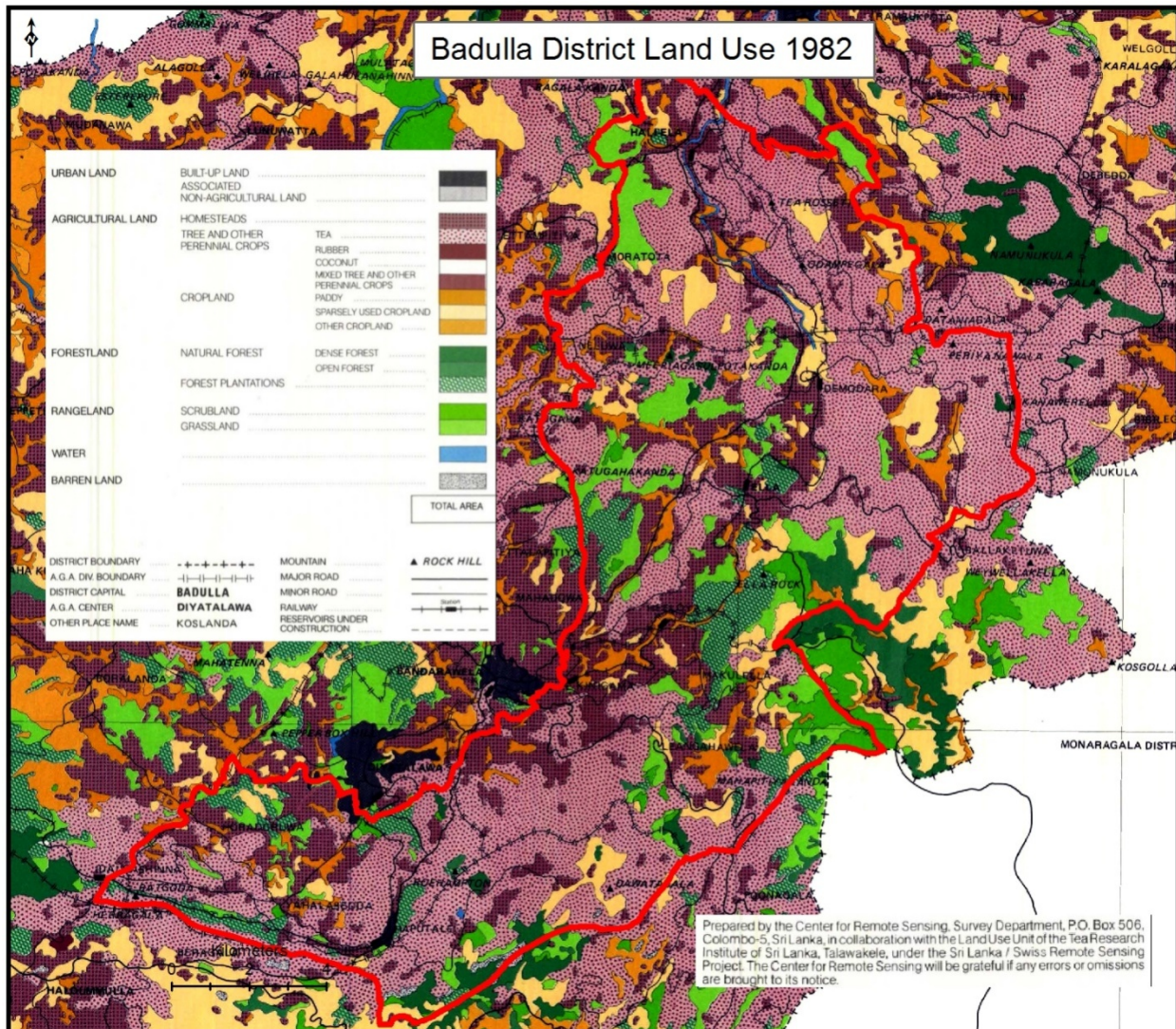
Source: Resource Profiles of Haputale, Ella, Hali-Ela 2015 and Bandarawela 2016, Department of Census & Statistics

The GEF-Tea project area comes under the governance of two municipal councils, Haputale and Bandarawela and four *Pradeshiya Sabha* areas (Local Government Authorities)-Haputale, Bandarawela, Ella and Hali-Ela.

Map 2. List of GN Divisions covered by the project and area of GNDs in Km²



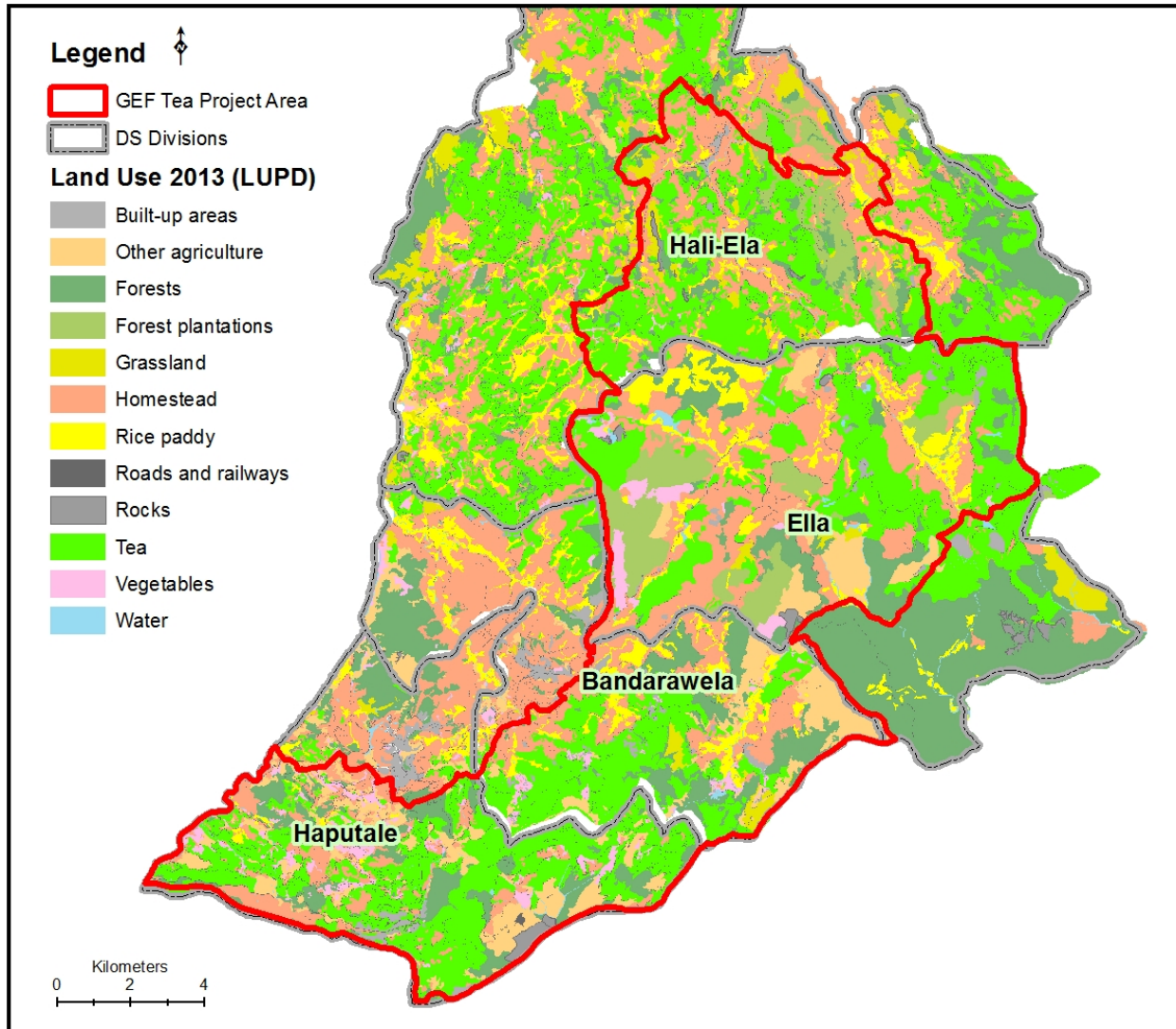
Source: Resource Profiles - Haputale, Ella, Hali-Ela 2015 and Bandarawela 2016
 Map 3. Land use classes in 1982 prepared by the Survey Department



4.2. Current Land Use

Land use in the GEF-Tea project area is dominated by agriculture, predominantly tea growing areas due to physical and environmental conditions that favours tea. Other than tea, the land area has been used for other agricultural crops as vegetables, *Chena* cultivations, fruit crops, cinnamon, pepper, rubber, paddy and homesteads (multi crops). A large area of land is under forests and includes dense forests, open forests, scrubs, forest plantations and grasslands. Build areas as buildings, roads, urban lands, and infrastructure as roads and railways etc., are also part of land uses. In addition, rivers, streams and minor tanks are also found within the landscape.

Map 4. Land use classes in 2013 prepared by the Land Use Planning Department (LUPD)



Based on land use analysis data available at planning units of the four Divisional Secretariat Divisions reviewed under this research, the following table presents land use patterns in the project area.

Issues in land use in the GEF-Tea project area:

- Areas which should be conserved and protected are not protected
- Lands which can be made use for development activities are not utilized or are under utilized
- Low productivity due to underutilization of land
- Land degradation due to bad land use practices
- Boundaries of protected areas, reservations and sensitive areas are not demarcated and as a result law enforcement is difficult when encroachments take place
- Areas with a slope of more than 60% are under cultivation
- Lands located above 5,000 feet are utilized for cultivations and settlements

4.3. Land Ownership and Tenure

As is well documented, land relations in Sri Lanka are complex and diverse, with a wide variety of laws, traditional practices and institutions in operation. The nature and legal definition of tenure depends on whether the land is under state or private ownership. Security of tenure in Sri Lanka is undermined by the prevalence of out-of-date permits and titles, incomplete land records and lack of registration; decreasing holding size and land fragmentation due to inheritance practices; encroachments on reserve lands due to population pressure; informal land and selling markets on LDO's lands; and weak decentralized land administration characterized by lack of funds and staff trained to deal with land tenure matters⁹. There are research findings which reveal that land tenure is one of the key reasons determining sustainable natural resource management. When tenure rights are weak, efforts and investment on natural resource conservation is also low.

The Transfer of Powers (Divisional Secretariat) Act No. 58 of 1992, made an important step towards the decentralization of land administration, and provided that all of the powers related to land which were previously vested in the Government Agent were transferred to the Divisional Secretariats. This Act provided the Divisional Secretariats with 16 land related functions, including, recommending land for alienation to other agencies; recommending lands for acquisition; making recommendations for surveys; taking action to protect reservations; locating land for mapping and survey activities; granting land permits; preparing preliminary drafts of land deeds; and keeping, maintaining and protecting state land-related documents. As a result of this Act, all land related policies are implemented on the ground at the Divisional Secretariat level, and the Divisional Secretary has a key role in regulating natural resources management within the respective DSD.

Land ownership and management in Sri Lanka is a complex and complicated systems with many owners and managers. The land owners are privately owned land, and temple land. Government owned land comes under the ownership of multiple agencies/ departments etc. and includes land under the Land Reclamation Commission (LRC), Housing Development Authority (HDA), Department of Irrigation (DOI), Railway Department, Forest Department (FD), Department of Wildlife Conservation (DWC), Urban Development Authority (UDA), Road Development Authority (RDA), Local Government (LG) and Municipal Councils (MC) etc. Furthermore, land alienated under the Land Development Ordinance (LDO), are also considered as government owned. This complex and complicated land tenure system has resulted in different land tenure issues and conflicts and has affected effective natural resources management in the country.

The data on land ownership and tenure in the GEF-Tea project landscape could not be able to locate, but due to poor land tenure the following administration issues have been identified:

- Unclear land boundaries in LDO lands and lands manage by government agencies
- Lands have been alienated without land surveys and therefore no titles are available
- Encroachment of reserve land, including tank reservations, reserved catchments, river reservations, road reservations, wetlands, forests and protected areas, and private lands
- Sub division of lands have resulted in decreasing the size of land units

⁹Ranasinghe, T., Munro Faure, P. and Herrera Garibay, A. 2012. Status of Land Tenure in the Dry Zone Livelihood Support and Partnership Programme (DZLiSPP) Districts: Kurunegala, Anuradhapura, Badulla and Moneragala

- Loss or lack of reliable documents to prove ownership is a common problem related to land occupied for over many generations. A majority of temple and Devala owned land lack documents because they were bequeathed over historic time periods
- Despite the large proportion of land owned by the State, there is limited land available for distribution among landless people
- Conflicts and disputes over land and resource sharing in public lands

5. Climate

The Meteorology Department maintains the national meteorological network and one of its daily read rain gauge stations is located in Bandarawela in the study area. In addition, the Department of Agriculture, Water Resources Board and large tea plantations (specially Rainforest Alliance Certified plantations) have installed equipment to measure rainfall and temperature in the study area.

5.1. Rainfall

There are four main rainy seasons in Sri Lanka and cultivation patterns are aligned to these rainfall patterns. The 1st inter-monsoon (1st IM) season is between March to April, the South-West Monsoon (SWM) season is from May to September, the 2nd Inter-Monsoon (2ndIM) is from October to November and the North-East Monsoon (NEM) is from December to February. Average annual rainfall in the project area in Bandarawela is 1,300mm, in Ella it is 2,500mm, Hali-Ela it is 2,500mm and Haputale is at 900mm. The highest rainfall to the area comes during the North-East Monsoon in November and December and in Haputale highest rainfall comes around January and the lowest is during the South-West Monsoon (SWM) season in July and August.

Figure 1 below shows rainfall patterns in the Bandarawela weathering point in the study area. The annual average rainfall from 2010 to 2015 has been calculated as 1,735.5mm per year, but a significant increase in rainfall was recorded in year 2014 and 2015 at 2,020.5mm and 2,013.9mm respectively. It can be observed that there is variation in monthly rainfall across the years.

Figure 1: Rainfall pattern in the Bandarawela weathering point

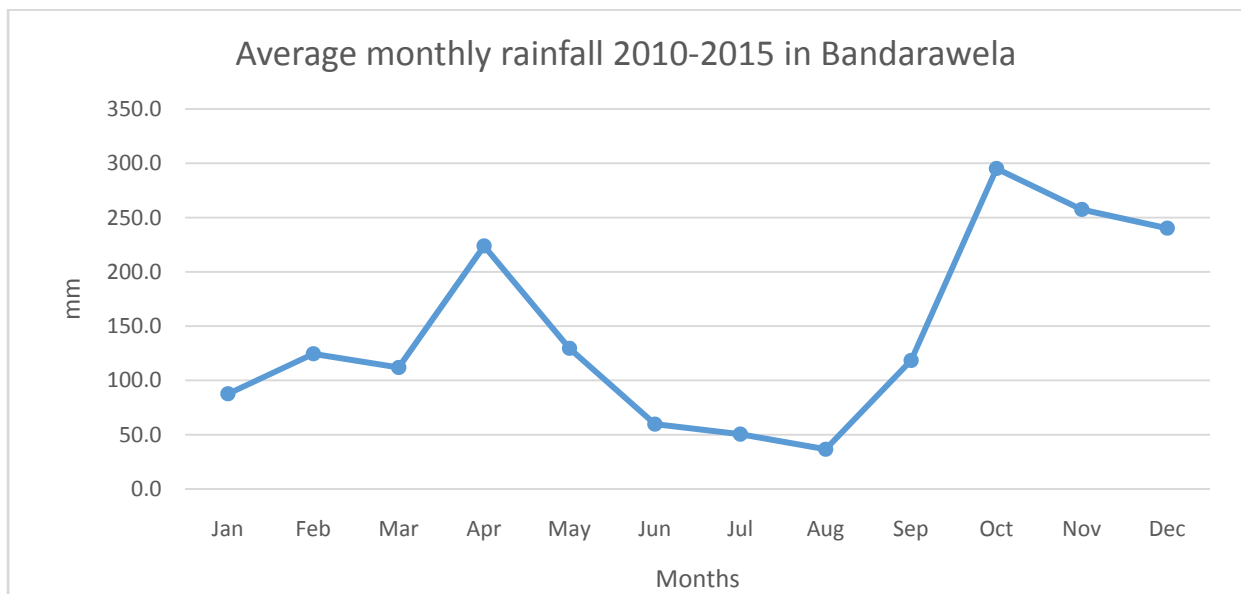
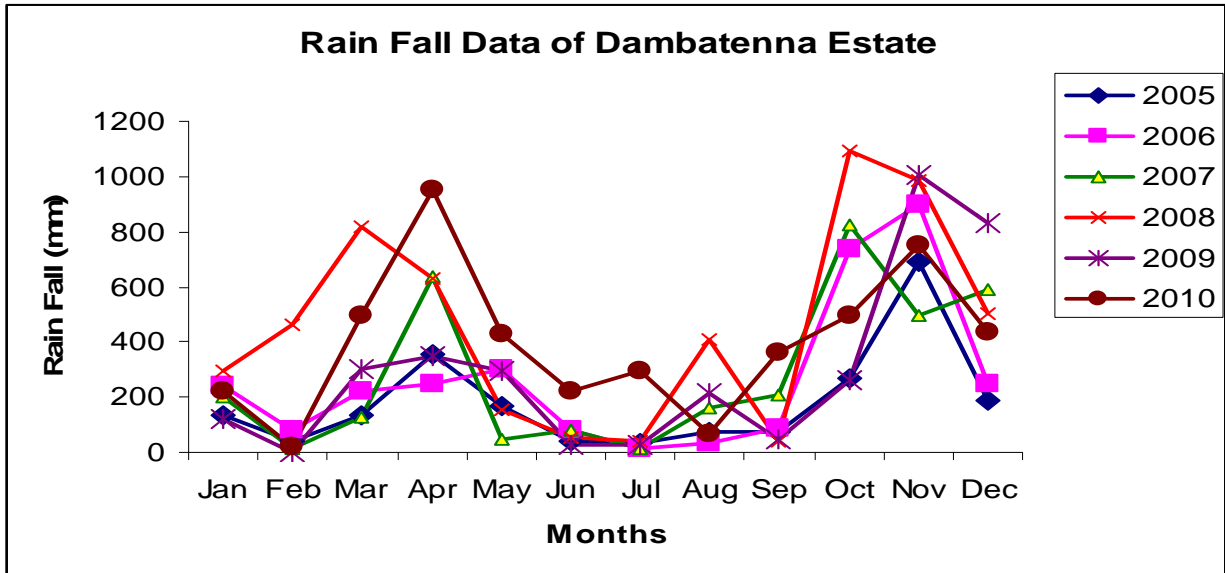


Figure 2 below shows rainfall patterns in the Dambatenna Estate, Haputale located in the study area from 2005 to 2010.



5.2. Temperature

The annual temperature in the GEF-Tea project area in Bandarawela and Haputale averages around 23C°, Ella and Hali-Ela at 25C° and the maximum is around 27C° in August and the minimum around 15C° in January.

According to the Tea Research Institute data on temperature from 1961 to 2010 in Bandarawela, minimum temperature was 15.6C°, maximum 24.8C° and mean temperature was 20.2C°. In Badulla, minimum temperature was 18.4C°, maximum 28.7C° and mean temperature was 23.5C°. The following table shows the variation of temperature C° per year over last 50 years.

Table 2: variation of temperature C° per year over last 50 years

Location	Annual	NEM	1 st IM	SWM	2 nd IM
Badulla (max)	0.028	0.028	0.040	0.027	0.020
Badulla (min)	0.010	0.010	0.006	0.013	0.010
Bandarawela (max)	0.020	0.015	0.017	0.026	0.013
Bandarawela (min)	0.026	0.021	0.029	0.029	0.025

Source: M.A. Wijeratne 2014

NEM-North East Monsoon; 1st IM-First Inter Monsoon; SWM-South West Monsoon; 2nd IM- Second Inter Monsoon

The results prove that monthly temperature has increased by around 0.5C° to 2C° over the last 50 years¹⁰.

5.3. Wind speed and direction

¹⁰M.A.Wijeratne 2014, Climatic variations in tea growing regions vulnerability of tea plantations for climate change

During the South West Monsoonal months, the GEF-Tea project area experiences winds identified as “Cachchan” that has an average speed of 65 to 80km per hour and a maximum of 150km per hour. The winds during this period impact on temperature, humidity and agriculture¹¹, with wind especially affecting the production of green tea leaf in mountain areas.

5.4. Geo Hazards

Landslides

Landslides have been identified as a serious problem in this landscape as a result of bad land use patterns, constructions for settlements in high sensitive areas, road construction on steep mountains, and operation of metal quarries. Furthermore, agricultural expansions as vegetable cultivations and tea, severe deforestation in the past, fragile geology, intense rains and the physiography of the project area are also contributing factors to landslides. Due to climate change considerations, weather patterns have also changed and heavy rains are experienced within a short time period. All these factors have contributed towards an increase in landslide vulnerability of the area.

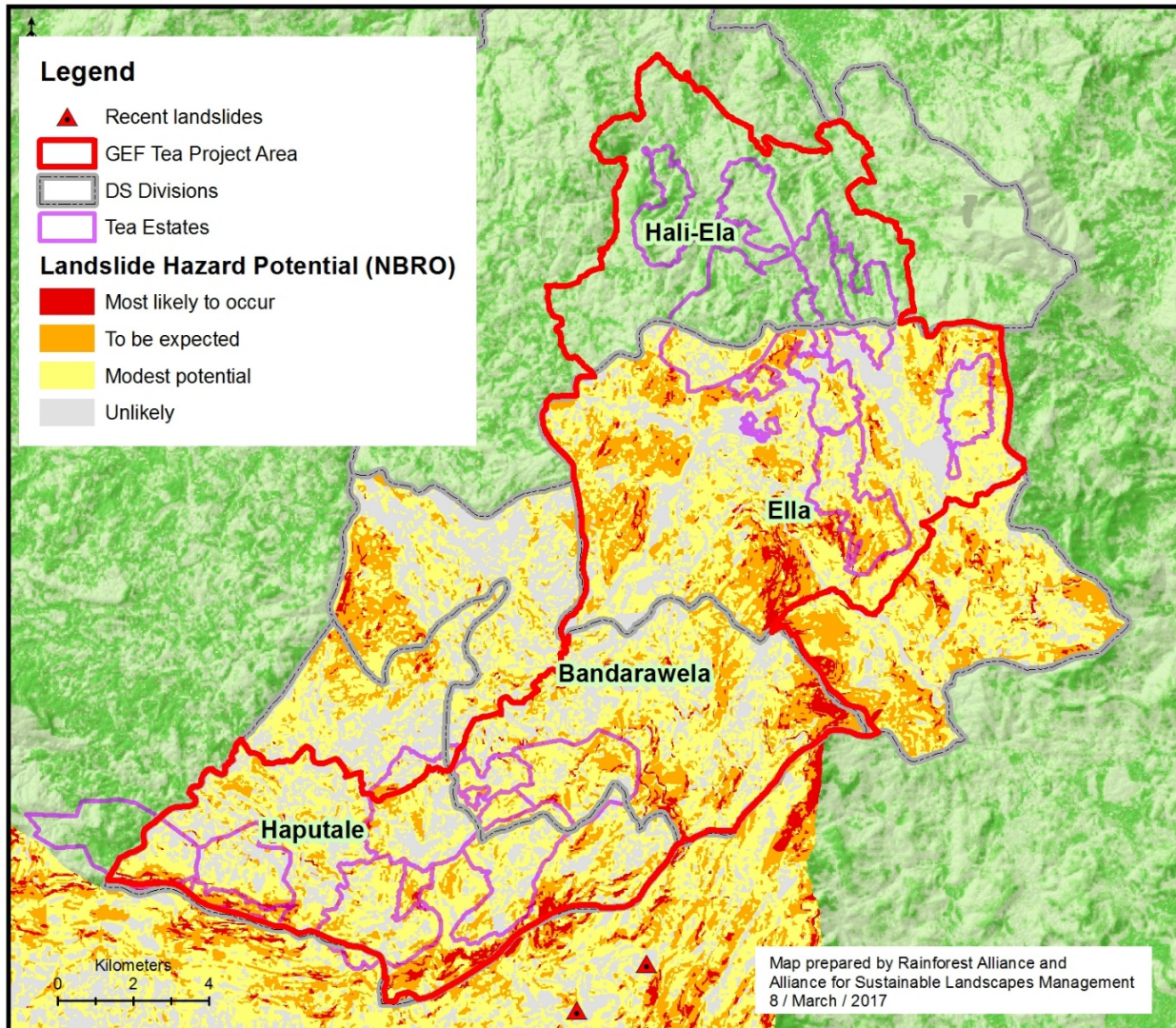
One of the main reasons for selecting Lipton’s Seat tea landscape to undertake the GEF-Tea project is that this area has been categorized as a landslide prone and erodible area. The selected landscape has a long history of landslides which have caused extensive damages to lives, property and the natural environment. Landslides have been recorded in Haputale, Bandarawela, Ella and Hali-Ela Divisional Secretariat Divisions. Landslides are particularly evident during heavy rains and are the result of both natural and manmade causes. According to the classifications of the National Building Research Organization (NBRO) Cutting Failure, Landslide, Earth Slip and Rock Fall are common occurrences in the project area. A large number of locations within this project area have been identified as high risks areas for landslides and communities living around these areas have been warned by the Disaster Management Centre (DMC), to evacuate, if the area receives more than 75mm of rain within a day. A study done by JAICA revealed that the main roads (Rank A to Rank C) in the project area is in high risk for land slides¹²

After carrying out a comprehensive field survey, the District Office of the Land Use Policy Planning Department in Badulla identified locations within the GN Divisions of the project area which are prone to incidents of landslides and has come up with recommendations. These findings and recommendations can be used to address issues which could contribute to increase the risk and occurrence of landslides in the project area.

¹¹M.M. Karunanayake 1988, Environmental Profile of Badulla District, Central Environmental Authority

¹²Japan International Corporation Agency (JICA) 2013, Data Collection Survey on Disaster Management Program in Sri Lanka, EARTH SYSTEM SCIENCE Co., Ltd. (ESS); IDEA Consultants, Inc. (IDEA); NIPPON KOEI Co., Ltd. (NK)

Map 5. Landslide hazard potential created by the National Building Research Organization (NBRO) in 2010.



Identified issues that increase the risk and damage of landslides:

- Settlements and infrastructures such as roads and amenities such as schools, temples etc., have been located on areas with landslide risks and most of the identified landslides prone locations within the project area have such settlements and amenities.
- The government's responsible authorities (CEA, LUPPD, NBRO, GSMB) have identified these areas, but have not taken any actions to relocate the settlements, infrastructures and amenities as well as moves to stabilize the unstable land due to various reasons such as lack of a proper programme and financial resources, political pressure etc. Recently, the District Secretary of Badulla made a statement to a national newspaper, stressing the need to identify alternative roads to travel from Badulla to Colombo and Haputale to Wellawaya due to the high risk of major landslides in the Haputale region.

- Although NBRO approval is mandatory to put up buildings within the district, people get their approval only to obtain bank loans and to get the building plans approved from the municipal council. Otherwise, people do not care about the regulations and build houses and make other constructions without following NBRO guidelines.
- There are no follow up mechanisms with the NBRO or other responsible agencies to check whether people follow the guidelines given by the authorities when constructing within the district.
- Large metal quarries are operating in the project area and it was reported that the quarry operators use explosives which are very powerful and beyond the legally allowed limit. The fragile soil structure gets destabilized and landslides can occur during rainy seasons due to the disturbance.
- The roadside buffer zone has been compromised in these mountainous areas for new constructions and expansion of existing roads. But, it was noticed and also revealed that construction companies do not follow the recommendations and standard guidelines to minimize the danger. As a result, frequent landslides can be observed along the roadsides in the project area.
- Poor drainage systems within the project area, large plantations, commercial vegetable farms, home gardens, settlements and municipal areas have also contributed to increase the risk of landslides. During the rainy seasons, excess water flows everywhere including the areas with fragile soil or cutting failures.
- Poor coordination among the responsible government agencies is also a major issue in addressing landslides and its related problems in the project area. Also, the responsible agencies are poorly staffed or equipped which has contributed to inefficiency in these institutions.
- Poor enforcement of existing laws is also a serious issue that increases the risks of landslides. It is a fact that encroachers in land slide prone areas are issued with permits or deeds to construct or live, due to different reasons.
- Political influence over responsible government agencies is also highlighted as a reason inaction against the violation of policies, laws and instructions. For example, although there is enough evidence to cancel the permits/licenses and stop operations of some metal quarries, they still continue to operate, claiming that they are harvesting raw material for development projects.

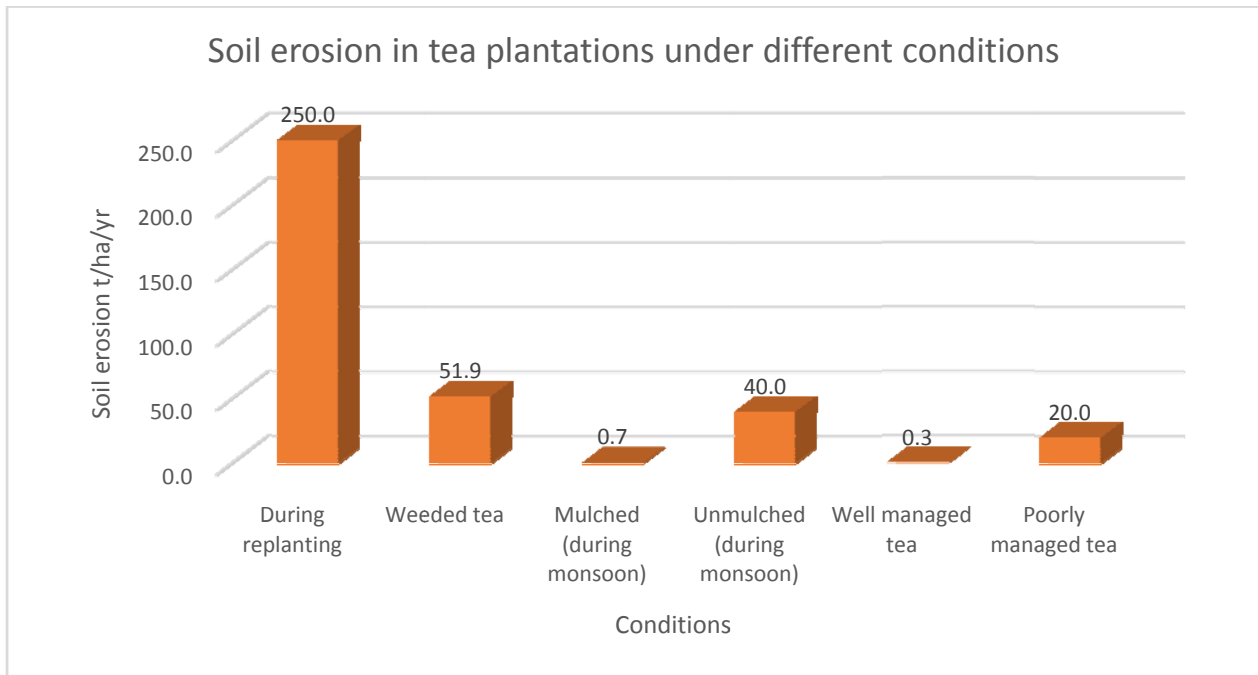
Soil Erosion

The GEF-Tea project, Lipton's Seat landscape has been identified as an area with high soil erosion. The topography, high rainfall, land use patterns are the main reasons for soil erosion in the project area. In the last 200 years, top soil in the project areas has eroded and signs of its severity can be observed in some of large tea plantations in the area. i.e. Poonagala Group. It has been reported in 1996 that 54.8% of land in the Badulla District (which include the GEF-Tea project area) is subject to soil erosion¹³ and nearly 100% of the study area was demarcated as an erodible area by the Central Environmental Authority in 2012¹⁴. The table below shows soil erosion in tea plantations under different conditions:

¹³Nayakakorala, H.B. 1996. Soil degradation and other environmental problems related to agriculture in Sri Lanka. National Workshop on International Strengthening and Collection of Environmental Statistics, Natural Resources Management Centre, Kandy, Sri Lanka.

¹⁴GEO-Informatics/CEA 2012

Figure 2: Soil erosion in tea plantations under different conditions



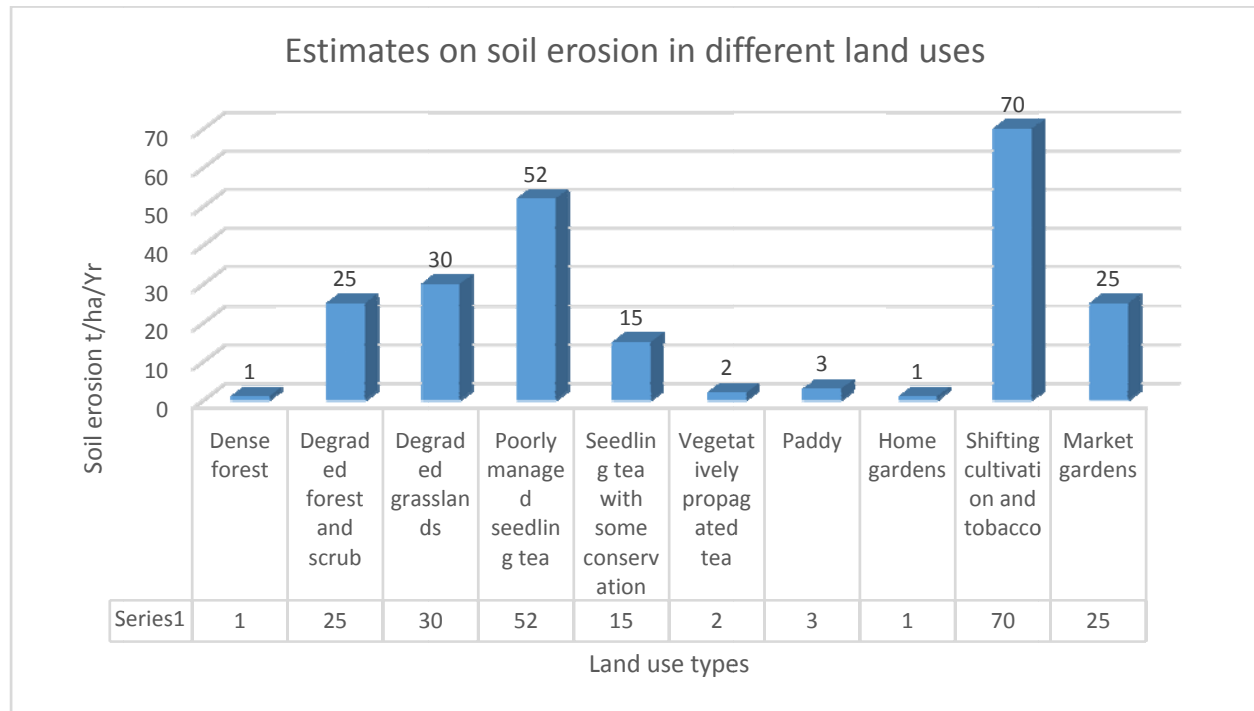
Source: P.B. Dharmasena 2014

According to Dharmasena 2014, soil erosion potential levels have been categorised as moderate to very high and erosion hazard levels in the project areas are high to extremely high.

Figure below shows the estimates on annual soil erosion by Gunatilake *et al* in 2000 in different land uses¹⁵.

¹⁵Gunatilake H.M. & Vieth G.R. (2000). Estimation of onsite cost of soil erosion: a comparison of replacement and productivity change methods. *Journal of Soil and Water Conservation* 55(2): 197-204

Figure 3: The estimates on annual soil erosion in different land uses



Dharmasena has reported in 2014 that the soil loss in agricultural land under vegetable and potato cultivations in IU2 and IU3 agro ecological zones in Haputale, Bandarawela, Ella and Hali-Ela DS Divisions is 100tonnes/ha/yr. Soil loss at 100m² territory in Uva region for the year 2010-2011 has been recorded as 25.52 tonnes/ha/yr and in seedlings tea plantations it is estimated at 3.414 tonnes/ha/yr in VP tea plantations¹⁶. The available estimates suggest that as much as 30cm of topsoil has been lost from upland areas over the last century since tea was introduced, equivalent to an average loss of 40 tonnes/ha/yr¹⁷. Another research carried out by Ananda in 1998¹⁸ has estimated that potential soil erosion rate in smallholder tea plantations in the Badulla District is 412tonnes/ha/yr and reduction in top soil depth is 31.7mm/yr. As such, time taken to reach 50% yield reduction is estimated as 15 years.

Issues in addressing soil erosion:

- Farmers including large tea plantations, smallholders and vegetable cultivators are not interested in applying soil conservation measures due to several reasons, including initial high cost of installing soil conservation mechanisms, lack of knowledge on onsite and offsite impacts and direct and indirect costs of soil erosion.
- The Department of Agriculture, Tea Research Institute (TRI) and Tea Smallholders Development Authority (TSHDA) carry out educational programmes and have provided subsidies to farmers

¹⁶PrasadDharmasenaand M.S. Bhat 2011, Assessment of Replacement Cost of Soil Erosion in Uva High Lands Tea Plantations of Sri Lanka; Current World Environment Vol. 6(2), 241-246 (2011)

¹⁷Coomaraswamy A, Ekanayake A, Chisholm A, Jayasuriya SK. 1999. Effect of land degradation on tea productivity. In: Chisholm A, Ekanayake A, Jayasuriya SK, editors. Economic Policy Reforms and the Environment: Land Degradation in Sri Lanka. Colombo: Ministry of Plantation Industries.

¹⁸Jayanath Ananda 1998, Soil Erosion Damage Function for Smallholder Tea in Sri Lanka: An Empirical Estimation, 1st World Congress of Environmental and Resource Economists, June 24-27, 1998, Isola di SanGiorgio, Venice, Italy.

to promote soil conservation on their own farms. However, this is effective only for the project period and sustainability is questionable.

- The responsible State agencies as the Department of Agriculture does not have access to large tea plantations and therefore, it is difficult to provide education and technical support to plantation workers who are involved in vegetable cultivations within tea estates.
- Ineffective enforcement of rules and regulations related to soil conservation under the Soil Conservation Act No. 25 of 1951 as amended in 1996 is also an issue to look at when addressing soil erosion.
- Actual onsite and offsite costs have not been estimated properly and therefore, even policy makers and policy implementers do not have a clear understanding on the need for enforcing laws to control soil erosion.

5.5. Environmental Hazards

The main environmental hazard found in the study area is the hazard created by the Uma Oya multipurpose river diversion project. The project started in 2009 with the aim of diverting 145MCM of water through a 26km long tunnel to develop irrigation, provide drinking water, and generate electrical energy. The construction of the tunnel is being processed and it passes through Ella and Bandarawela DS Divisions. So far, Udaperuwa, Makulella, Egodagama, Veheragatenna, Bambaragama, Thanthiriya, Keenigama, Bandarawela east, Heel Oya and Palleperuwa GNDs in the study area have been seriously affected. Ground water levels have reduced up to 56.9 meters, sinking of the ground and caused damaged to around 2,800 houses, dried out 900 wells, almost all the springs and streams such as Heel Oya, and damaged crop land used for tea, paddy, vegetable and other crops. Thousands of people have lost their livelihood activities specially related to agriculture and property. Interviews with people in affected areas revealed that the amount of water in the Uma Oya has reduced over the last few decades and there is not enough water to divert. Also, they expect conflicts on sharing water in future.

Map 6. Uma Oya multipurpose development project map



Forest Fires

Forest fires that occurred annually within the study area (in the natural forests, man-made forests and grasslands) were primarily due to human negligence. The fires were caused by carelessly tossed off cigarette butts, burning degraded forests for *Chena* (slash and burn) cultivation, burning of debris by workers maintaining highways and railway tracks without proper precautionary measures, burning dead grass in order to obtain fresh grass for cattle and setting fire to the forest by hunters to drive animals out.

These forest fires cause negative impacts to the overall national economy. These impacts include damage to forest ecosystems and biodiversity, causing soil erosion during the rainy season as a result of the forest cover being removed, destroying seed bank of native plants and risking long-term survival of those plant species, deterioration of watershed functions and causing springs to die out within the area and downstream (due to inadequate ground water levels), which adversely affect the supply of water for human consumption.

In 2015 and in 2016, several forest fires were reported within the study area. In 2016, over 40 hectares of forest were damaged in Ravana Ella and Beragala Forest Reserves, 50 hectares in Kinigama Forest Reserve, 100 hectares in Haputale forest plantations and 30 hectares in Bandarawela.

Issues related to preventing and controlling forest fires:

- The Department of Forest Conservation and the Department of Wildlife Conservation do not have adequate support staff or facilities to follow up and apprehend arsonists responsible for causing forest fires. This is one of the major obstacles.
- Putting out forest/ grassland fires is a major operation which costs the Government human and monetary resource including having to usually employ security forces personnel and military helicopters for firefighting.
- Inadequate awareness on the severe impacts of forest fires and lack of organized civil society groups to prevent such illegal activities within forest areas, is also a major obstacle in preventing and controlling forest fires. Communities and community based organizations are not sensitized and do not have the capacity to deal with illegal activities carried out by individuals that affect the quality of life of all members of the community. Existing laws related to illegal activities within forests and protected ecosystems are out of date and need to be reviewed and amended to suit present conditions.
- Clearing and burning of scrub forest for *Chena* (slash and burn) cultivations is also a contributing factor to the spread of forest fires.

Climate change

There is enough evidence to show that the Sri Lankan climate has changed over the last several decades. Data from 1961 to 1990 shows that there is a 0.016°C increase in temperature every year (Chandrapala, 1996a; Chandrapala, 1996b; Fernando and Chandrapala, 1992). There appears to be no significant trend in Sri Lanka's mean annual precipitation change during the last century although a higher variability is evident (Jayatillake *et al.*, 2005). Since tea production is dependent on rainfall and temperature, changes in these conditions directly affect tea production. The optimum temperature and rainfall for cultivation of tea are in the range of $18-22^{\circ}\text{C}$ and 223 to 417 mm per month, respectively (Wijeratne *et al.*, 2007). Reduction of rainfall by 100mm per month was found to reduce tea productivity by 30-80 kgs of tea per

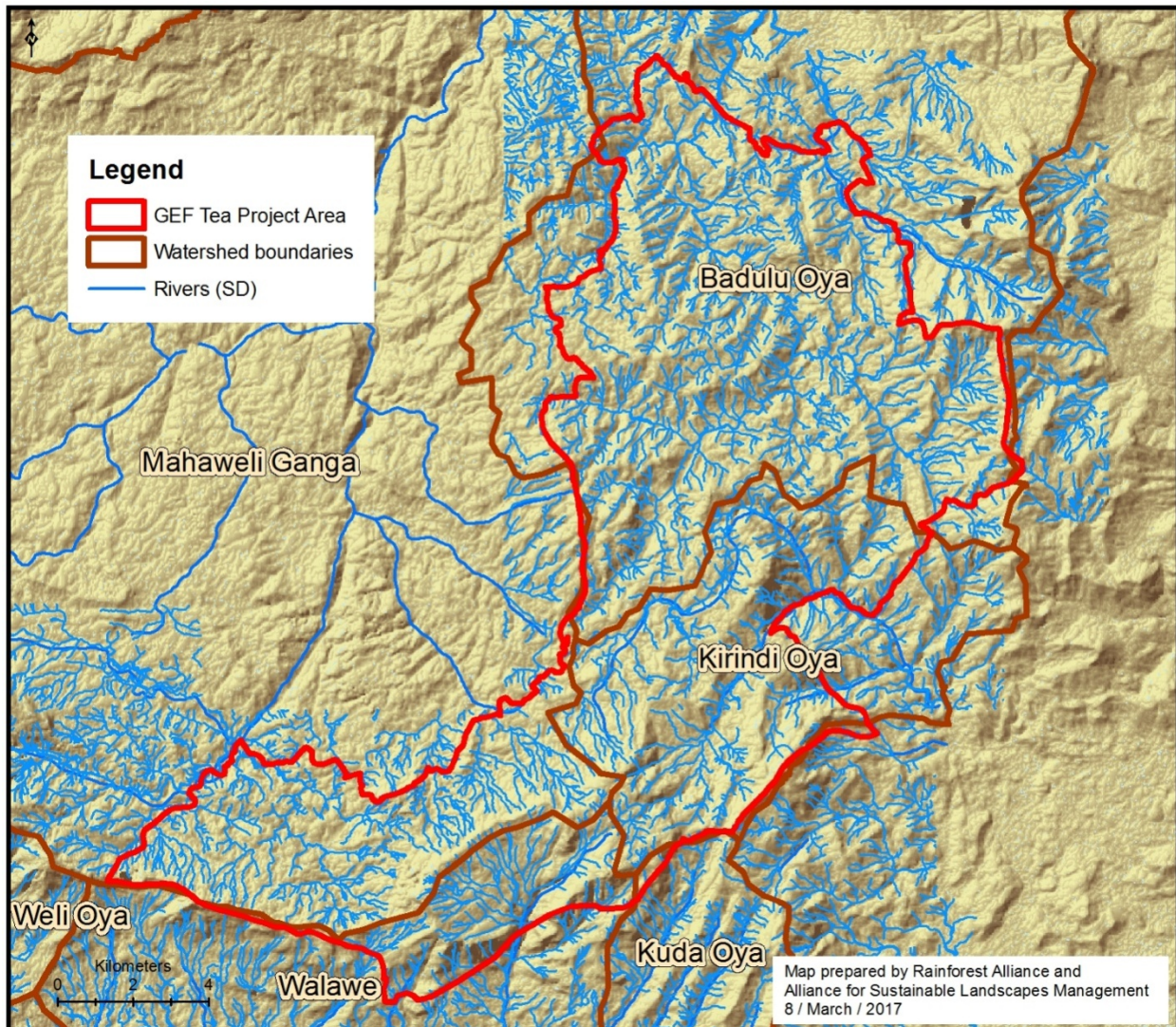
hectare per month. In addition, long drought periods have been reported in the GEF-Tea project area and reduction of yield and dying of tea bushes was reported by both smallholders and large plantations.

6. Soils, Geology and Hydrology

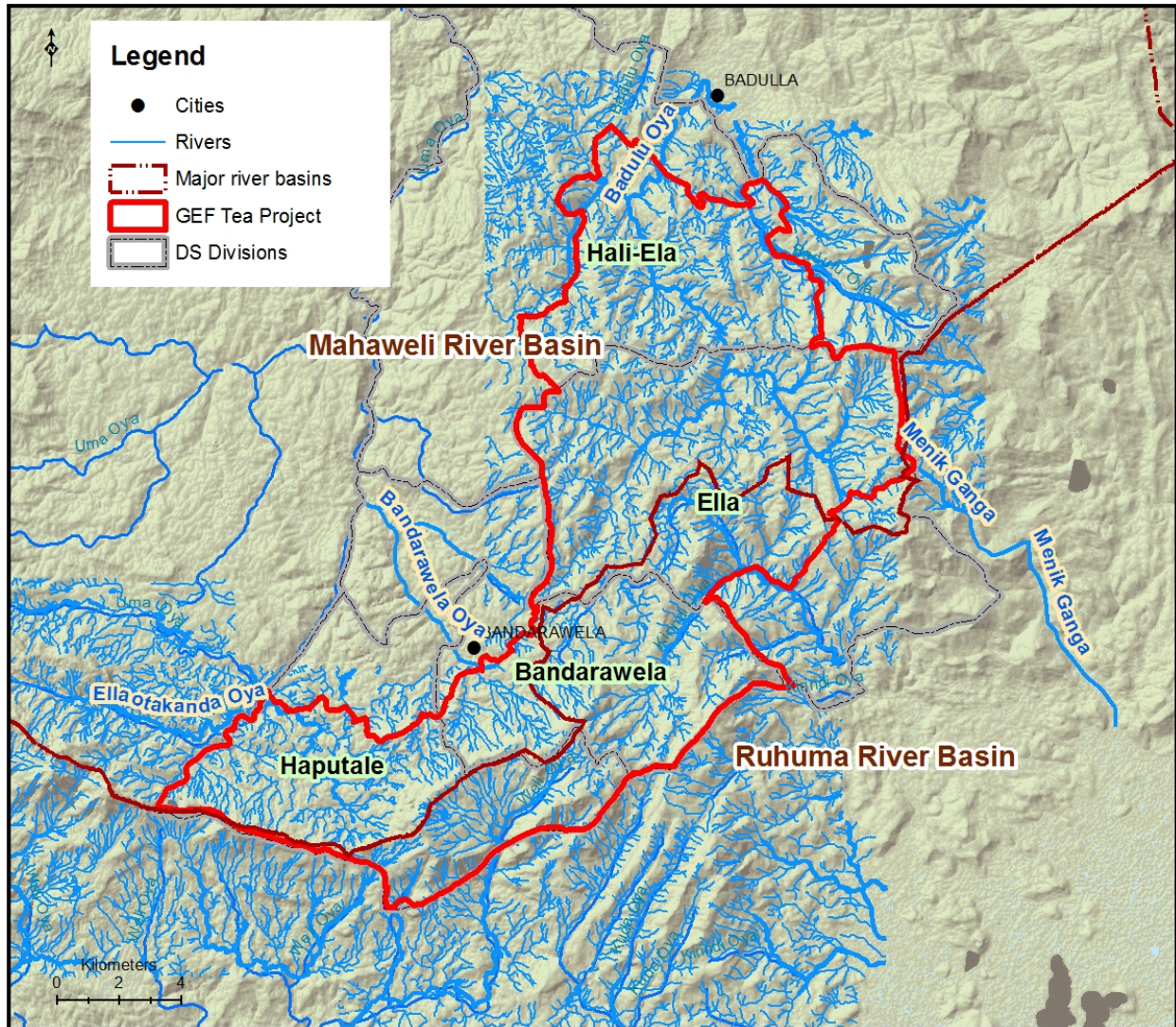
6.1. Topography, Drainage and Hydrology

The study area is spread across and is connected to three catchments. They are Kirindi Oya, Menik Ganga and Uma Oya and a large number of feeder river branches commence from the study area. (seemap below). The water that flows from streams in the study site feed irrigation reservoirs in Dry Zone areas. Rain and drainage water from the study area in Haputale flows to the Ellatotakanda Oya and Diyaluma Oya which starts from the study area, Hali-Ela flows to Kuda Oya and Badulu Oya, Ella flows to Badulu Oya, Nawelagama Oya and Kirindi Oya, Bandarawela Oya falls to Kirindi Oya. Hundreds of small and medium size streams carry the water while enriching vegetation, vegetable plots, paddy and home gardens in the study area along the way.

Map 7. Topography, watersheds and major rivers



Map 8. Hydrology



6.2. Geology, Geomorphology & Soils

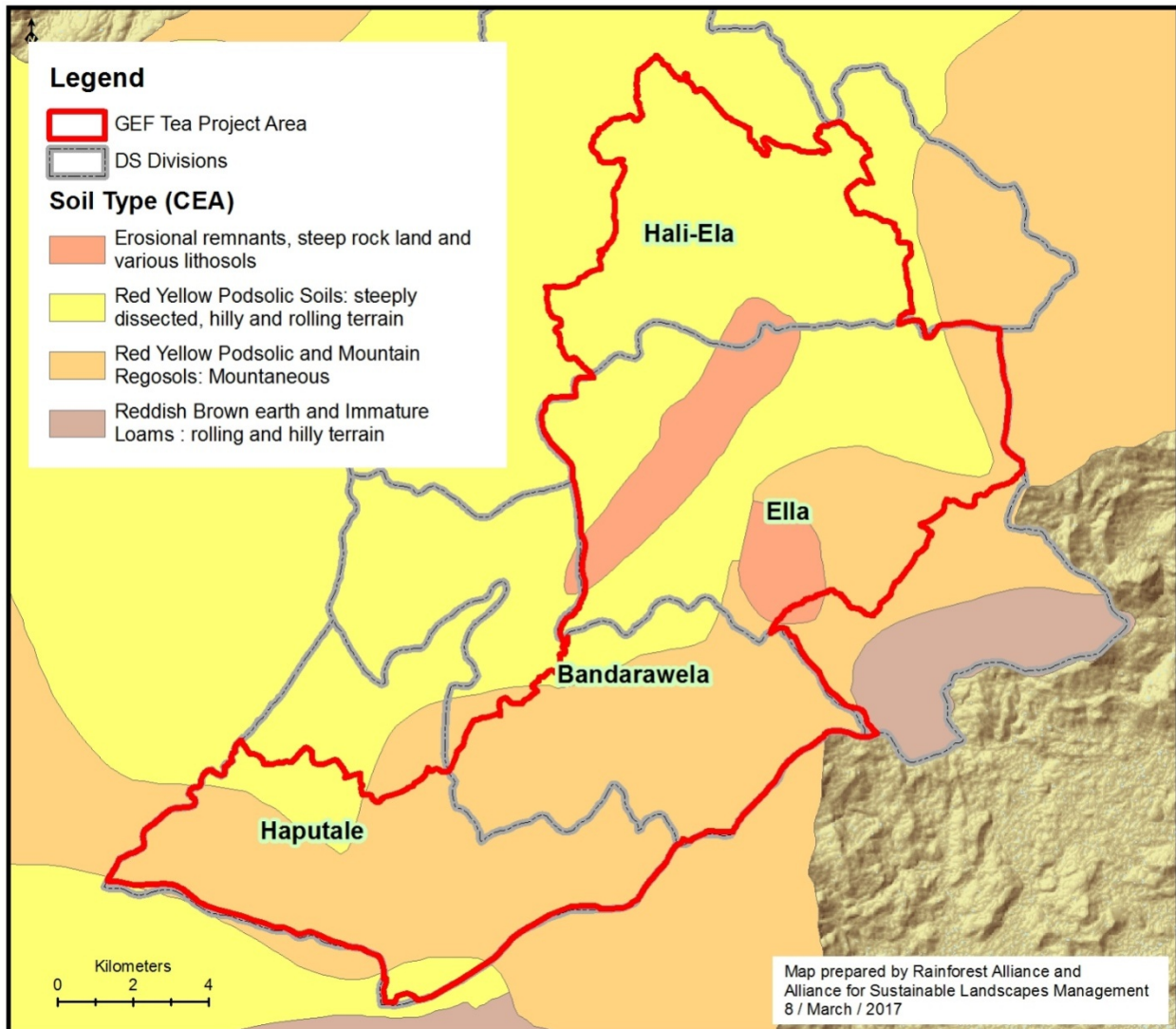
Geology in the study area consists of rocks, and these rocks are highly weathered, especially in the south-western and central part of the Island, and here a thick weathered mantle of clays and lithomarge rests on the top of the bed rock¹⁹. In addition, underground caves are also found in the study area. A survey carried out by Jayasinghe et al revealed that subsidence is likely to be correlated with collapsing of cavities and weathered zones, and disturbances to the ground water table. Further several large underground caves are found in the area, with some more than 100m wide. Most cave roofs have been thinned by the breakdown of the bedrock, expansion of caves, and act as water conduits and storage during rainy seasons. Soil erosion, human interactions on slopes causes threat to lives and property. Therefore, according to a study by Jayasinghe et al, future land subsidence and landslide occurrence is highly predictable²⁰.

¹⁹Manchanayake and Madduma Bandara 1999, water resources of Sri Lanka, National Science Foundation.

²⁰P.Jayasingha et al 2015, Landslide and Subsidence Potential due to the Progressive Development of Cave Network in Ella Wellawaya Area, Sri Lanka

According to the geological and climatic characteristics, soil groups representing the wet zone are found widely within the study area. The study area is located in relatively wet, higher slopes and are characterized by highly leached red-yellow podsollic, mountain Regosols, Mountancous, while their lower slopes have lateritic reddish brown soils²¹.

Map 9. Major soil types from the Central Environmental Authority (CEA)



7. Ecosystems and Habitats

The GEF-Tea project area in Lipton’s Seat landscape is located in the Intermediate Zone which lies between the dry and wet zones. Sub montane forests, lower montane forests, cloud forests, planted

²¹CEA 2010 – Environment Resource Information System

forests, grasslands and dry patana habitats, intermediate zone rock outcrops, springs, streams and water fall habitats, home gardens, vegetable farms and tea plantations are found on this landscape.

7.1. Agro ecological Zones

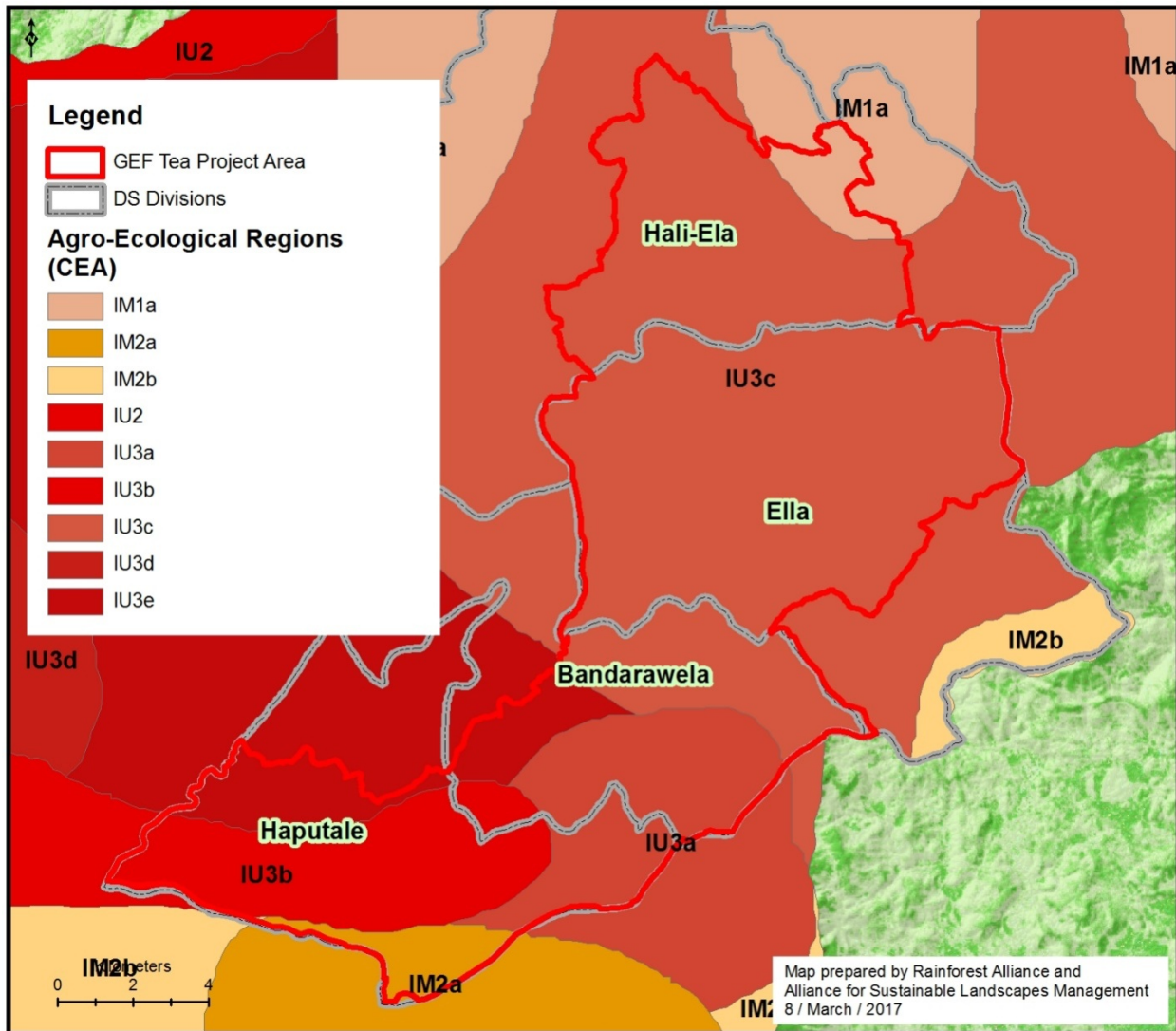
Agro ecological zones have been demarcated based on parameters such as present land use, soil, vegetation types, rainfall patterns etc. There are seven agro-ecological sub-regions in the up country Intermediate Zone of which IU1 is reported to receive the highest annual rainfall from the North-East Monsoon from among all sub-regions of the Intermediate Zone. Complex geographical settings of the IU3 agro-ecological region which encompasses almost the whole of the Uva basin have resulted in five agro-ecological sub-regions due to high spatial variability of inter-monsoonal and North East Monsoon rains in this region. The mid country Intermediate Zone has seven agro-ecological sub-regions. Most of these sub-regions also do not receive adequate rainfall. The map below shows the different agro ecological zones in the Lipton’s Seat landscape.

Table 3: Agro Ecological Zones in project landscape²²

Divisional secretariat	AE regions	Annual dependable rainfall (mm)
Hali-Ela	IM 1a and IU 3c	1,600-2,000
Ella	IU 3c and IM 2b	1,600-1,800
Bandarawela	IU 3a, IU 3c and IU 3e	1,400-1,900
Haputale	IU 3a, IU 3b and IU 3e	1,100-1,900

²²P.B. Dharmasena 2014, Current Status of Land Degradation in Badulla District, Rehabilitation of Degraded Agricultural Lands in Kandy, Badulla and NuwaraEliya Districts of the Central HighlandsGCP/SRL/067/GFF

Map 10. Agro-ecological zones, from Central Environmental Authority (CEA)



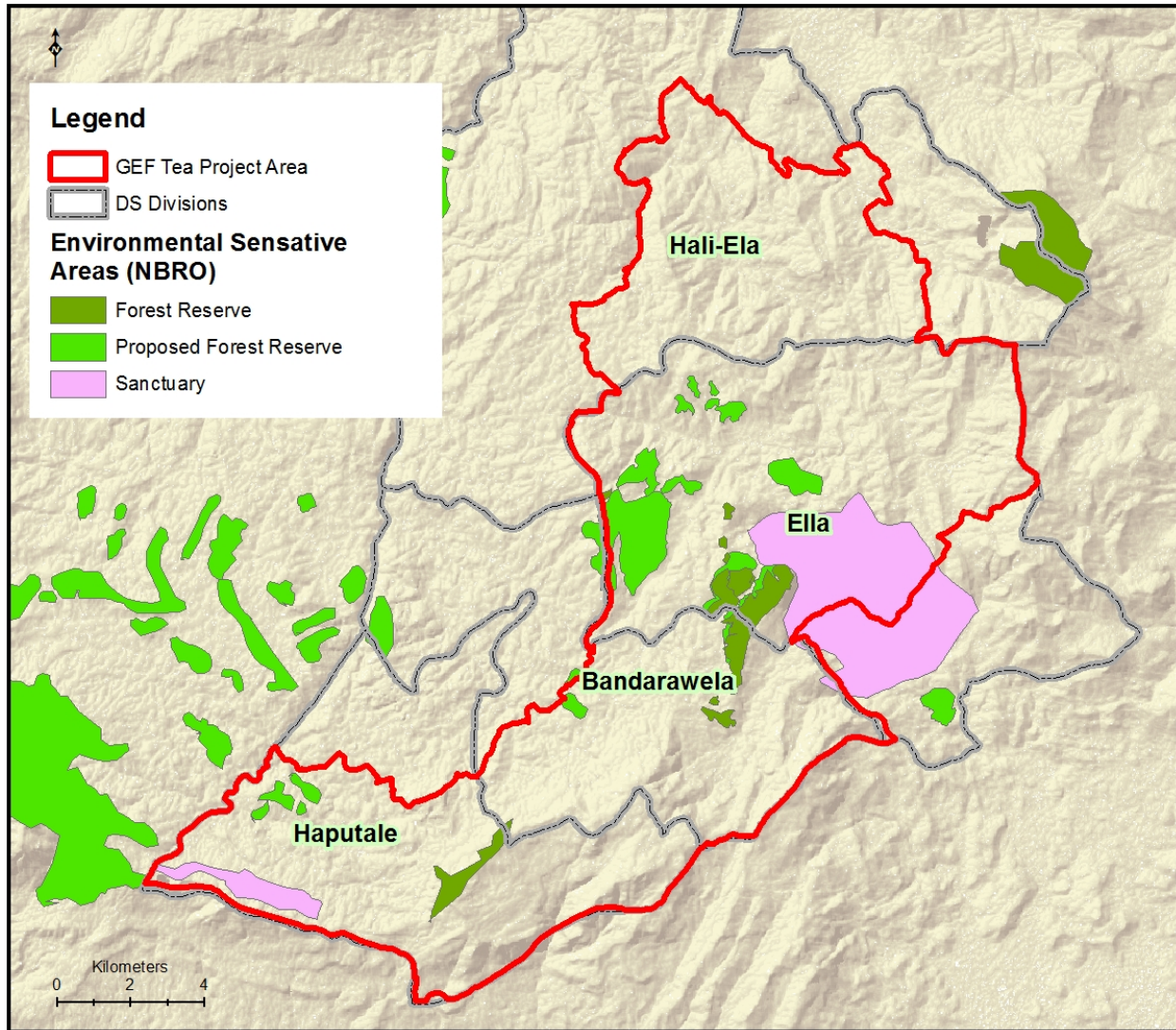
7.2. Protected areas

In the Haputale study area, there are four important protected forests areas, i.e. Thangamale Sanctuary, also considered as a bird sanctuary has 131 hectares of land declared as a protected area in 1938, Kalukele Forest Reserve with 50 hectares of land located at Pitaratmale Estate, and Haputale protected forest located just above the Haputale Town with 39 hectares and Thotalagala forest of 10 hectares, and Panketiya forest with an extent of around 40 hectares. In Ella DSD study area, Kinigama Reserved Forest is 3.46 km² and Ella Reserved Forest is around 0.75 km². Part of the Kirindi Oya reserve which is located in the project area in the Bandarawela DSD has also been declared as a reserve due to its location on a mountain top.

All of the above protected areas are isolated and have high pressure from human activities. There are many illegal encroachments cultivations. Some of the areas located above 5,000 feet within the project landscape are protected, but still in other areas above the same elevation are under tea cultivation. Also, the protected areas are surrounded by tea estates and settlements and no natural corridors are

found for the wild animals to move freely. Thangamale, Haputale, Kinigama and Ella protected areas are open to tourists.

Map 11. Environmental sensitive areas identified by the National Building Research Organization (NBRO)



7.3. Forests

Badulla District has 94.5 hectares of montane forests, also known as cloud forests which occur at elevations beyond 1500m above sea level and 3,030 hectares of sub montane forests at altitudes ranging from 1000-1500m²³. The Lipton’s Seat landscape is dominated by tea and also within the landscape there are patches of tropical lower montane forests, cloud forests, sub montane forests and dry patana grasslands.

Sub and lower montane forest type is common at an elevation between 900m to 1370m. The structure of these forests consists of a canopy (about 60-70 feet), sub-canopy and an under storey layer. The main canopy tree communities are *Eleaeocarpus*, *Myristica*, *Semecarpus*, *Calophyllum*. The sub-canopy

²³http://www.forestdept.gov.lk/web/index.php?option=com_content&view=article&id=112&Itemid=131&lang=en

includes species such as *Fahrenheltia* spp, *Pygeumzeylanicum*, *Bhesamontana*, and *Gordonia ceylanica*. The endemic shrub *Hortonia floribunda* in these forests that used for ayurvedic medicinal purposes and cosmetic industry. The understory is dominated by *Strobilanthes* shrub.

Upper montane forests (also called cloud forests) are common at elevations above 1370m. The structure consists of a dense canopy layer (about 25-30 feet) and an understory. The canopy layer consists mainly of tree communities *Calophyllum-Syzygium-Michelia-Garcinia*. Among the tree species is the endemic wild cinnamon (*Cinnamomum ovalifolium*). The understory consists of shrubs such as *Disporum leschenaultianum*, and endemic herbaceous species such as *Exacum walker.*, A variety of orchids, lichens, mosses and ferns occur in these forests, including many endemic species. Mosses and filmy ferns cover many of the tree trunks, while lichens hang from twigs.

Upper montane rain forests are widespread in the southern escarpment above 1525 M. The canopy consists of tree communities *Stemonoporus-Syzygium-Garcinia-Gordonia*. An epiphytic climber with beautiful pinl/purple flowers (*Kendrickia walker*) occurs in these forests²⁴.

The Lipton's Seat landscape does not have large areas of natural forests. However smaller patches of natural forests exist on mountain tops, steep slope areas and scarps in many locations. Furthermore, natural forest patches are also found in the Haputale protected forest, Thangamalai Sanctuary, Kalukele Protected Forest, Kinigama protected forest and Rawanaella protected forest and also it should be noted that these forests are secondary forests and harbor flora and fauna species endemic to Sri Lanka. One of six botanic gardens in Sri Lanka, a herbarium is located in Haputale. The Haputale herbarium provides sanctuary to approximately 200 species belonging to 50 taxa.

In the Haputale DSD area there are 400 hectares of dense forest, 442 hectares of natural forests and 800 hectares of scrub forests²⁵. In the Bandarawela study area which consists of 14 GNDs, there is 420 hectares of forests²⁶. In Ella DSD area there are 1,971 hectares of forests, 435 hectares of dense forests, and 440 hectares of scrub forests²⁷. In Hali-Ela DSD with 14 GNDs in the study area, there is 50 hectares of forests.

Since available forests within the study area is very limited, it has created a number of issues regarding sustainable management of natural forests. A majority of available natural forests (primary or secondary type of forests) are prone to higher levels of pressure from human activities. The following key issues have been identified as factors affecting sustainable management of natural forests in the study area.

Some issues regarding the conservation of forests are:

- Encroachment of forest land for vegetable and tea cultivations, constructions and settlements.
- Felling forests for timber, for fuel wood and to use as fencing etc. in vegetable cultivations.
- Forest fires lit by hunters.
- Undemarcated forest boundaries and lack of enforcement of management plans.
- The spread of *Pinus* and *Eucalyptus* plantations into forest areas as often many natural forests are surrounded by planted forest species as *Pinus* and *Eucalyptus*. The natural forest areas are

²⁴ FRA 2000 - Forest resources of Sri Lanka - Country report, FAO Rome

²⁵ Divisional Resources Profile 2015, Haputale DS Office

²⁶ Divisional Resources Profile 2015, Bandarawela DS Office

²⁷ Divisional Resources Profile 2015, Ella DS Office

being slowly engulfed by these planted forests and these species are fast becoming the dominant species suppressing natural forests and biodiversity.

- Limited space for natural regeneration or expansion of natural forests due to being surrounded by monoculture tea plantations and forest plantations with exotic species.
- Forest patches less than one hectare in extent are not identified and mapped.

7.4. Forest Plantations

Historical reports document how the plantation of exotic forest species took place in the study area. *Eucalyptus* was introduced by the Department of Forests in 1931, laying down series of seven arboretum plots to test the performance of *Eucalyptus*, *Acacia*, *Araucaria* and *Cupressus* under plantation conditions in the grasslands of Uva. In 1954, the Forest Department extended this activity to plant windbreaks, mainly with *eucalyptus*, in several places in the Uva Basin²⁸. In the Lipton's Seat landscape study area, patana lands, grasslands, abandoned and marginal tea lands and lands in higher elevations had been converted to forest plantations and planted with exotic tree crops such as *Pinus* and *Eucalyptus* spp i.e. *E. urophylla*, *E. camaldulensis*, *E. robusta*, *E. grandis*, *E. tereticornis*, *E. citriodora*, and *Euca/Acacia*. Forest plantations outside large tea estates are managed by the Department of Forest Conservation while areas located within large tea estates are managed by the plantation companies. These forest plantations are grown purely for commercial purposes and are considered economic crops.

There are 449 hectares of planted forests in the study area in the Bandarawela DS Division, the Ella DS Division has 683 hectares of planted forests and 1493.46 hectares of open forest plantations, and the Haputale DS Division has 125 hectares of planted forests and the study area in Hali-Ela DS Division has 18 hectares of planted forests.

In some areas, the planted forests have been felled for timber and areas where there was *Pinus* have been replanted with *Eucalyptus*. It was revealed that there are many issues related to forest plantations that have exotic forest plants species. Community members in these areas and officers responsible for natural resources management in relevant government offices stated that *Pinus* and *Eucalyptus* plantations are environmental hazards while some consider them an environmental disaster.

Some of key issues highlighted with regards to planted forests are as follows:

- They affect watershed functions and catchments, as planted forest vegetation has a lower water yield than those under scrub or grasslands.
- Monoculture plantations with exotic tree species are poor in understory floristic composition. According to observations, in many forest plantations within the study area, growth of understory vegetation has significantly reduced, to the extent that in many places there appears to be no vegetation at all.
- These forest plantations do not provide a habitat for most species of fauna and other floral species and, as a result, show minimum biodiversity.
- Soil erosion is high as there is no ground vegetation cover, top soil is open to heavy rains and they are washed downstream where they become deposited in irrigation canals, rivers and reservoirs.

²⁸H. M. Bandaratilake, *Eucalyptus Plantations in Sri Lanka: Environmental, Social, Economic and Policy Issues*, FAO Publication

- In some planned the planted forests, invasive alien species as *Panicum maximum* and *mimosa invisa* thrives.
- These forests are prone to forest fires during the dry season and suffer extensive damage to its natural balance. These fires are difficult to extinguish and will burn fast due to the inflammable nature of leaves of exotic plant species.
- Communities living in adjacent areas say that water quality of shallow ground water wells and springs are lower near these forest plantations. This is a point that needs to be researched and scientifically verified.
- These plant species spread naturally into natural forest areas and become dominant species while affecting the growth of natural forests.
- Planted forests are located around/ adjacent to limited natural forests and as a result regeneration of natural forests have been affected.
- Most forest plantations managed by the Department of Forest Conservation are located on the top of the mountains and as a result recharging of ground water is minimal.
- Boundaries of the forest plantations are not properly demarcated and as a result people encroach them for settlements and cultivations. In addition, there is a high demand for lands with forest plantations for alternative use in the areas with high demographic density such as in the Haputale and Bandarawela municipal areas.
- Planted forests belong to plantation companies, located above 5,000feet (1,524 m) are not allowed to be harvested by the Department of Forest Conservation. These forest plantations have been planted for commercial use which is now prohibited.

The Fifth National Report to the Convention on Biological Diversity stated that the trend to move away from past practice of planting exotic species such as teak, *Pinus* and *Eucalyptus* and the move towards indigenous species is beneficial²⁹.

7.5. Patana Grasslands

Dry patana grasslands, located between 500 – 1000m elevation, are relatively widespread in the Uva Basin. These grasslands have resulted from the removal of tree vegetation for agriculture and subsequent abandonment. The dominant grass species in them are *Cymbopogon nardus* and *Themeda tremula*, both forming tussocks. Other species seen among the grasses include a large number of tall composite herbs (*Blumea spp.*, *Vernonia spp.* etc.) and semi-woody to woody shrubs (*Cassia spp.*, *Crotalaria spp.*, *Lantana camara*, *Osbeckia octandra*, *Psidium guajava*, *Wikstroemia indica*). During the dry months, these dry patana lands are purposely burnt to obtain fresh grass for fodder or to hunt animals. Their very existence is a result of fire. Much of these grasslands are now converted to agricultural land and *Pinus* and *Eucalyptus* plantations. They are also being taken over by the aggressively competitive exotic fodder grass *Panicum maximum* and invasive species like *Clusia rosea*. Some dry patana grasslands in the Uva Basin are gradually becoming urbanized, or giving way to, agricultural and exotic mono-specific forest plantations³⁰.

There are 178hectares of grasslands in Ella DSD area and 27.55hectaresof grass lands in Haputale DSD area.

Issues:

²⁹Sri Lanka's Fifth National Report to the Convention on Biological Diversity 2014

³⁰NimalGunatilleke et al 2008, Biodiversity of Sri Lanka, J.Natn.Sci.Foundation Sri Lanka 2008 36 Special Issue 25-62

- Encroachment for vegetable cultivations and tea plantations
- Annual fires lit by hunters and livestock farmers to get fresh grasses
- Spreading of invasive alien species of flora
- Soil erosion
- Gradual conversion into forest due to natural germination of *Pinus* and *Eucalyptus* on the grasslands.

7.6. Biological Diversity

Biological diversity in the study area is significantly important in the regional, national and global scale. Sri Lanka being a country with the highest species density (number of species present per 10,000sq.km) for flowering plants, amphibians, reptiles, and mammals in the Asian region³¹. The geographical area covered by this study is very important as the area is categorized as an intermediate zone which harbors a number of endemic flora and fauna species and also endangered, threatened and vulnerable species. The agro-ecosystem in the study area is dominated by tea plantations. In addition, forest plantations with exotic timber species are present in the area especially within large scale plantations as well as on higher elevations.

According to the National Red List 2012 *“Even though Sri Lanka is endowed with a rich biodiversity, at present only a small fraction of Sri Lanka’s biodiversity is known to science. For instance, higher plants and vertebrates are the only taxa that have been studied in sufficient detail to date. Lower plants and invertebrates are largely neglected except for few selected groups such as butterflies, dragonflies, land snails, pteridophytes and algae. Even the vertebrates and, for that matter, higher plants are not completely listed, as during the last two decades alone large number of new species have been discovered”*³².

7.6.1. Flora

Dry evergreen forests at comparatively high precipitation or soil moisture levels are richer in species and harbour more endemic species than the lowland dry forests areas of the island. Similarly, the riparian and hill forest communities are rich in species with the presence of many endemic species. According to plant records available in Flora of Ceylon (Dassanayake and Fosberg 1980-2004), 43 woody plants endemic to the country grow in the dry lands of Sri Lanka. These include 26 tree, 2 liana and 15 shrub species. Of these, 33 are also found in the wet zone of the country but the 10-remainspecies are only reported from the dry zone. However, 7 of the 10 species are restricted to wet localities in the lowlands or in hill forests of the intermediate zone. *Hopea cordifolia* (Dipterocarpaceae) is also a noteworthy endemic species found from the southern part of the country, restricted to the gallery forest along the Walawe Ganga and Kirindi Oya and their tributaries in the dry zone of the Uva Province.

Despite their biological and hydrological importance, vast areas of these montane forests have been cleared during the latter part of the 19th century for introduction of plantation crops such as tea. Only about 3,100 hectares of montane forests are remaining at present (MENR, 2009). In Sri Lanka, these montane forests, also known as upper montane forests, are found at elevations beyond 1500m above

³¹NARESA., (1991). *Natural resources of Sri Lanka: conditions and trends*. Colombo: Natural Resources, Energy and Science Authority.

³²MOE 2012. The National Red List 2012 of Sri Lanka; Conservation Status of the Fauna and Flora. Ministry of Environment, Colombo, Sri Lanka. viii + 476pp

mean sea level. Montane forests are also the home to around 500 endemic plant species which constitute about 50% of all endemic species in Sri Lanka (Pieris, 1975).

The table below presents the tree species in the study area. They have been categorized accordingly **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT; Least Considered - LC.**

Table 4: Tree species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Schefflera exaltata</i>		EN	
<i>Elaeocarpus glandulifer</i>	Gal-Weralu	VU	VU
<i>Mallotus fuscescens</i>		EN	
<i>Actinodaphne ambigua</i>		EN	
<i>Cinnamomum ovalifolium</i>		VU	
<i>Arisaema leschenaultia</i>		EN	
<i>Rhododendron zeylanicum</i>		EN	
<i>Semecarpus acuminata</i>	Badulla	VU	EN
<i>Semecarpus nigro-viridis</i>	Badulla	EN	VU
<i>Schefflera exaltata</i>	Itha	EN	
<i>Schefflera hererobotrya</i>	Itha	NT	
<i>Bhesa ceylanica</i>		EN	VU
<i>Garcinia hermonii</i>	Madol, Kana-Goraka	VU	
<i>Garcinia echinocarpa</i>	Madol	VU	
<i>Vaccinium leschenaultii</i>	Boralu	VU	
<i>Glochidion coriaceum</i>		EN	
<i>Actinodap hnescpiosa</i>	Pol-katu gas	EN	
<i>Actinodaphne elegans</i>		EN	
<i>Litsea walkeri</i>		VU	
<i>Litsea ovalifolia</i>		NT	
<i>Litsea gardneri</i>	Talan	VU	VU
<i>Fagraea ceilanica</i>	Etamburu	NT	
<i>Michelia nilagirica</i>	Wal-Sapu	VU	
<i>Hortonia floribunda</i>	Wawiya	EN	
<i>Artocarpus gomezianus</i>	Kana-Gona	NT	
<i>Horsfieldia iryaghedhi</i>	Ruk, Malabodde	VU	CR
<i>Syzygium alubo</i>	Alu-Bo	NT	
<i>Psychotria gardneri</i>	Kalu-Kuratiya	NT	EN
<i>Psychotria glandulifera</i>		VU	EN
<i>Isonandra zeylanica</i>		VU	
<i>Symplocos bractealis</i>	Bombu	EN	VU
<i>Gordonia dassanayakei</i>		EN	
<i>Calophyllum tomentosum</i>	Keena, Tel-Keena	VU	
<i>Cyathea walkerae</i>	Gini-hota, Giniwatara	VU	
<i>Actinodaphne stenophylla</i>	Nika-Daula	VU	
<i>Litsea glaberrima</i>		NT	
<i>Anthocephalus chinensis</i>	Nawatha, Ambul Bakmi	NT	

Note: NCS - national conservation status; GCS - global conservation status

The table below presents shrubs species in the study area. They have been categorized accordingly **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT; Least Considered - LC.**

Table 5: Scrub forest species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Arisaema leschenaultia</i>	Wal kidaran	VU	
<i>Rhododendron zeylanicum</i>	Maharathmal	EN	
<i>Osbeckia octandra</i>	Heen-bowitiya	EN	
<i>Osbeckia parvifolia</i>	Bowitiya	EN	
<i>Strobilanthes walkeri</i>		NT	
<i>Moonia heterophylla</i>		NT	
<i>Impatiens macrophylla</i>		VU	
<i>Euonymus walkeri</i>			VU
<i>Osbeckia rubicunda</i>		EN	
<i>Ardisia gardneri</i>		EN	
<i>Ardisia crenata</i>		EN	
<i>Lasianthus gardneri</i>		EN	VU
<i>Murraya gleniei</i>		NT	

Note: NCS - national conservation status; GCS - global conservation status

The table below presents herbs species in the study area and are categorized as **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT.**

Table 6: Herb species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Impatiens truncata</i>		NT	
<i>Adenosma camphoratum</i>	Kaha-gonakola	NT	
<i>Cyanotis villosa</i>		NT	
<i>Desmodium repandum</i>		EN	
<i>Didymocarpus humboldtianus</i>		VU	
<i>Rhynchosyris notonianum</i>	Diya-nilla	NT	
<i>Nymphaea nouchali</i>		VU	
<i>Impatiens grandis</i>		EN	
<i>Begonia malabarica</i>	Hak-Ambala	NT	
<i>Commelina indehiscens</i>	Gira Pala	NT	
<i>Desmodium repandum</i>		EN	
<i>Nymphaea nouchali</i>	Water Lily	VU	
<i>Liparis caespitosa</i>		VU	
<i>Bulbophyllum wightii</i>		VU	
<i>Pileamela moides</i>		NT	

Note: NCS - national conservation status; GCS - global conservation status

The table below presents the vines species in the study area and are categorized as **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT.**

Table 7: Vines species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Mukia maderaspatana</i>	Gon-Kekiri, Heen-Kekiri,	NT	
<i>Stephania japonica</i>	Lunu-Ketiya-Wel	VU	
<i>Macrosolen parasiticus</i>		VU	
<i>Kendrickia walkeri</i>		VU	
<i>Medinilla maculata</i>		EN	
<i>Stephania japonica</i>	Lunu-Ketiya-Wel	VU	
<i>Freycinetia walkeri</i>		NT	
<i>Ficus Diversiformis</i>		EN	
<i>Peperomia pseudo-rhombea</i>		VU	
<i>Paramignya beddomei</i>		EN	
<i>Piper Zeylanicum</i>		EN	
<i>Cayratia Recticulata</i>		EN	

Note: NCS - national conservation status; GCS - global conservation status

7.6.2. Fauna

Sri Lanka is the habitat for around 453 bird species of which 240 species breed in Sri Lanka, 23 species are considered as endemic, 6 are considered as proposed endemics and the rest, 213 are considered as migrants. The Uva zone, is home to mostly common bird species as well as few rare species that are restricted to this zone³³. Around 59 species of bird have been recorded in the Lipton's Seat landscape, out of which 7 are endemic, 1 categorized as critically endangered and 6 categorized as endangered.

Capturing species for the illegal pet trade, habitat loss including forests and wetlands, pollution of water ways, spread of invasive species and land use changes are identified as the main threats affecting bird populations in the area.

Table below presents bird species found in the study area and the level of threat they face **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT.**

Table 8: Bird species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Ictinaetus malayensis</i>	Black Eagle	NT	
<i>Columba livia</i>	Rock Pigeon	CR	
<i>Dicaeum agile</i>	Thick Billed Flowerpecker	NT	
<i>Megalaima flavifrons</i>	Sri Lanka Yellow-fronted Barbet	EN	
<i>Eumyias sordida</i>	Sri Lanka dull-blue flycatcher	VU	

³³Devaka K Weerakoon and Kithsiri Gunawardena 2012. The National Red List 2012 of Sri Lanka; The Taxonomy and Conservation Status of Birds in Sri Lanka. Weerakoon, D.K. & S. Wijesundara Eds., Ministry of Environment, Colombo, Sri Lanka. 114-117 pp

<i>Gallus lafayetii</i>	Sri Lanka junglefowl	EN	
<i>Picus xanthopygus</i>	Streak-throated Woodpecker	EN	
<i>Picus chlorolophus</i>	Lesser Yellownape	NT	
<i>Loriculus beryllinus</i>	Lanka Hanging Parrot	EN	
<i>Turdus merulakinnisii</i>	Eurasian Black bird	EN	
<i>Zosterops ceylonensis</i>	Sri Lanka White Eye	NT	
<i>Lonchura malabarica</i>	White Throated Munia	VU	
<i>Saxicola caprata</i>	Pied Bushchat	EN	
<i>Pycnonotus penicillatus</i>	Sri Lanka Yellow-eared Bulbul	VU	NT
<i>Hirundo domicola</i>	Hill Swallow	VU	
<i>Psittacula calthropae</i>	Sri Lanka Emerald-collared Parakeet	NT	

Note: NCS - national conservation status; GCS - global conservation status

There are 144 described species and subspecies of mammals in Sri Lanka and of these, 24 are currently considered as exotic species, 95 species are considered as indigenous of which 21 species are endemic to the island. Another 12 species have been introduced to Sri Lanka³⁴. Out of seven mammalian zones, the study area spreads across three zones – i.e. (C), rain forests and grasslands below 3,000 feet (D1), between 3,000-5,000 feet (D2) and above 5,000 feet (D3).

Based on available records on mammals in the study areas, a list of 16 have been identified and out of which 2 species are endemic to Sri Lanka, and of this group according to the Red List 2012, 4 species have been categorized as endangered. Degradation of habitat, especially in the montane zone, fragmentation of habitats, influx of pest species, domestic predators, hunting, and death due to human wild life conflict, destruction and disturbance of migration corridors due to large plantations such as tea are the main threats for these mammals.

The table below presents the list of mammals found in the study area which are categorized according to the level of threat they face **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT**.

Table 9: Mammal species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Macaca sinica</i>	Sri Lanka toque monkey		EN
<i>Rusa unicolor</i>	Sambur	NT	VU
<i>Muntiacus muntjak</i>	Barking deer	NT	
<i>Elephas maximus</i>	Elephant	EN	EN
<i>Prionailurus rubiginosus</i>	Rusty-spotted cat	EN	VU
<i>Prionailurus viverrinus</i>	Fishing cat	EN	EN
<i>Vandeleuria nolthenii</i>	Sri lankalong tailed tree mouse	CR	EN
<i>Funambulus obscurus</i>	Dusky-striped jungle squirrel	VU	VU
<i>Ratufa macroura</i>	Giant squirrel		NT

Note: NCS - national conservation status; GCS - global conservation status

³⁴Devaka K Weerakoon 2012. The National Red List 2012 of Sri Lanka; The Taxonomy and Conservation Status of Mammals in Sri Lanka. Weerakoon, D.K. & S. Wijesundara Eds., Ministry of Environment, Colombo, Sri Lanka. 114-117 pp

The current list of reptile fauna of Sri Lanka comprises 211 species of which 59% (124) are considered as endemic species. Majority of the endemic and threatened reptiles are restricted to the lowland and montane forests that are fast disappearing. Loss of habitat is identified as the biggest threat to reptile fauna of Sri Lanka³⁵. Deforestation, wild fires, use of agrochemicals, road accidents, killing by man and predation by farm and domestic animals have also been identified as threats to their existence. About 14 reptile fauna species have been identified in the study area of which 9 are endemic species and 1 is critically endangered and 4 considered endangered.

The table below presents the reptiles found in the study area which are **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT.**

Table 10: Reptile species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Haplocercus ceylonensis</i>	The black spine snake	EN	
<i>Cnemaspis kandiana</i>	Kandyan day gecko	EN	
<i>Cnemaspis latha</i>	Elegant day gecko	CR	
<i>Ceratophora stoddartii</i>	Rhinohorn lizard	EN	
<i>Cnemaspis podihuna</i>	Dwarf day gecko	VU	
<i>Eutropis madaraszi</i>	Spotted skink	VU	
<i>Rhinophis blythii</i>	Blyth's earth snake	EN	

Note: NCS - national conservation status; GCS - global conservation status

The vast majority of amphibians are restricted to the south-western wet zone quarter of the island³⁶. However, 9 amphibians have been recorded from the study area which is 8% of the total number of 111 described amphibian fauna species and of them 7 are endemic, 2 species are critically endangered and 3 endangered. Loss and fragmentation of habitats especially forests, use of chemical pesticides, environmental pollution from different sources have been identified as threats to amphibian species in Sri Lanka. Gradual degradation of natural forest species, high use of chemical pesticides and fertilizers, environmental pollution and unusual and unpredictable weather patterns due to climate change can affect amphibians in the Lipton's Seat landscape.

Table below presents the amphibians found in the study area which are **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT.**

Table 11: Amphibian species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Hylarana temporalis</i>	Bronzed frog	NT	
<i>Taruga longinasus</i>	Long-snouted tree frog	EN	EN
<i>Pseudophilautus sarasinorum</i>	Muller's shrub frog	EN	EN
<i>Fejervarya kirtisinghei</i>	Kirtisinghe's frog	VU	
<i>Taruga eques</i>	Mountain hourglass tree frog	EN	EN
<i>Pseudophilautus ocularis</i>	Golden-eyed shrub frog	CR	EN

³⁵L. J. Mendis Wickramasinghe 2012. The National Red List 2012 of Sri Lanka; The Taxonomy and Conservation Status of the Reptile Fauna in Sri Lanka. Weerakoon, D.K. & S. Wijesundara Eds., Ministry of Environment, Colombo, Sri Lanka. 99-103 pp

³⁶Dutta, S. K. & Manamendra-Arachchi, K., (1996). The amphibian fauna of Sri Lanka. Colombo: Wildlife Heritage Trust of Sri Lanka.

<i>Pseudophilautus fulvus</i>	Knuckles shrub frog	CR	EN
<i>Lankanectes corrugatus</i>	Corrugated water frog	VU	

Note: NCS - national conservation status; GCS - global conservation status

The study area provides habitat for around 27 butterfly species and 4 dragonfly species. The butterfly species namely *Symphaedra nais*, *Ypthima singala*, *Pratapa deva* are found only in Uva and Sabaragamuwa Provinces because their main habitats, Savannah grasslands are found in the Uva Province.³⁷The specific threats to butterflies and dragonflies have been identified as degradation of forests and grasslands, illegal encroachments for settlements, expansion of tea and rubber plantations, introduction of non-native tree species, spread of invasive alien species, fires in grasslands and forests and felling of young trees for different purposes.

The table below presents insects (Dragonflies and Butterflies) found in the study area which are **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT.**

Table 12: Insects species found in the project area and their conservation status

Scientific Name	Common Name	NCS	GCS
<i>Parantica taprobana</i>	Sri Lanka Tiger	EN	NT
<i>Baracus vittatus Felder</i>	Sri Lanka Hedge Hopper	VU	
<i>Argynnis hyperbius</i>	Indian Fritillary	EN	
<i>Vanessa cardui</i>	Painted Lady	VU	
<i>Appias paulina</i>	Sri Lanka Lesser Albatross	EN	
<i>Appias galena</i>	Lesser Albatross	EN	
<i>Melanitis phedima</i>	Dark Evening Brown	NT	
<i>Euphaea splendens</i>	Sri Lanka Shining Gossamerwing	NT	
<i>Indolestes gracilis</i>	Mountain Reedling	VU	
<i>Orthetrum pruinosum</i>	Pink skimmer	NT	
<i>Trithemis festiva</i>	Indigo Dropwing	VU	
<i>Celaenorrhinus spilothyrus</i>	Sri Lanka Black Flat	VU	
<i>Udara singalensis</i>	Singalese Hedge Blue	EN	
<i>Junonia orithya</i>	Blue Pansy	NT	
<i>Lethe drypetis</i>	Tamil Treebrown	EN	
<i>Rohana parisatis</i>	Black Prince	VU	
<i>Papilio helenus</i>	Red Helen	VU	
<i>Melanitis phedima</i>	Dark Evening Brown	NT	
<i>Ypthima singala</i>	Sri Lanka Jewel Fourring	EN	
<i>Neurobasis chinensis</i>	Oriental Greenwing	VU	
<i>Elatoneura tenax</i>	Sri Lanka Redstriped Threadtail	EN	

Note: NCS - national conservation status; GCS - global conservation status

³⁷George van der Poorten 2012. The National Red List 2012 of Sri Lanka; The Taxonomy and Conservation Status of the Butterflies of Sri Lanka. Weerakoon, D.K. & S. Wijesundara Eds., Ministry of Environment, Colombo, Sri Lanka. 26-31 pp

7.7. Invasive Species

Spreading of Invasive Alien Flora (IAS) species within the study area was observed. This is a serious issue and no attention has been paid to control the threat of these species spreading further and affecting natural ecosystems in the area. Unutilized, underutilized and reserve lands such as roadside reservations, poorly managed tea plantations, barren lands, abandoned tea plantations, forest plantations, watershed reservation areas including stream reservations within the Lipton's Seat landscape have been encroached by different species of Invasive Alien Flora. The following lists of IAS prepared based on observations and secondary information from published research papers.

Table 13: Distribution of Invasive Alien Flora Species in the Lipton's Seat landscape

Scientific Name	Common Name	Affected Habitats/Ecosystems
<i>Ageratina riparia</i>		Open areas in montane forests, roadsides
<i>Austroeupator iuminulifolium</i>		Agricultural fields, fallow fields, waste lands and roadside etc.,
<i>Cestrum aurantiacum</i>		
<i>Aristea ecklonii</i>		Grasslands and patana
<i>Calliandra calothyrsus</i>	Kelliandra	Tea plantations, reservations of streams and watersheds, roadsides
<i>Miconiaca lvescens</i>	Wathupalu	Open areas in montane forests and abandoned tea plantations
<i>Psidium litorale</i>		Home gardens
<i>Pennisetum clandestinum</i>	Rila Thana	Grasslands, riparian areas
<i>Lantana camara</i>	Higuru/Gandapana	Open areas in montane forests, roadsides, reservations
<i>Panicum maximum</i>	Gini Thana	Open areas in montane forests, under growth in planted forests, roadsides, reservations, agricultural lands
<i>Alstonia macrophylla</i>	Hawarinuga	Forests
<i>Antigonon leptopus</i>		Open areas in montane forests, roadsides, boundaries of agricultural lands and reservations,
<i>Clidemia hirta</i>		Open areas in montane forests, under growth in planted forests, roadsides, reservations, agricultural lands, tea plantations
<i>Colocasia esculenta</i>		Aquatic ecosystems
<i>Cuscuta campestris</i>	Cuscuta	Open areas in montane forests, roadsides, reservations, open areas in tea plantations
<i>Mimosa pigra</i>	Maha Nidikumba	River banks, fallow fields, irrigation canals
<i>Mimosa invisa</i>	Wal nidikumba	Waste land, scrub forests, agricultural lands, roadsides
<i>Myroxylon balsamum</i>	Balsam Tree/Kattakumanjal	Sub montane forests
<i>Pteridium revolutum</i>		Grasslands, riparian areas
<i>Sphagneticola trilobata</i>	Wedelia	Waste lands, tea plantations, road side,

		forest patches
<i>Tithonia diversifolia</i>	Naththasooriya	Waste lands, reservations, agricultural lands
<i>Ulex europaeus</i>	Gorse	Clouds forests, wet patana grasslands
<i>Setaria barbata</i>	Una kola	Waste lands, tea plantations, agricultural lands
<i>Clerodendrum quadriloculare</i>		Home gardens
<i>Imperata cylindrical</i>	Iluk	Waste lands, grasslands
<i>Pinus caribaea</i>	Pine	Grass lands, scrub forests, native forests
<i>Chromolaena odorata</i>	Podisinchomaran	Forest edge, scrub forests, reservations, roadsides

Table 14: Invasive Alien Fauna Species recorded in Lipton's Seat landscape

Scientific Name	Common Name	Affected Habitats/Ecosystems
<i>Oreochromis mossambicus</i>	Mosambique Tilapia	Rivers and marshes
<i>Bubalus bubalis</i>	Feral Buffalo	Forests
<i>Milaxga gates</i>	land slug	Pests of root vegetables as carrot, potato
<i>Lissachatina fulica</i>	Giant African snail	Pests of vegetables
	Exotic earth warms	Agroecosystems in Uva
<i>Canis familiaris</i>	Feral dog	Act as predators and is a threat to wild animals
<i>Mus musculus</i>	House mouse	Agricultural pests and hybridization with native biota
<i>Felis catus</i>	Feral cat	Act as predators, vector for rabies virus
<i>Acaphylla theae</i>	Pink tea mite	Pest in tea cultivations

It was observed that IAS are spreading all over the study area, especially in road reservations, forest reservations and public lands. The area is vulnerable for further spread of IAS.

Issues identified:

- Spread of IAS is a major threat to biodiversity in the project area.
- Responsible government agencies or civil society organizations have not given adequate attention or do not have reliable programmes/ controlling mechanisms to address the spread of IAS within the study area.
- People are not adequately aware of IAS and their socioeconomic and environmental impacts, controlling methods etc.
- There is not enough coordination between the responsible agencies as the Department of Agriculture, Ministry of Plantations, Central Environmental Authority, Department of Wildlife Conservation and Department of Forest Conservation to manage IAS.

7.8. Endangered and Endemic Species

The following table presents the total number of different species found in the study area and the number of species that are **Critically Endangered - CR; Endangered - EN; Critically Endangered Possibly Extinct CR(PE); Vulnerable - VU; Near Threatened - NT**. In addition, the number of endemic species found in the landscape is also presented.

Endemic Tree species: *Schefflera exaltata*, Gal-Weralu (*Elaeocarpus glandulifer*), *Mallotus fuscescens*, *Actinodaphne ambigua*, *Cinnamomum ovalifolium*, *Badulla (Semecarpus coriacea)*, *Semecarpus nigro-viridis*, *Schefflera heterobotrya*, Et-Heraliya, Palen, Pelang, Uru-Honda (*Bhesa ceylanica*), Madol, Kana-Goraka (*Garcinia hermonii*), *Glochidion coriaceum*, *Actinodaphne spciosa*, *Actinodaphne elegans*, *Litsea walker*, Bombee, Bomee (*Litsea glutinosa*), *Litsea ovalifolia*, Talan (*Litsea gardneri*), Kota-Dimbula (*Ficus hispida*), Wawiya (*Hortonia floribunda*), *Horsfieldia iryaghedi*, Kalu-Kuratiya (*Psychotria gardneri*), *Psychotria glandulifera*, *Isonandra zeylanica*, *Gordonia dassanayakei*

Endemic Herb species: Kundalu (*Impatiens truncate*) and Kaha-Gona-Kola (*Adenosma camphoratum*)

Endemic vine species: *Medinilla maculate*, *Ficus diversiformis*, *Freycinetia walker*, *Piper Zeylanicum*, *Cayratia reticulate*,

Endemic shrubs species: Bowitiya, Heen Bowitiya (*Osbeckia octandra*), *Rhododendron zeylanicum*, *Strobilanthes walker*, *Impatiens macrophylla*, *Euonymus walker*, *Ardisia gardneri*, *Lasianthus gardneri*, *Chassalia curviflora*, *Murraya gleniei*

Endemic Mammal Species: Sri Lankan toque monkey (*Macaca sinica*) and Sri Lanka Long-tailed Tree mouse (*Vandeleuria nolthenii*)

Endemic Bird Species: white-eye (*Zosterops ceylonensis*), Sri Lanka yellow-fronted barbet (*Megalaima flavifrons*), Sri Lanka jungle fowl (*Gallus lafayetii*), Sri Lanka hanging parrot (*Loriculus beryllinus*) Sri Lankan Grey horn bill (*Ocyrceros gingalensis*), Sri Lankan Yellow-earned bulbul (*Pycnonotus penicillatus*) and Sri Lanka dull-blue flycatcher (*Eumyias sordida*).

Endemic Butterfly Species: Ceylon Tiger (*Parantica taprobana*), Ceylon Lesser Albatross (*Appias paulina*) and Lesser Albatross (*Appias galena*), Ceylon Hedge Blue (*Lycaenopsis lanka*).

Endemic Reptile Species: Kagamuwa angkatussa/ Rhino horned lizard (*Ceratophora stoddartii*), RathKarawala/Black-spined snake (*Haplocer cusceylonensis*), Kandyan daygecko (*Cnemaspis kandiana*), Flowery daygecko (*Cnemaspis latha*), Dwarf day gecko/ Podi gal huna (*Cnemaspis podihuna*), Spotted skink / Pulli Hikandala (*Eutropis madaraszi*), Blyth's shield tail/ Gomara thudulla (*Rhinophis blythii*)

Endemic Amphibian species: Dikhombu gas madiya (*Polypedates linginasus*), Mullerge panduru mediya (*Philautus sarasinorum*), Tanbawan diyam ediya (*Rana temporalis*), Keerthisingha gediya media (*Fejervarya kirtisinghei*), Kadukara gas media (*Polypedates eques*), Golden eyed Shrub Frog (*Philautus ocularis*), Knuckles shrub frog (*Philautus fulvus*)

Total number of floral and faunal species found in project area and their conservation status is as follows:

Table 15: Total number of floral and faunal species found in project area

Species	Total Number Recorded	Number of Endemic Species	CR	EN	VU	NT
Tree Species	63	24		14	15	8
Shrub Species	50	9		7	2	3
Herb Species	45	2		3	5	7
Vine Species	27	5		5	5	2
Bird Species	59	7	1	6	4	5
Mammal Species	16	2		4	1	3
Reptile Species	14	9	1	4	2	
Amphibian Species	9	7	2	3	2	1
Insect Species	59	4		8	8	5
Fern Species	10					
Total	352	69	4	54	44	34

It should be noted that the list of different species presented in the above table consists only of species found within the boundaries of the Finlay's and Agarapatana Plantations which is RA certified. The natural forests, forest plantations, grasslands and watershed areas outside the above plantations were not covered in this assessment. Therefore, the biodiversity in the study area may be higher than the numbers in the above section on "Biological diversity".

7.9. Ethno botanical uses

Badulla District is well known as a district where there are traditional healing methods called *Deshiya Chikitsa* which are considered as the earliest known system of medicine that existed in Sri Lanka before the advent of Ayurveda³⁸. It is said that this traditional medicinal system is more than 5,000 years old. There are families who practice this system at present and have continued to transfer their knowledge from generation to generation. They use local herb species available in forests and cultivated in forest gardens and one of the main problems they face at present is the lack of herb species as a result of diminishing forest cover and degrading home gardens. An interview with one such traditional healer was carried out and he mentioned that they have to import a majority of these medicinal species from other countries (India). These are species that were found in abundance in mid and up country forest areas in the past. As there have been no in-depth research on this subject, it is recommended that a research on ethno botanical uses of herb and other plant species in the project area be carried out.

7.10. Human wildlife conflict

Although, clear statistics are not available, it is reported that human-wildlife conflict is very present in the study area. Elephants, bumble bees, monkeys, wild boar and porcupines are the prominent wildlife species that damage crops. Wild boar, sambur, barking deer, porcupine and black-naped hare are threatened by human activities.

³⁸<http://instituteofayurveda.org/english/history.htm>

8. Water resources

8.1. Ground Water

Geologists have recognized that the potential for presence of groundwater in the hard rock region of the study area is limited because of low groundwater storage capacity and transmissivity of the underlying crystalline basement - hard rock. It is also recognized that there is no continuous body of groundwater with a single water table in these metamorphic rocks, but rather separate pockets of groundwater. The deeper fracture zone occurs at depths of around or beyond 30 to 40m in this hard-metamorphic rock region, and groundwater in this fracture zone is referred to as the deep fracture zone aquifer³⁹. The ground water depth in Bandarawela has been recorded as 25 meters and Badulla has been recorded 10 to 20 meters (in dry Season)⁴⁰. The shallow open dug wells that are distributed across the study area made in metamorphic and hard rock regions have provided basic drinking and domestic water supplies to the inhabitants. No evidence or records are found from the study area on the exploitation of deep ground water.

However, due to the Uma Oya river diversion project, it is noted that aquifers have been damaged and ground water levels have reduced significantly.

8.2. Surface Water

The study area is the starting point of a number of streams which ultimately feed into rivers as Uma Oya, Kirindi Oya, Menik Ganga, Kuda Oya, Badulu Oya, Ellatotakanda Oya and Diyaluma Oya. Diyaluma Oya starts from the Haputale DS Division. Watersheds in the eastern part of the highlands are located in the study area and water springs can be seen throughout the area especially within forests, tea plantations and grass lands and most of them are perennial.

In addition, several minor irrigation tanks also located within the project area, including upper Makulella tank, lower Makulella tank, Egodagama tank, Bora wewa (tank) and Pitaratmale tank.

Adequate studies have not been conducted on surface water availability in the Badulla District and therefore it is difficult to gather data on water flow, water quality, demand for water and water stress etc. for this area.

Issues:

- Springs in the watershed areas have been tapped by people for vegetable cultivations and domestic use by connecting pipelines to these springs. The common resource is used by the people as a privately-owned resource. As a result, irrigation water for paddy and downstream irrigation schemes, vegetable cultivations, drinking water distribution schemes and other uses are reduced. Most notably, as a result, water for aquatic ecosystems will be reduced and biodiversity, especially aquatic biodiversity will be affected. This problem is severe during the drought period.
- Watershed areas have been encroached by people who have constructed permanent houses and some areas have been converted into other uses as tea and vegetable cultivations. This has resulted in loss of the protective natural vegetation around water sources.

³⁹ C.R. Panabokke et al 2005, Ground water resources in Sri Lanka, Water Resources Board, 2A, Gregory's Avenue, Colombo 07

⁴⁰ The ground water depth has been recorded when the tube wells are dug by the National Water Supply and Drainage Board. The figures were obtained by personal communications.

- Excessive use of pesticides, weedicides and chemical fertilizers affect the quality of water in the project area.
- Dumping of waste into rivers and streams and diversion of sewage lines is a serious issue in the project area. In some places, toilets and waste water is being discharged directly into rivers visibly (i.e. into the Badulu Oya)
- Different infrastructure development activities are being carried out in the project area including road development, setting up pipe borne drinking water supplies, construction of playgrounds and buildings etc. These activities generate considerable amounts of debris and further soil are also dumped into rivers, streams and watershed areas. The ultimate result is water quality deterioration, siltation of river beds and downstream reservoirs.
- Mini hydropower plants operating in the area have been constructed by arresting the water flow and diverting water to a turbine using pipelines or channels. This reduces the flow of water to downstream users.

9. Mineral resources

Sand mining, metal quarries and clay mining are carried out within the study area. Licenses have been issued by the Central Environmental Authority (CEA) and Geological Survey and Mines Bureau (GSMB). The study area in Ella has 11 licensed quarries, 23 sand mining locations in Gawarawela Oya and Badulu Oya. In Haputale, one sand mining location has been reported in Maha Oya at Welanhinna GN Division. In the Bandarawela study area, no sand mining activities are reported but 9 metal quarries are functioning in Liyangahawela GN Division. In Hali-Ela study area 13 sand mining locations have been reported in Mugunumatha, Athuduawela, Hapuwalakumbura, Dokwella and Uduwara GN Divisions along the Badulu Oya and 7 metal quarries in Samagipura, Hapuwala Kumbura, Wewelhinna GN Divisions. In addition, clay mining in Uduwara for roofing tiles and the clay pot industry have also been reported. Furthermore, illegal gem mining is also reported and about 6.63 hectares have been damaged in Bobuhinna in the Horadorowa GN Division and Siddiarawa in the Welanhinna GN Division and Glenanore in the Haputale project area.

Since the study area is located within a fragile area of the highlands with high risk of landslides and higher rate of soil erosion, sand mining and metal quarries can have a negative impact on people living in the area. The community in the study area reported that sand mining and metal crushing have created a number of social and environmental issues. Some studies report that large-scale sand mining in the Badulla District has eroded river banks and affected the stability of bridges⁴¹. The following issues related to mining and the quarry industry were reported by communities and government officials in the study area:

- River and stream banks have been damaged and are eroding due to extensive mining of sand and have led to the destabilization of bridges.
- Rivers and natural water streams have been deepened and as a result farmers who used to get water from rivers and streams for farming are facing difficulties when getting irrigation water using gravity, and instead they have to use motors to pump water from streams and rivers.

⁴¹Natural Resources of Sri Lanka Conditions and Trends 1991

- Sedimentation of downstream water bodies and land and the stream flow has been changed (rapid upped).
- Aquatic ecosystems have been destroyed leading to negative effects on aquatic biodiversity.
- As a result of regular blasting of rocks, top soil has become destabilized within the project area leading to landslides during rainy seasons.
- Houses and roads located near quarries have been damaged and a number of incidences leading to injuries to people living near quarries have been reported.
- A majority of quarries are located in mountainous areas, and land on the other side of the mountain have been affected and there are reports of forest plantations been damaged.
- It was reported that these quarries carry out high power blasts, using more than the recommended quota of explosives required to break a unit measure of rock and this has resulted in high levels of vibrations leading to cracks appearing on walls and floors of houses and roads etc.
- Earth removed from metal quarries are dumped into water ways.
- Poor enforcement of existing laws by responsible authorities.

10. Social Setting

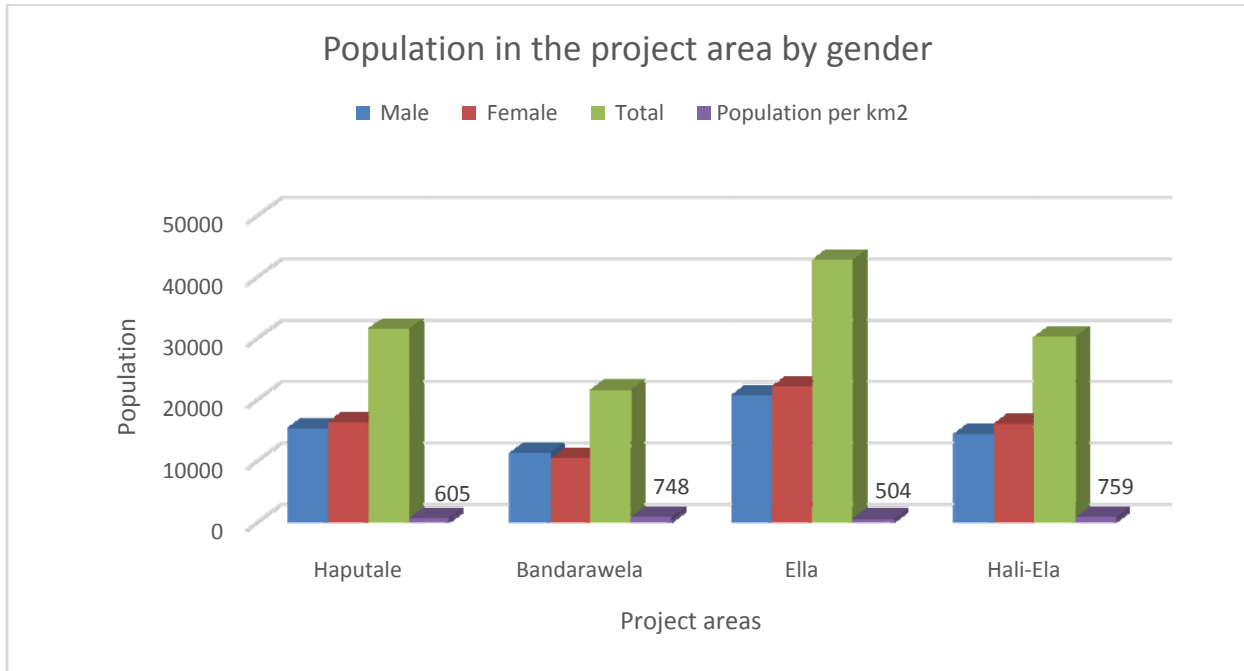
Sri Lanka has the highest Human Development Index in the South Asia region which is 0.75 (in 2013), and literacy rate for males at 96.8% and females at 94.6% (in 2012). According to the income and expenditure survey in 2012/2013 carried out by the Department of Census and Statistics, the Poverty Headcount Index (PHI) in the Uva Province is estimated at 15.4%, poor household's percentage at 13.5%, Poverty Gap Index (PGI) 2.6% and the number of poor households was 1,783 which is the highest among the nine provinces in Sri Lanka⁴².

10.1. Population and Demographic Patterns

Badulla District area is 2,818.17 km², and the population density per km² in 1953 was 56, in 1988 it was 244 and in 2015 it is 299 per km². The total population in the study area is 126,227 and population per km² is 612.8. When compared to the district figure, population density in the study areas is nearly twice the amount. Hali-Ela has the highest per km² population which is 758.7 while the lowest recorded in the study area at Ella DSD is 503.5km².

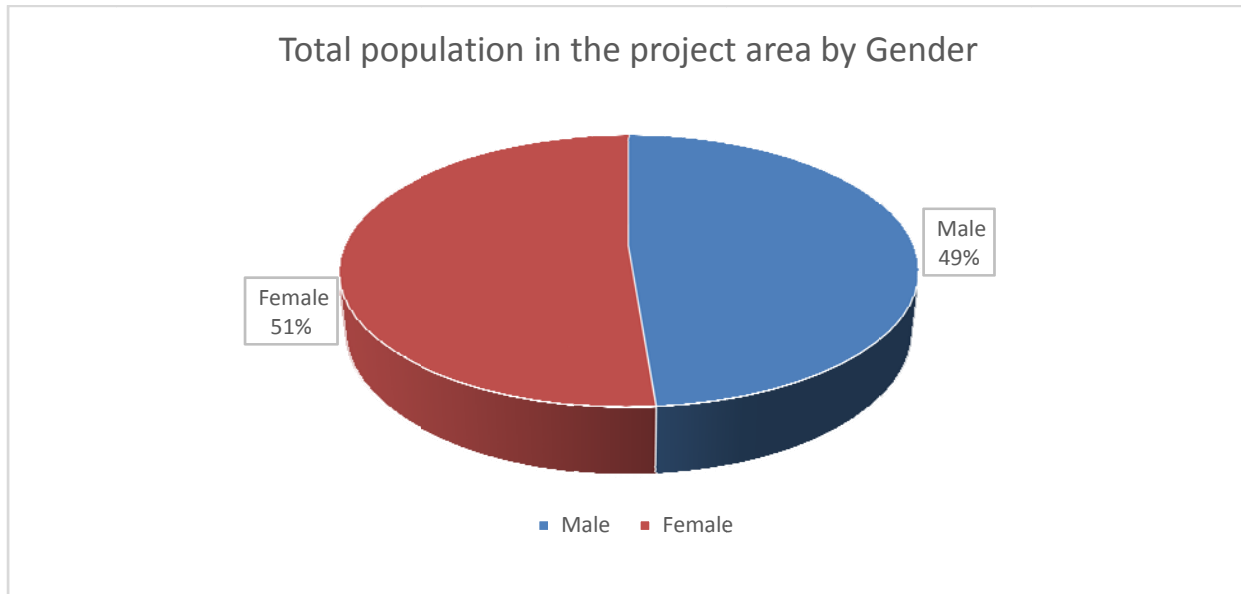
⁴²Census and Statistics 2012/13, Household Income and Expenditure Survey Series, Department of Census and Statistics

Figure 4: Population of the project area by sex and per square km



Source: Resource Profiles Haputale, Ella, Hali-Ela 2015 and Bandarawela 2016

Figure 5: Total population in the project area by gender



10.2. Ethnic composition

The table below presents the disaggregation of population in the study area based on ethnicity. About 60.7% of the population in the study area in Haputale is Tamil and 30.7% is Sinhalese. In other three DSDs the majority is Sinhalese and as a total 57% are Sinhalese, 36.8% Tamil, 5% Muslim and the rest constitutes to 0.85%.

Figure 6: Population in the project area by ethnicity

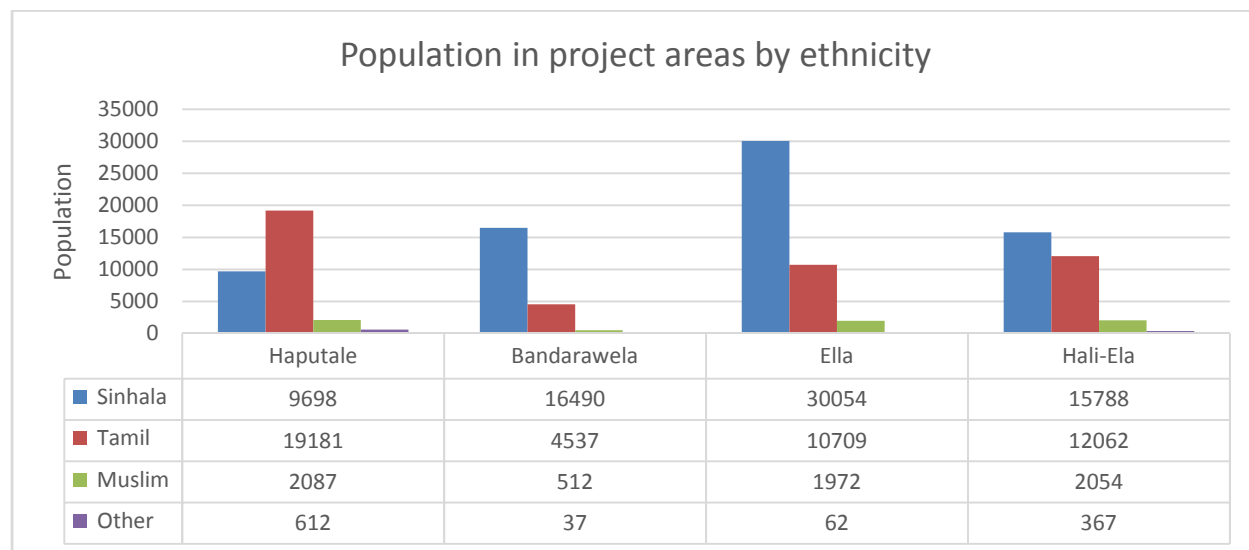
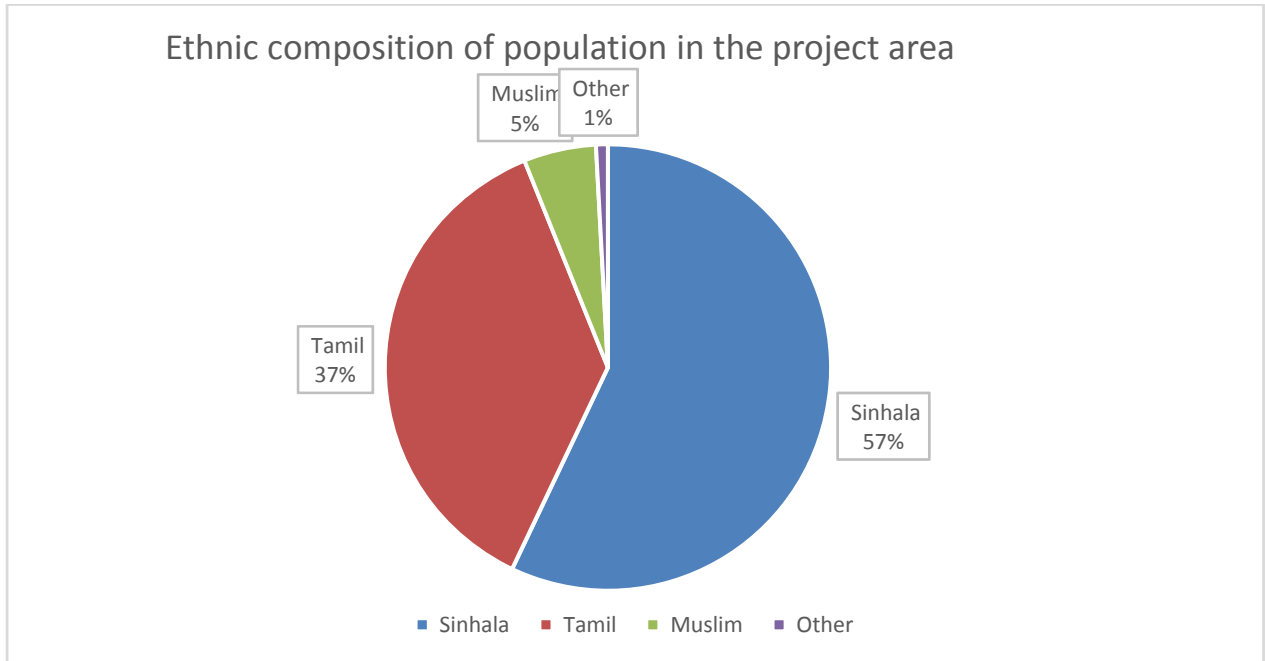


Table 16: Population of the Project Area by Ethnicity

Study Area	Sinhala	Tamil	Muslim	Other	Total
Haputale	9,698	19,181	2,087	612	31,578
Bandarawela	16,490	4,537	512	37	21,581
Ella	30,054	10,709	1,972	62	42,797
Hali-Ela	15,788	12,062	2,054	367	30,271
Total	72,030	46,489	6,625	1,078	126,227

Source: Resource Profiles Haputale, Ella, Hali-Ela 2015 and Bandarawela 2016

Figure 7: Ethnic composition of the population in the project area



Source: Resource Profiles Haputale, Ella, Hali-Ela 2015 and Bandarawela 2016

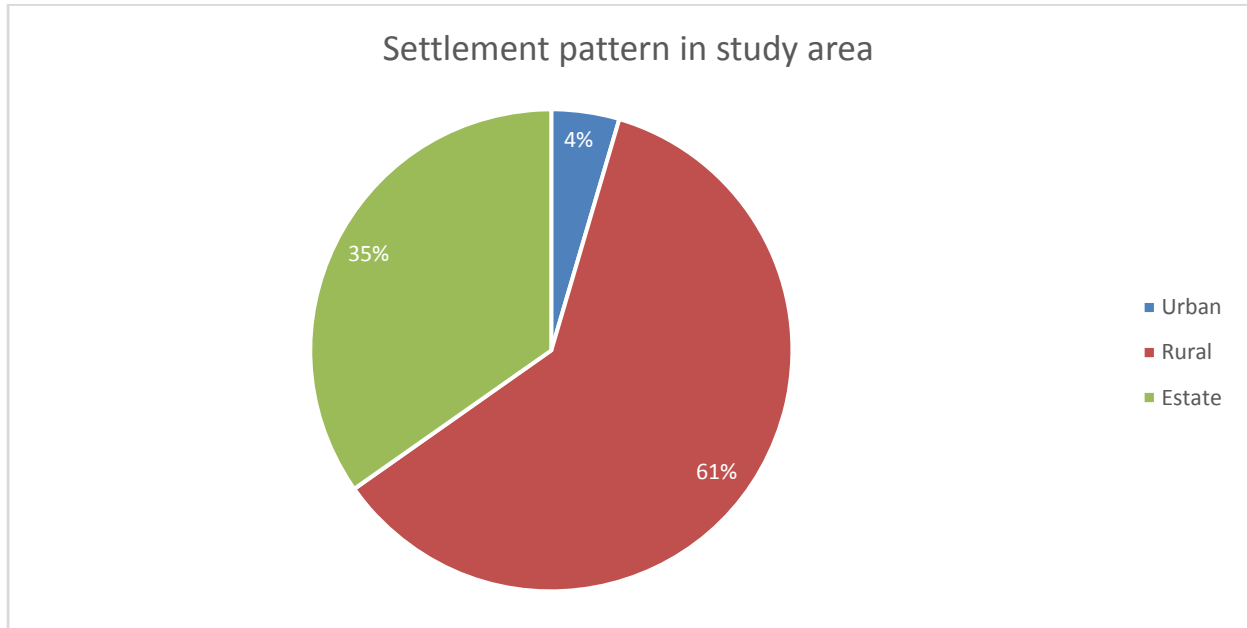
10.3. Settlement Patterns

Settlement patterns can be classified based on the location of settlements as Urban, Rural and Estate. The urban population is settled and confined to areas administered by local government bodies, i.e. Urban Councils, while the rural population are people who have settled in villages under the administration of local government bodies known as *Pradeshiya Sabha* and estate population is settled within plantations. The Table below presents the settlement pattern of the population in the study areas.

Table 17: Settlement Pattern in the Study Area

Study Area	Urban	Rural	Estate
Haputale	3,395	7,618	17,252
Bandarawela	1,391	16,006	3,453
Ella	428	28,756	9,421
Hali-Ela	-	17,117	9,667
Total	5,214	69,497	39,793

Figure 8: Settlement pattern in the project area



10.4. Households by Tenure

Table 18: Households by tenure

Study Area	Total	Owned by a household member	Rent/Lease-Government owned	Rent/Lease-Privately owned	Rent free occupied	Encroached	Other
Haputale	7,185	3,272	163	257	3,377	75	41
Bandarawela	5,228	3,932	42	221	906	60	67
Ella	10,030	7,299	339	478	1,689	129	96
Hali-Ela	6,999	3,902	81	210	2,092	660	54
Total	29,442	18,405	625	1,166	8,064	924	258

According to the Department of Census and Statistics, in 2015 there were 29,442 households within the project area and out of that 62.51% households were owned by the household members themselves, 2% lived in rented, leased or houses owned by the government, 3.9% lived in rented or leased houses which are privately owned, 27.3% occupied houses which are rent free and 924 households, which is about 3%, live in houses which have been built on lands encroached by them.

10.5. Housing (quality and Materials)

Table 19: Housing units by principal material used to construct the floor

Study Area	Total	Cement	Tile/Granite /Terrazzo	Mud	Wood	Sand	Concrete	Other
Haputale	7,019	5,792	217	874	7	9	112	8
Bandarawela	5,117	4,075	300	536	1	10	144	51
Ella	9,858	7,513	510	1,365	10	5	280	175
Hali-Ela	6,857	5,416	360	744	5	14	199	119
Total	28,851	22,796	1,387	3,519	23	38	735	353

Table 20: Housing units by principal material used in the construction of the roof

Study Area	Total	Tile	Asbestos	Concrete	Zink Aluminum sheet	Metal sheet	Cadjan/ Palmyrah/ Straw	Other
Haputale	7,019	572	1,969	235	253	3,960	11	19
Bandarawela	5,117	1,332	2,318	134	58	1,269	3	3
Ella	9,858	2,626	3,802	303	110	3,000	9	8
Hali-Ela	6,857	730	3,353	158	55	2,546	10	5
Total	28,851	5,260	11,442	830	476	10,775	33	35

Table 21: Housing units by principal material used in the construction of walls

Study Area	Total	Brick	Cement block/Stone	Cabook	Soil bricks	Mud	Cadjan/ Palmyrah	Plank/ Metal Sheet	Other
Haputale	7,019	662	4,940	286	971	109	4	33	14
Bandarawela	5,117	1,739	1,942	153	1,180	79	1	18	5
Ella	9,858	2,841	3,407	371	2,995	179	1	31	33
Hali-Ela	6,857	2,002	3,163	99	1,507	54	3	12	17
Total	28,851	7,244	13,452	909	6,653	421	9	94	69

It should be noted that conditions of housing units occupied by estate workers (labourers) in a majority of large tea estates is very poor. They are called Line Room Housing, which are a group of rooms connected together in one line and are over 80 years old in most places in the study area. They are poorly ventilated with limited space. According to the Plantation Housing and Social Welfare Trust, one of the most common issues faced by the estate sector are overcrowded line rooms, leaking roofs, lack of light and ventilation, weakened structures, inadequate sanitary facilities and kitchens without chimneys to let the smoke out⁴³. In some plantations, several generations of the same family live in one housing

⁴³PHSWT, 1999 Social Welfare Programme-ii 1993-1998, Completion Report, Colombo:Plantation Housing and Social Welfare Trust.

unit which has resulted in economic, social and cultural issues. Housing programmes to uplift living condition by giving individual housing units to estate workers are being implemented by the government and by some plantation companies. However, progress is slow. Another issue identified relating to housing schemes for plantation workers is that new housing units are constructed on marginal lands within plantations. It was observed that steep land has been allocated for some housing projects and these can lead to issues of disposing waste water and sewage management, soil erosion as well as the threat of landslides in the future.

In 2015, the government proposed to grant 7perch blocks of land for each family living in the plantation sector to build a house, but this programme is still in its initial stages.

Issues:

- The condition of a majority of houses of plantation communities living in the project area is of a very low standard.
- Limited land availability to expand settlements within tea plantations as well as in other areas outside the plantations due to its mountainous geography, susceptibility to landslides and location of large tea plantations.
- Inadequate investment by the government and plantation companies to improve housing conditions in the plantation sector.
- Lack of guidelines on the construction of housing units and other buildings in fragile areas in the central hills with limited land to expand settlements. A majority of housing units built are still single story housing units. There is perception that one family needs one single housing unit.
- Most estates workers are settled on land that belongs to the estates. However, they believe that the houses belong to them, despite not having proper legal documentation to prove this claim of ownership.

10.6. Energy (including lighting)

Sources of energy used by the housing units in the study area are good indicator to measure the pressure on natural resources, specially forest resources in the area and to identify possible impacts on health of the communities. The table below presents the number of housing units by principal type of cooking fuel used within the project area in 2015. According to this date, out of 29,442 households, 27,088 households which is 92% of the total, use firewood as a source of fuel for cooking, and the remaining 8% (housing units) use LP gas, kerosene and electricity for the same purpose. Almost 100% of the demand for firewood in housing units are met by using resources available in the surrounding areas. Main sources of fuel wood in the area are branches of tea bushes and trees that provide shade, collected during the pruning of tea, firewood collected from home gardens, fuel wood collected from natural forests and forest plantations.

Plant species used as fuel wood and found in tea lands are, *Gliricidiasepium*, *Erythrina lithosperma*, *Grevillea robusta*, *Calliandraca lothrysus*, *Swietenia mahogany*, *Micheliachampaca*, *Eucaliptasspp.* and *Toonasinensis*⁴⁴

⁴⁴Plaihakkaraet.al. 2015, Prospect of Fuelwood Plantations for Marginal Small Tea Farmers: A Case

Table 22: Housing units by principal type of cooking fuel

Study Area	Total	Fuelwood	Kerosene	Gas	Electricity	Saw dust/ Paddy husk	Other
Haputale	7,185	6,526	47	591	14	4	3
Bandarawela	5,228	4,847	19	351	8	1	2
Ella	10,030	9,320	32	647	22	2	7
Hali-Ela	6,999	6,395	26	563	9	1	5
Total	29,442	27,088	124	2,152	53	8	17

In 2015, according to the Department of Census and Statistics, around 91.4% of housing units in the project area are connected to the national electricity network and meet their energy requirement for lighting, and about 8.4% of housing units use kerosene for lighting and only 0.06% housing units use sustainable and environmentally friendly energy sources as solar and bio-gas.

Table 23: Households by principal type of lighting

Study Area	Total	Electricity- National Electricity Network	Electricity- Rural Hydro Electricity Projects	Kerosene	Solar power	Bio Gas	Other
Haputale	7,185	6,561	-	20	-	-	4
Bandarawela	5,228	4,901	-	317	4	2	4
Ella	10,030	9,177	-	834	9	-	10
Hali-Ela	6,999	6,280	-	714	3	-	2
Total	29,442	26,919	-	2,485	16	2	20

Around 92% of the housing units in the study area use firewood for cooking and electricity for lighting of housing units. Use of firewood is not a sustainable source of energy, because it affects forest ecosystems and health conditions negatively as it reduces the quality of forests due to exploitation and affects the lives of people living within these housing units through (indoor) air pollution.

Issues:

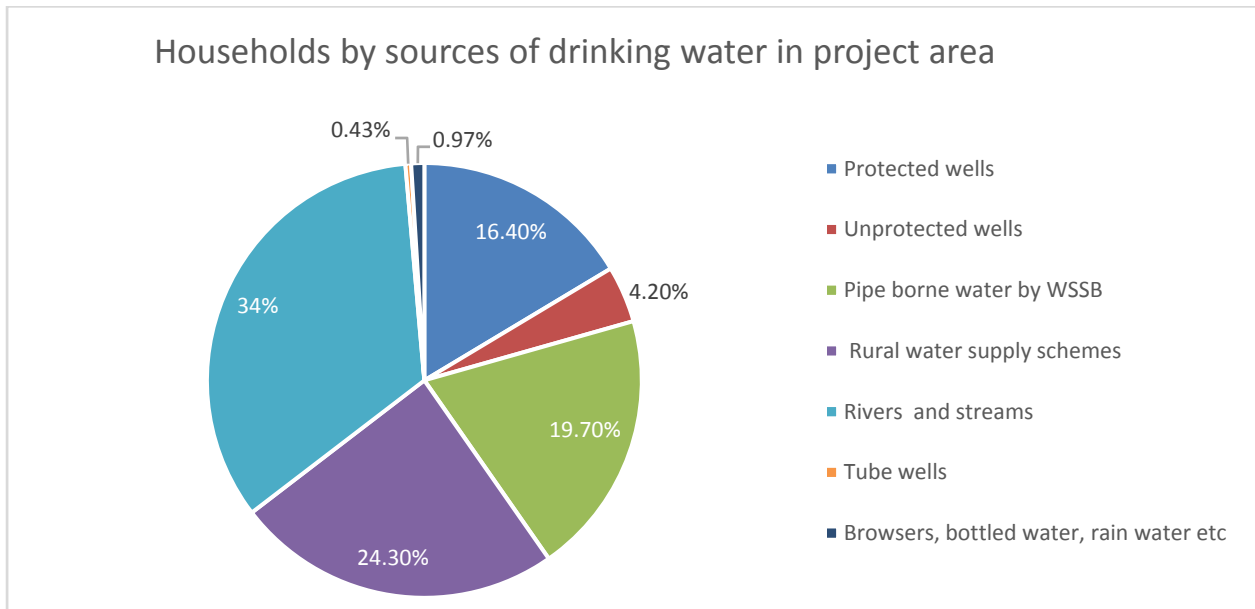
- Indoor air pollution leading to respiratory illnesses.
- Use of traditional stoves which are not energy efficient.
- Lack of programmes to introduce sustainable energy sources in housing units for cooking and lighting.

10.7. Drinking Water

There are several sources of water as dug wells, pipe borne water supplied by the Water Supply and Sanitation Board or the local government/rural water supply projects managed by local civil

society/community based organizations and/or tube wells, rivers, tanks and streams, rainwater harvesting, distributed through bowsers and bottled water etc. carried out by the local government authority for domestic uses as cooking, washing and bathing. According to the data available at the Department of Census and Statistics, in 2015, 16.4% of housing units used protected wells, 4.2% used unprotected wells, 19.7% used pipe borne water supplied by the Water Supply and Sanitation Board, 24.3% used water from rural water supply schemes, 34% obtained water from rivers, tanks and streams, and only 0.43% used tube wells. It is a fact that water supplies in the dry period is limited and difficult to meet, but alternative water collection as rain water harvesting is possible during the rainy seasons. It should be noted that despite the high potential to harvest rainwater for domestic use, only 0.06% use rain water harvesting to meet the requirement.

Figure 9: Households by sources of drinking water in project area



Issues:

- No data is available on the quality of water at different sources, except on the supply of water by the Water Supply and Sanitation Board. Since the project area is under extensive agriculture excessive amounts of chemical fertilizers, pesticides, weedicides and organic fertilizers are used and runoff is high with heavy rainfall, it can be assumed that water quality must be below the recommended levels.
- Water shortage is a serious problem during the drought period, and this situation is exacerbated by the Uma Oya river diversion project and mini hydropower projects operating in the project area.
- Wastage of water is high as water is provided at subsidized rates or at no cost.
- Lack of programmes to promote sustainable harvesting methods as rainwater harvesting and economical and efficient use of pipe borne water supplied by the Water Supply and Sanitation Board and rural water supply schemes.
- Dumping of waste and poor waste management, especially in municipal council controlled areas and estate sector has resulted in the contamination of water sources within the project area.

10.8. Health and Sanitation

Nearly 98.3% of households in occupied housing units have a toilet which are varied in type and include water seal, pour flush or direct pit. Around 0.64% of households do not have toilet facilities at all. It is estimated that 91% of households in the project area use water seal type toilets. The corresponding percentages for pour flush and pit types are 6.6% and 1.4% respectively. Majority of households which do not use toilets are located in the estate sector.

Table 24: Households by type of toilet

Study Area	Total	Water sealed and connected to a septic tank	Water sealed and connected to a piped sewer system	Pour flush toilet (Not water sealed)	Direct pit	Other	Not using a toilet
Haputale	7,185	5,890	420	624	154	2	95
Bandarawela	5,228	4,757	65	349	45	1	11
Ella	10,030	8,218	854	728	171	4	55
Hali-Ela	6,999	6,322	331	260	54	2	30
Total	29,442	25,187	1,670	1,961	424	9	191

10.9. Poverty Status

The Badulla District has been identified as one of the districts with a higher poverty level. According to data available at the Department of Census and Statistics in 2012-2013, around 10.4% of the total population in the District lived below the poverty line. In 2002, this was at 31.5% and shows a reduction in poverty over the years. The Department of Census and Statistics releases monthly official poverty line Minimum Expenditure per person per month to fulfill the basic needs for all the districts in Sri Lanka and in 2016 December Badulla District's official poverty line was Rs.3,959, whereas the national average is Rs. 4,130⁴⁵.

There is no data on the status of poverty in the project area, but the government provides a monthly subsidy "Samurdhi" for selected poor households in each GN Division. The monthly subsidy values varies from Rs.420 to Rs.3,500 per month per household. In the GEF-Tea project area, there are around 847 households in Haputale, 1099 in Hali-Ela, 3457 in Ella and 1586 Bandarawela who receive the "Samurdhi" subsidy. Using this information to estimate the percentage of poor households in the project area he see that 11.7% of households in Haputale project area, 30.3% of households in Bandarawela project area, 15.7% of households in Hali-Ela project area and 34.14% households in Ella project area can be identified as living below the poverty line.

The estate community receives non-monetary benefits such as free housing, free health care, child care and some other facilities from estate management which are difficult to quantify and are of relatively low quality. The common wage structure in the plantation sector enables a relatively uniform income

⁴⁵http://statistics.gov.lk/poverty/monthly_poverty/index.htm

pattern. Expenditure patterns among estate sector workers highlight that 50 % of their income is utilized for food, the highest in the country. This is a clear indication of the low socio-economic conditions prevailing in the estate sector when compared to rest of the country.

10.10. Employment and unemployment

The table below presents the employment and unemployment status of the GEF-Tea project area. The private sector, employs the highest number at 12,236 individuals which is 24 % of total employed in the project area. The second highest employment is in the agriculture and livestock sector, totaling to 10,390 persons which amounts to 20.4%. As a single sector, the third highest employment is in the government sector totaling to 15.6%. Around 11.5% of the employed population work as labourers while 5.1%, 4.9% and 2.1% are self-employed, in the security forces and work in foreign employment respectively. The “Other” sector represents areas which are not individually covered in the table as the services sector etc. Around 10,078 persons or 16.5% of the total workforce in the project area come under the “Other” category. There are limitations in data categorizations as the different DSDs are not homogeneous and unemployed population of the economically active workforce is not estimated in Ella DSD.

Table 25: Sector wise employment and unemployment status of the project area

Sector	Haputale	%	Bandarawela	%	Ella	%	Hali-Ela	%	Total	%
Government sector	1,209	8.6	1,550	17.5	2,515	14.2	2,651	25.5	7,925	15.6
Private sector	4,293	30.7	2,376	26.8	2,725	15.4	2,842	27.3	12,236	24.0
Security forces	449	3.2			578	3.3	1,460	14.0	2,487	4.9
Self-employment	552	3.9	643	7.3	1,404	7.9			2,599	5.1
Foreign employment	525	3.8	366	4.1			473	4.5	1,364	2.7
Labor	1,924	13.8	1,338	15.1	2,581	14.6			5,843	11.5
Agriculture & Livestock	1,584	11.3	1,228	13.9	5,115	28.9	2,463	23.7	10,390	20.4
Other	3,456	24.7	1,349	15.2	2,785	15.7	521	5.0	8,111	15.9
									50,955	100.0
Unemployed	5,581	28.5	1,845	17.3	-	-	2,652	20.3	10,078	16.5

11. Tourism, Trade and Industry

Haputale, Bandarawela, Ella and Hali-Ela are all naturally scenic locations with a mild climate creating ideal conditions for the tourism industry to thrive. In Haputale, Bandarawela and Ella there are facilities for tourists as hotels, guest houses and restaurants. But, these three tourism hubs are not final destinations and work as a transit point for tourists who wish to travel to other areas as the South (Yala, Kataragama, Matara etc.,) or the Central part of the country (Nuwara Eliya and Kandy). There is a great potential to develop tourism in the GEF-Tea project area where the scenic Lipton’s Seat is located and the Horton Plains National Park is nearby.

In the project area, there are several places of historical importance, including religious sites and other archaeologically/ culturally/ environmentally important locations. They include several ancient temples in Dova, Rawana Ella, Heeloya, Viharatenna, the Ravanacave, Paththini Kovil in Halpe, Halpe Tea Factory, Kurullangalapre-historic cave paintings, RawanaElla waterfall, Black pool in Namunukula, Uduwara Tea Factory, Demodara railway track, Demodara Nine Arch bridge, Adisham Bungalow, Lipton's Seat, Dambatenna Tea Factory, Pitaratmale large tea bush, Dambatenna tunnel, Welanhinna Fort, Thotalagala cave, Thangamalai Bird Sanctuary are some of them. However, there are limitations to tourism development as the study area is also located within an ecologically fragile area.

A research carried out by N. Fernando concludes that Haputale, Bandarawela and Ella areas attract tourists but they seldom consider it their final destination⁴⁶. They use this area as a transit point on their journey to Kataragama, Yala National Park and down south beaches, despite the natural beauty, salubrious climate, culture, historical and archeological sites. The same research highlighted, based on data analysis, that inadequate facilities as accommodation, food, sanitary and transportation facilities, places of interest being hidden or unknown and lack of information on these locations from the Sri Lanka Tourist Board have resulted in these areas being overlooked and promoted as tourist destinations.

12. Public transport and Road Network

Main roads as the A04 highway via Colombo - Ratnapura - Wellawaya -Baticaloa, A05 highway via Peradeniya - Badulla - Chenkaladi and A16 highway via Beragala - Hali-Ela pass through the GEF-Tea project area and around 13 km of the A04 highway pass through the entire project area. Condition of main roads in A, B, and C categories have significantly improved during the last seven years. However, there has been little or no investment to develop the road network inside plantations managed by RPCs and roads on rural and hilly areas where a lot of tea smallholdings are located. It was reported that transport facilities/ services are also scant to areas where the RPCs and smallholdings are located. Almost all the TSHDS have raised the issue of poor road conditions and transport facilities and the negative impact it has on their lives and livelihoods.

13. Waste generation and management

The table below presents the methods of waste management used by the households in the project area. About 6.4% of household waste is collected by the local authorities, 34.6% of households burn their household waste, 31.7% bury their households waste, 20% compost their waste and around 4% of households dispose waste in an unsustainable manner including dumping waste on roadsides, in rivers, canals and forests etc. It was clear that waste management in municipal council controlled areas and plantation sector is a serious issue.

⁴⁶Imali N. Fernando..... Promote Uva as a remarkable tourist destination: with special reference to Badulla district, Sri Lanka.

Figure 10: Households by principal method of waste disposal in project area

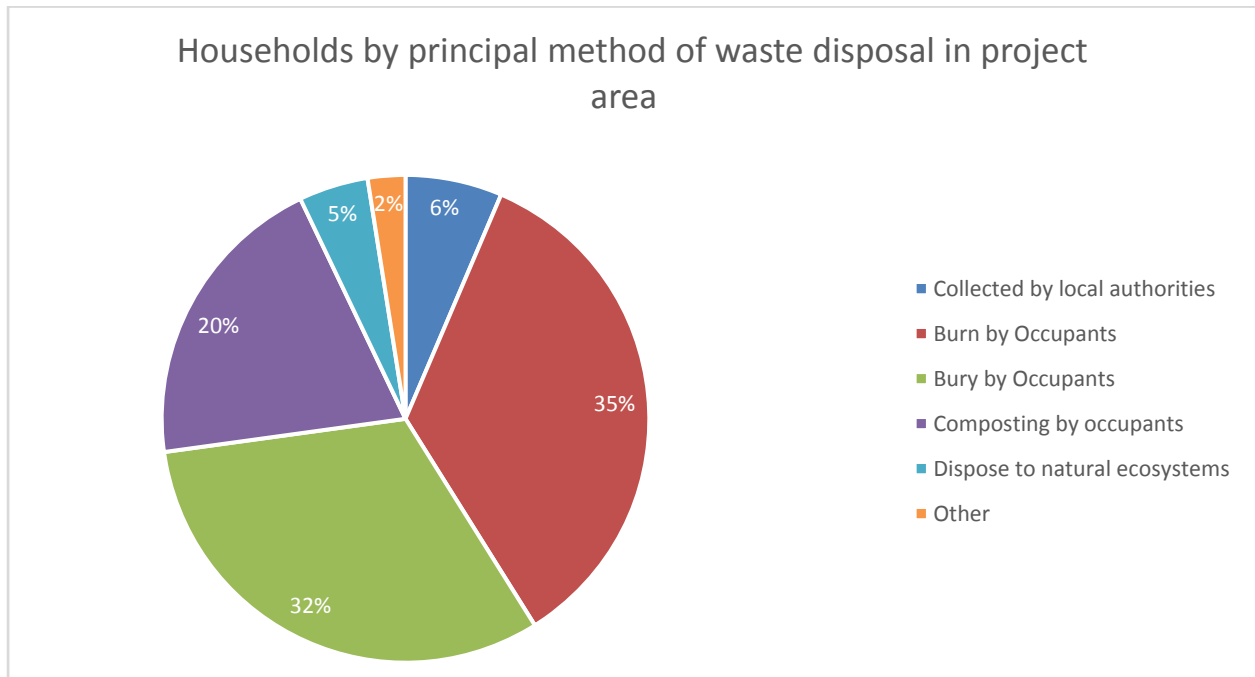


Table 26: Households by principal method of waste disposal

Study Area	Total	Collected by local authorities	Burn by Occupants	Bury by Occupants	Composting by occupants	Dispose by Occupants into Road/River/Canal/Sea/Creek/Forest etc	Other
Haputale	7,185	693	2,525	1,498	1,313	735	421
Bandarawela	5,228	48	1,710	2,307	955	129	79
Ella	10,030	503	3,597	3,565	2,202	22	141
Hali-Ela	6,999	645	2,377	1,972	1,441	470	94
Total	29,442	1,889	10,209	9,342	5,911	1,356	735

In the Haputale Urban Council area, where around 1MT of waste is generated daily, there is an open waste dumping site as well as recycling facilities. In Ella DS Division, a waste management centre was established in Kithal Ella. Here too, around 1 MT of waste is collected daily from its local government administered areas. In the Bandarawela Urban Council area, around 10 MTs of waste is generated and some of it is recycled using its waste recycling facility. In the Hali-Ela local government area around 9MTs of waste is generated daily and a recycling facility is available to recycle some of them.

Issues related to waste management:

- Poor waste management in the project area is easily recognizable as there are piles of accumulated waste in public areas/ lands.
- Waste dumping and diversion of waste water into the rivers and streams is a serious issue in the project area.
- Waste management in the plantation sector is very poor (except in RA certified plantations) and in estates where the waste is collected, they do not have facilities to transport them to recycling centers or dispose of them in a sustainable manner.
- Lack of/ low awareness among people on the negative socio, environmental and health impacts of poor waste management/ disposal.
- Lack of interest to segregate waste before they are collected. People often do not follow instructions given by local government authorities on proper segregation of waste as there is no mechanism for punishment/ or fine households that fail to segregate.

14. Commercial Agriculture/Plantations

Tea is the main commercial agricultural crop cultivated in the project area and in addition, minor export crops as pepper, coffee and cinnamon is also grown by farmers on a small scale. The project area is popular for vegetable cultivations and large areas of land are under vegetable cultivations.

14.1. Large tea plantations

Within the boundaries of the GEF-Tea project landscape there are 17 large plantations managed by 3 Regional Plantation Companies (RPCs). Agarapatana Plantations Ltd manages 8 estates, Maskeliya Plantations Ltd manage 4 estates and Finlays Plantations Ltd manages 7 large plantations. Total area under these large plantations is around 11,242 hectares and the total production area is around 5,784 hectares which is around 51.4% of the total land area managed by the three plantation companies. The table below shows the land use patterns in the 17 large plantations located within the project landscape.

Map 12. Large tea plantations within the project landscape

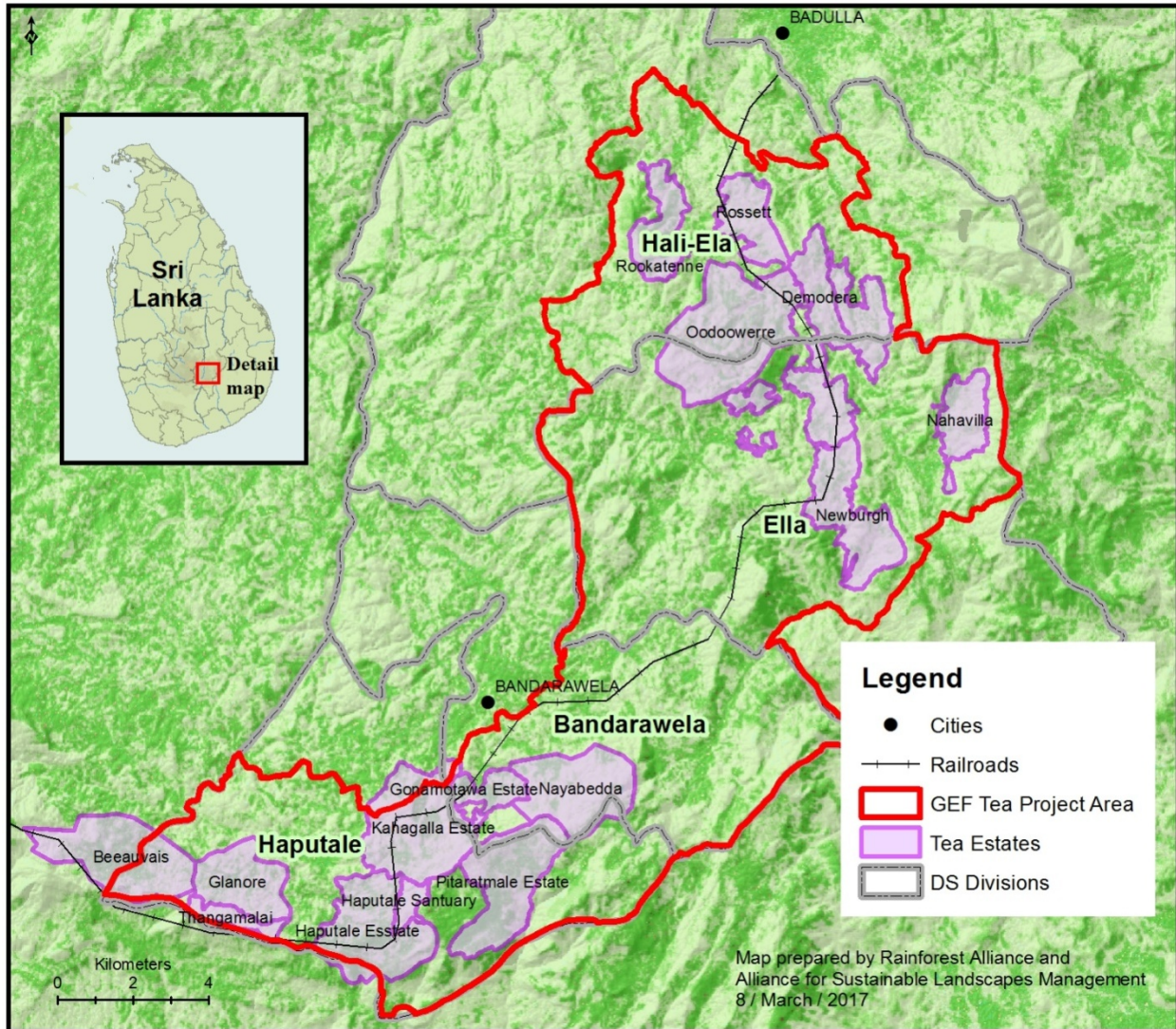


Table 27: Land use patterns in large tea plantations

Name of the farm	Size of the farm (ha)	Total Production Area (ha)	Protected areas (ha)	Other Conservation areas (Ha)	Watershed reserves (ha)	Timber Plantations (ha)	Infrastructure (ha)
Agarapatana Plantations Ltd							
Nayabedda	498.70	415.18	-	-	-	44.12	47.93
Gonamotawa	267.00	194.22	8.00	2.00	8.02	4.00	50.76
Beauvais	357.18	256.37	45.21	2.28	2.45	35.5	28
Dambatenne	873.00	386.95	107.60	1.00	29.10	202.20	134.80
Glenanore	552.05	369.23	120	15		72.64	10
Haputale	700.02	386.15	1950	6487	1	44.55	

Kahagala	402.14	296.56	354.15	57.59	4.72	26.8	43.27
Pitaratmalie	667.78	348.35	14.32			45.98	66.85
Maskeliya Plantations Ltd							
PoonagalaGroup	1,801.27	516.55	-	15.50	10.00	232.77	107.80
Ampitakanda	1,244.62	496.66				58.23	110.00
Lyangahawela	460.79	196.58	95.50	22.71	22.20	54.24	69.56
Creigh	418.48	289.00	47.25	10.61	3.30	38.74	29.47
Finlays Plantations Ltd							
Demodara	1,109.30	533.79	179.02			167.29	76.00
Rookatenna	600.84	332.72	15.55			127.72	64.28
Oodowera	674.50	363.33	101.68			80.76	61.10
Nahavilla	273.69	159.32	25.05			48.69	34.04
Newburgh	340.66	242.99	13.01			16.99	27.59
Total	11,242.02	5,783.95	3,076.34	6,613.69	80.79	1,301.22	961.45

Source: Records in Plantations

There are nearly 10,876 households within these plantations and the population is around 47,800 out of which 9,036 people (around 18.9%) work in the estates. There are about 6,249 line room houses and 1,579 improved individual houses. The houses are managed by the Plantation Housing and Social Welfare Trust. However, plantation companies annually spend a considerable amount of money to maintain plantation housing as estate workers live in these houses. The table below presents the population and housing in large tea plantations within the project landscape.

Table 28: Population and housing in large plantations

Name of the farm	Number of Households	Total population	Number of people work on the farm	Number of line room houses	Number of improved houses
Agarapatana Plantations Ltd					
Nayabedda	68	3,470	546	576	34
Gonamotawa	379	2,052	376	366	6
Beauvais	592	2,642	406	303	255
Dambetanne	1163	4,319	1,028	830	228
Glenanore	845	3,725	573	497	208
Haputale	797	5,127	777	638	27
Kahagala	653	3,167	392	456	145
Pitaratmalie	212	3,066	619	101	107
Maskeliya Plantations Ltd					
Poonagala group	896	5,452	882	1115	25
Ampitakanda	1238	5,043	861	905	284
Lyangahawela	456	1,727	215	112	63
Creigh	516	2,667	460	350	197
Finlays Plantations Ltd					

Demodara	1078	5,346.00	679.00		
Rookatenna	697		419.00		
Oodowera	620		423.00		
Nahavilla	262		120.00		
Newburgh	404		260.00		
Total	10,876.00	47,803.00	9,036.00	6,249.00	1,579.00

Source: Records in Plantations

The 17 large tea plantations produce around 27.5 million kgs of tea green leaf and around 5.8 million kgs of made tea. Annual per hectare yield varies from 1266kgs to 7006kgs per year (Average around 4752 Kgs per year). Majority of plantations have at least one standard certificate (RA, ETP or ISO) and 5 out of 8 estates in Agarapatna Plantations Ltd and all five estates under Finlays Plantations Ltd are Rainforest Alliance (RA) certified and 9 estates have obtained Ethical Tea Partnership (ETP) certification.

Table 29: Tea production and certification in large plantations

Name of the farm	Total green leaf production per year (Kg)	Green leaf production per ha per year (Kg)	Total Made tea production per year (Kg)	Certifications
Agarapatana Plantations Ltd				
Nayabedda	2,243,891	6,959	513,550	ISO9001-2008,ISO22000-2005,ETP 2012
Gonamotawa	1,133,525	5,837	262,277	
Beauvais	1,039,493	4,055	266,000	RA
Dambetanne	2,711,005	7,006	713,472	ISO 9001- 2008,ISO 22000- 2005,RA, ETP, FSC
Glenanore	2,089,422	5,659		ETP, FSC
Haputale	2,094,920	5,425	420,448	ISO HACCP, FSC, ETP, RA
Kahagala	1,112,283	3,750	320,366	ISO HACCP, FSC, ETP, RA
Pitaratmalie	2,060,788	5,766	473,250	RA
Maskeliya Plantations Ltd				
Poonagala group	1,662,000	3,230	367,630	
Ampitakanda	1,783,088	3,590		ISO 22000-2005
Lyangahawela	944,689	4,757	213,874	
Creigh	1,731,900	6,064	407,000	ISO 22000-2007, Fair Trade, ETP
Finlays Plantations Ltd				
Demodara	2,287,441	4,285	478,565	RA, ETP, ISO
Rookatenna	1,284,041	3,859	295,734	ISO,Fair trade,RA,ETP
Oodowera	1,844,364	5,076	416,611	ISO900-2008/22000-2005,RA,ETP
Nahavilla	460,048	1,266	138,135	Fair trade,RA,ETP
Newburgh	1,020,010	4,197	236,171	ISO,RA,ETP
Total	27,502,908.00	80,781.00	5,523,083.00	

Challenges related to tea production

- Management of all large plantations in the study area reported the issue of labor shortage for maintenance of plantation, tea plucking and processing. As a result, during the peak harvesting season, they hire labour from outside, but that too has limitations due to lack of seasonal labourers. Some areas have to be abandoned without plucking during the peak harvesting season from March to June. Factory workers require a certain level of technical knowledge and experience and finding skilled replacement labor is difficult.
- Traditional markets in the Middle East and North Africa absorb over 150 million kgs or 50% of Sri Lankan tea exports annually. Sri Lankan tea is exported to countries as Iran, Iraq, Turkey, Syria, UAE, Kuwait, Libya and Jordan who are the major importers of Ceylon Tea. Russia is the single largest buyer of Ceylon Tea and together with other CIS countries, the region accounts for 24% or 75 million kgs of the annual tea export volume⁴⁷. The international tea market has been gradually depreciating over last few years due to crisis in Middle Eastern countries and trade bans enforced by USA on Iran and Russia. In addition, other tea producing competitors as Kenya have captured a share of the traditional Sri Lankan tea market. The ultimate result is the reduction of demand, and prices of tea and an overall reduction in the income of plantation companies.
- Increase in the prices of fertilizers, fuel and electricity is one of the challenges faced by the tea industry.
- High wages in the plantation sector. The table below shows the per day salary for labourers in different sectors in Sri Lanka in 2014. According to that, the highest per day wage per labourer of Rs. 620 was paid by Regional Plantation Companies. In 2016, this was further increased up to Rs. 730 per day. Since 1990 to 2016, labour wages in Regional Plantation Companies has risen by 1252% (an increase from Rs.58.30 in 1990 to Rs.720 in 2016). In average, annually about 9.4% can be attribute to inflation. The Sri Lankan plantation sector pays the highest wage rate for workers when compared to other tea producing countries as Kenya (Rs. 443.30), South India (Rs.426) and Assam (Rs.202.35)⁴⁸.

	Regional Plantation Companies	Garment Industry	Tea Export Trade	Manufacturing industry Laborers	Services House Keeping	Food and Beverages	Hotel and Tourism	Kitchen Steward	Services Day Care Assistance	Tea wages board
Per day wage	Rs. 620	Rs.590	Rs.570	Rs.554	Rs.520	Rs.487	Rs.479	Rs.446	Rs.412	Rs.405

Wages and Fringe Benefits Survey, EFC 2014

- Compared to other tea exporting countries, higher cost of production is also a significant challenge faced by the Sri Lankan plantation sector. According to estimates of the Department of Census and Statistics, the per kg cost of production of made tea was Rs.458.84 in 2014/2015⁴⁹ and composition of the cost is as follows - labor wages and benefits 67%, materials as firewood, fuel, fertilizer, chemicals, packing materials and other physical goods 15%, staff and

⁴⁷Tea Exporters Association of Sri Lanka: <http://www.teasilanka.org/globalpresence.php>

⁴⁸Ministry of Hill Country Villages, Infrastructure and Community Development: http://www.mpid.gov.lk/en/images/NPA_UNDP/13_Mr_Roshan.pdf

⁴⁹Department of Census and Statistics: http://www.statistics.gov.lk/agriculture/COP/COP_Tea.html

management 9%, services such as medical, welfare, insurance, electricity, legal and taxes 5% and miscellaneous 4%⁵⁰.

- Tea plantations have strong trade unions who are also highly influenced politically. Plantation workers are mobilized to achieve political objectives and motivated to create issues in the plantations to seek the attention of the government. Also, due to this political influence, politicians attached to particular trade unions influence plantation companies in labour related issues as labour wage decisions and dispute resolution etc.
- Operational workforce shortage is the main cause for low production and poor quality in tea. Main field operations in a tea plantation are all labour intensive as harvesting (plucking), applying fertilizer (manuring), weeding, chemical spraying, pruning, and planting and this has affected large plantations significantly. In 2012, only 20% of the estate population worked in the tea plantations and the land to labor ratio was 2.42 per hectare in 2011⁵¹.
- Lack of interest among the younger generations to work plantations is also one of the main challenges faced by RPCs.
- Results of Climatic Change have affected tea plantations in the project area with long drought periods and short rainy seasons being experienced. Also, traditional patterns of rain and drought have also changed and as a result, crop production has been affected. The area is also susceptible to natural disasters as landslides.
- Introducing new technology (mechanization) to the tea plantation sector is a challenge, as workers are not interested in learning about new technologies mainly due to their low level of education/ understanding and reluctance to deviate from traditional practices.
- The Sri Lankan tea industry continues to follow old methods. Tea cultivators and manufacturers still use orthodox methods of tea production which are relatively slow and labor-intensive. However, industry experts believe that the orthodox method is the best way to produce black tea. Therefore, planters in the present generation also follow the same old school teachings and introduction of new technology to the sector is nearly impossible. In addition, new methods such as integrated pest management, chemical free weed controlling, increasing production efficiency using methods other than fertilizers etc., are also difficult to introduce in the sector due to this traditional way of thinking and practices.
- Some plantation companies do not have full property rights to the plantation land and this has resulted in some of natural resource use decisions within tea plantations being made by government agencies who have legal ownership of the land as the Land Reclamation Commission (LRC).
- Lack of qualified professional agriculturalists and plantation managers within the plantation sector.

⁵⁰Ministry of Hill Country Villages, Infrastructure and Community Development:
http://www.mpid.gov.lk/en/images/NPA_UNDP/13_Mr_Roshan.pdf

⁵¹ TRI 2012;

Future Negative and Positive trends related to tea production

Positive trends

- Trend of producing good quality tea to meet market requirements and face competition in the international market
- Introduction of high yielding improved clones of tea varieties
- Trend of gradual introduction of new technology and practices to increase productivity of tea
- Value addition to made tea and diversification of the industry by introducing agriculture based tourism in the plantation sector
- Improvement of land productivity by introducing other crops and livestock within the farm and implementation of integrated farm management practices.
- Increasing trend to follow sustainable agricultural production methods, industry and trade practices and certification. This will contribute to improve the socio-economic status of populations within and around the plantation, improve environmental quality and health.

Negative trends

- Regular wage revisions based on the influence of trade unions which has no connection with the labour market, labour productivity or product prices.
- Strong labour unions who are able to influence workers and interrupt tea production by organizing strikes etc leading to reduction of crop production and income and increasing cost of crop management.
- New competitors in the international tea market will be an influence/ deterrent when securing the market share for Sri Lankan tea.
- Adulteration of Ceylon Tea by mixing single origin Ceylon Tea with imported low quality tea or reprocessed refused tea and exporting under the brand name of Ceylon Tea and Lion Symbol.
- Impacts of Climate Change on tea production in intermediate grown and high grown tea.

Challenges and trends related to planting materials

- There are no significant issues with planting material in the tea industry. The Tea Research Institute (TRI) continues to carry out research and introduce improved, high yielding, drought and rain tolerant tea varieties which are also resistant to pests and diseases. Different clone varieties are available at TRI Talawakelle, Passara and Ratnapura. In addition, there are nurseries within tea estates which provide planting material to the sector and therefore there are no significant difficulties to obtain planting materials.
- The varieties of planting material available are TRI 2025, CY 09, DGN, DT I, NAY 3, TRI 2016, NL, TRI 2023, NAY 13, TRI2042, TRI 2024, TRI 3016, DN 95, KO 145 and TRI1408.

Challenges related to soil management

- Plantation management face challenges in managing soils within their estate boundaries. These issues include encroachment of forest land, streams and river reservations, watershed areas within plantations by plantation workers and outsiders for cultivation of vegetables. Encroachers seldom use soil conservation measures and since these areas are close to water ways, soil erosion is also high. Eviction is seldom possible due to the involvement of trade unions and politicians who side with the encroachers/farmers.

- Natural water flow has been disturbed by cultivations and different constructions and proper drainage systems are not properly maintained within plantations. Therefore, during the rainy seasons, water runs through fields causing soil erosion along the way.
- Unsuitable and unsustainable traditional cultivation practices when replanting tea is one of the main reasons for soil erosion in tea plantations. Improper land preparation and low investment on soil conservation measures in steep areas, non-use of mulch or shade tree crops in newly developed tea lands, complete clearing of weeds within fields and clearing of grasses and bushes on roadsides, soil bunds and poor drainage systems results in increasing soil erosion. The challenge is the difficulty to convince traditional method following plantation managers on best practices.
- Large tea plantation companies who do not have full property rights to their plantations are reluctant/ not bothered to invest in soil conservation due to high costs etc. The private sector is more concerned about cost reduction and profit maximization
- Construction of roads, play grounds, preparing land for new settlements by removing soil and dump them in vacant areas including rivers/ streams or unutilised marginal land which do not have tree cover or any other protection from the rain. The soils erode during the rainy season and get deposit in downstream water bodies etc. Although the activities take place within plantations, the plantation management does not have control over some of these actions.
- Due to effects of Climate Change, high rainfall within short time periods leading to earth slips and soil erosion etc.
- Naturally forested areas within plantations are being converted to crop lands and are being cultivated with crops that contribute to soil erosion. These crops include potato, carrots and tomatoes etc., and it is often difficult for plantation management to control this due to trade union action and political influence.
- Construction of dams for power generation and irrigation purposes contributes to soil erosion. This is also out of the mandate of plantation management.

Identified pest and diseases and control measures

- Blister Blight, White Grubs and Mites are diseases found in project area tea plantations. Systemic spraying of copper oxychloride is used as a method to control Blister Blight and application of Cabofuran to control White Grubs.

Challenges related to maintaining made tea quality

- Fertilizer deficiency and improper application in tea plantations. The traditional mind set in the tea planting sector do not consider existing conditions in the soil and actual requirement of nutrients based on recommended levels and cycles. As a result, yield and quality of leaf are deteriorating.
- Green leaf can become bruised due to poor handling in the field and also when being transported by plantation workers. This will damage the leaf and affect the quality of made tea.
- Since plantations in the study area still uses traditional methods of manufacturing, it involves handling of tea at different stages by humans and maintaining hygiene and quality is a challenge.
- In processing factories, old machinery is still used. There is also a shortage of quality machinery and it is affecting the quality of processing tea.

- The quality of fertilizers is a problem in the tea industry which can affect yield and health of tea bushes.
- Unpredictable weather conditions affect plucking cycles and also quality of leaves.
- Due to traditional old school mind set, pressure from plantation companies to earn profit there are no innovations or introduction of new technologies, investments in uplifting social conditions and better natural resources management in the sector. Income of the plantation companies have been decreasing due to a decrease in demand for Sri Lankan tea in the international market. The introduction of new technology and upgrading manufacturing facilities will not happen in the short term. Under these circumstances, upgrading made tea quality will not become a reality in the near future.

14.2. Smallholder tea plantations

Small Tea Farm Holders (STH) are defined as farmers with tea plantations less than 20.2 hectares (50 acres) in size and without their own processing facilities. This definition was operationally established during the 1972 and 1976 land reform laws when all tea farms larger than 50 acres were expropriated⁵². The tea smallholder sector has increased by 16% during the 1982-92 period, while the plantation sector as a whole has declined. Tea smallholders are scattered in all tea growing districts. The Badulla District accounts for 7.57% of smallholders, 7.47% of tea smallholdings and 6.8% total tea smallholding extent in Sri Lanka. The average farm sizes are small, being just 0.3 hectares in the Badulla District (TSHDA 2014)⁵³.

The table below shows the total extent of smallholders in the GEF-Tea project area in Haputale, Bandarawela, Ella and Hali-Ela, including total extent of tea smallholdings and average extent per smallholder.

Table 30: Total number of tea small holders and extent

DS Division	Number of villages covers by the study	Total number of smallholders in the study area	Total extent of tea belongs to smallholders ha.	Average extent per smallholder ha.
Haputale	14	1,359	405.4	0.30
Bandarawela	14	1,206	350.0	0.29
Ella	26	3,418	866.5	0.25
Hali-Ela	13	1,312	317.0	0.24
	67	7,295	1,939	0.27

Source: TSHDA 2015

⁵²Indika R. Palihakkara et al 2015, Current Livelihood Condition of and Futurity of Tea Farming for Marginal Small Tea Farm Holders (MSTH) of Sri Lanka: Case Study from Badulla and Matara District, Environment and Natural Resources Research; Vol. 5, No. 1; 2015 ISSN 1927-0488 E-ISSN 1927-0496; Published by Canadian Center of Science and Education.

⁵³Tea Small Holdings Development Authority (2014), *Annual Report 2014*

Table 31: Total number of tea small holders in each TI Region

TI Region	Total TSH	TSH in project area	Percentage
Liyangahawela	2,759	1,206	43.7
Ella	2,172	2,172	100
Ballaketuwa	1,637	1,246	76.0
Haputale	1,869	1,359	72.7
Hali-Ela	1,779	1,312	73.7
Badulla District	28,101	7,250	25.8

Source: TSHDA 2015

In Badulla District, there are 9,020ha of tea smallholdings and 21.5% of which exists in the study area. The study area has 5 Tea Inspector Regions (TI Regions) namely Liyangahawela, Ella, Ballaketuwa, Haputale and Hali-Ela. The above table shows the total number of tea smallholders operating within the study area in each DSD, total extent of tea land belonging to smallholders and average smallholding size per smallholder. The highest per smallholder tea extent has been recorded in Haputale and Ella TI Regions which is 0.30 hectares and the lowest is recorded at Ballketuwa TI Region which is 0.18hectares.

Tea Smallholder Development Societies (TSDS)

The Tea Smallholdings Development Authority (TSHDA) is the responsible government agency to provide guidance and support to improve operations of tea smallholders. In the GEF-Tea project areas, there are 4 Tea Inspector (TI) regions, and under each region, Tea Small Holder Development Societies (TSDS) have been formed and a majority of smallholders are members of TSDSs. The functions of TSDSs are interventions related to tea to increase productivity and product quality, land development initiatives with provision of financial support especially for replanting, social development interventions through TSDS to facilitate service provisions and collective bargaining for benefits. In addition, some of the large tea plantation companies operating in the study area with processing facilities (i.e. Finlays) has formed their own smallholder groups to formalize the collection of green leaves. The table below presents the information gathered from each TSDS in the project area.

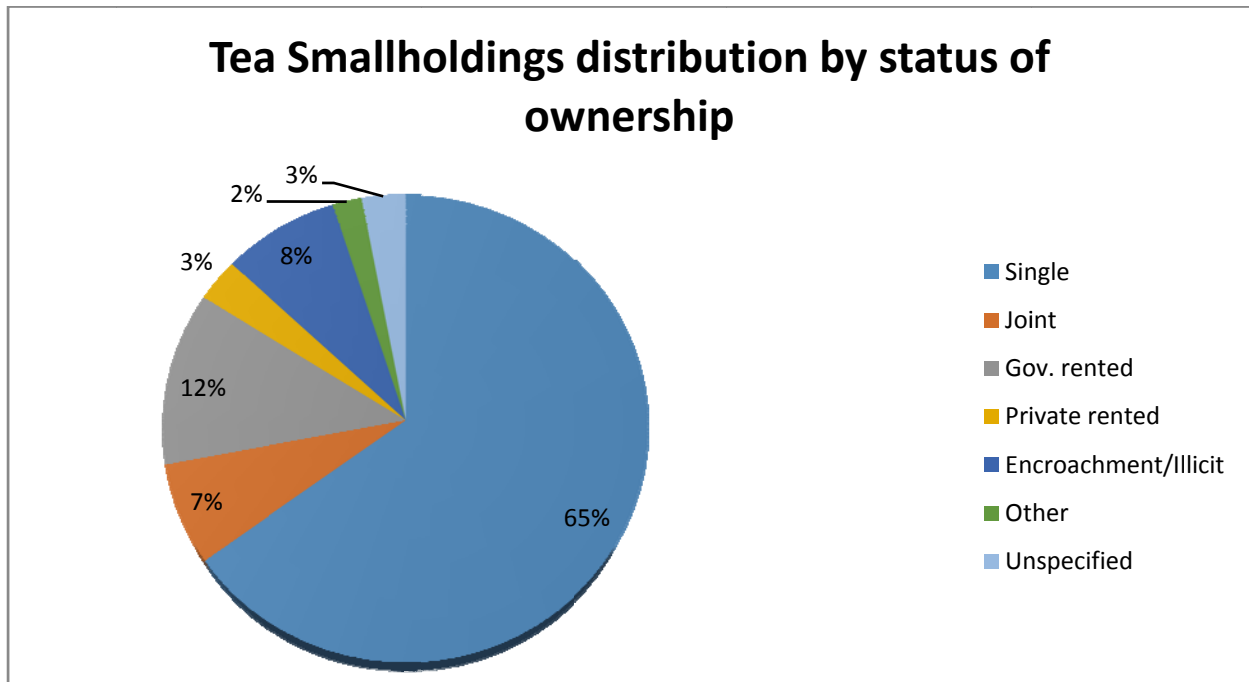
Table 32: Information on Tea Smallholder Development Societies in GEF Tea project area

No	TSHDS name	Community	TI region	Members	Female	Male	Yield per month per Acre(Kg)	Average price per Kg of green leaves (Rs)	Total tea land area(Hectares)for TSHDS
1	Dowa TSHC		Ella	80	30	50	250-300	65-70	20
2	Heeloya TSHC		Ella	190	110	80	450-500	71-77	55.6
3	Kithalella TSHC		Ella	136	10	126	150-200	50-45	32.8
4	Piyarapandowa TSHC		Ella	446	100	346	300	69-81	124.4
5	Dehigolla TSHC		Ella	86	20	66	500-600	60-80	15.6
6	Walasbedda TSHC		Ella	210	50	160	400-450	60-70	30.4
7	Ella TSHC		Ella	110	60	50	150-160	60-80	3.6

8	Maduragama TSHC	Ella	186	96	90	78-85	60-83	16
9	Nethweel TSHC	Ella	171	30	141	1000	45-50	17.6
10	Welanhinna TSHC	Haputale	154	50	104	100-200	50-70	36.8
11	Hela Pupula TSHC	Balleketuwa	135	20	115	300-350	50-60	27.2
12	Galtanhena TSHC	Balleketuwa	179	36	143	300-400	72-73	23.6
13	Dulgolla TSHC	Lyangahawela	177	60	117	250-300	50-60	18
14	Makulella TSHC	Lyangahawela	176	100	76	300-350	65-70	19.6
15	Kurundugolla TSHC	Lyangahawela	275	60	215	150-200	55- 84	50
16	Baddearawa TSHC	Lyangahawela	60	10	50	150-200	45- 85	26
17	Egodagama TSHC	Lyangahawela	143	81	62	250-300	45-50	12
18	Lyangahawela TSHC	Lyangahawela	70	21	49	250-300	50-40	11.2
19	Mahaulpatha TSHC	Lyangahawela	43	22	21	100-175	60-55	5.6
20	Hela Kadurugamuwa TSHC	Haputale	136	30	106	150-250	50-55	20
			3163	996	2167			566

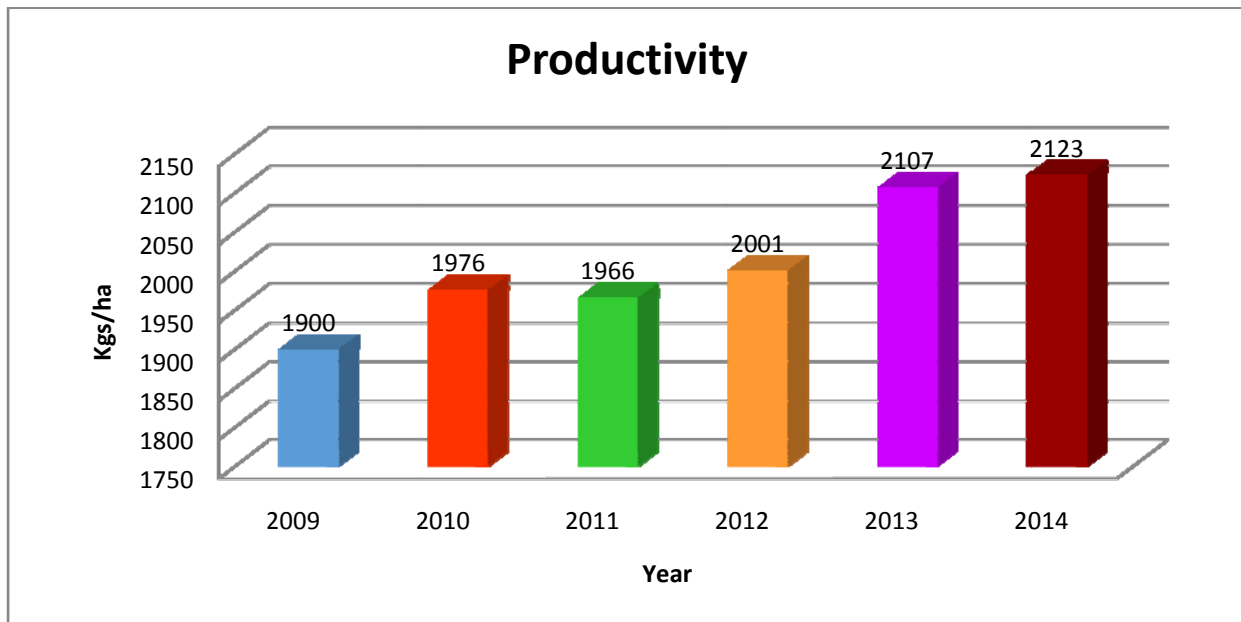
There are 3,163 tea smallholder members in 20 TSDS within the project area and of that, 996 members are female and 2167 are male. The total extent of tea under the 20 TSDS is 566 hectares. The average yield per month per acre (0.4ha) varies from 78kgs to 1000kgs. The monthly yield figures show a big variation due to the variation in management practices, condition of plants as age and planting material as seedlings and VP tea and the location of the estate and because different TSHS have given different figures as yield in well managed tea, yield in drought period, yield in seedling plantations and annual average yield. The prices per kg of green leaf is determined by several factors as price for made tea in the Colombo tea auction, the factory which they provide leaf to (different factories have different markets), quality of green leaf and sometimes the government sets a minimum price for green leaf provided by smallholders etc. Accordingly, there is a significant variation in the prices per kg of green leaves which varies from Rs.45 to Rs.85. Some of the TSDS had given the names of the factories which pay higher price for their leaves.

Figure 11: Tea small holding distribution by ownership in Sri Lanka



Source: TSHDA 2015

Figure 12: Productivity per hectare per year



Source: TSHDA 2015

Issues faced by smallholder tea planters are discussed below:

- Price instability of tea is a key issue faced by smallholders and it has resulted in reducing profits from tea.

- Labour shortages and lack of interest among the younger generation to be involved in agriculture including tea.
- No financial resource to invest on soil and water conservation and to address land degradation.
- Recommended use of fertilizer is twice a year. However, smallholders use fertilizer three times a year as yield is low (4x50kg per acre). Farmers' experience is that the quality of fertilizer has decreased.
- Tea smallholdings in the Uma Oya River Diversion project area have been affected. Many areas have been destroyed due to lack of water.
- Lack of road access to tea smallholdings, poor conditions of available access roads in rural areas where the tea smallholdings are located.
- Climate Change has affected tea significantly and caused reduced yield. During long drought periods and short heavy rainy seasons, crop get affected and yield reduced.
- There is not enough knowledge on Climate Change adaptation technologies and therefore smallholders have to bear the cost caused by negative impacts of Climate Change.
- Wide spread poverty in the tea smallholding sector is also a major issue.
- *Eucalyptus* and *pinus* plantations have caused negative impacts on water resources in the project area.
- Soil erosion in tea smallholdings is very high and no proper mechanisms for soil conservation available. Also, adopting soil conservation measures are very expensive and therefore most marginal tea smallholding farmers are unable to afford these measures.
- Forest fires in *pinus* plantations spread into smallholding tea lands.
- Education and awareness programmes are provided only by the TSHDA, but due to limited capacity with the TSHDA, most farmers do not get an opportunity to participate in the programmes.
- Tea smallholders provide green leaves to middlemen and they charge for transport and as a result tea smallholders get lower prices than the market rate for their tea.
- Glyphosate was used as weedicide by smallholders and when it was banned by the government, they were forced to control weeds manually. This is an impossible task due to lack of labor. The decision to ban the pesticide has worsened their situation.
- Tea small holders complain that they are not getting proper guidance from Tea Inspectors. According to them, Tea Inspectors do not actively participate in discussions and guide smallholders on how to adopt best practices.
- Most tea smallholding lands are owned by the government and the TSH do not have ownership and carried out cultivation on annual permits. Sine there is no private ownership for lands, the smallholders cannot use the land as a guarantee for a bank loan to improve the tea plantation.
- Knowledge on soil conservation measures are very low.
- Smallholder face issues during peak harvesting seasons from March to June, because factories limit the buying of green leaf due to their limited capacity to process. Under this situation, the community cannot provide all excess leaves to other factories and tea smallholders have to bear the loss.
- TSH community face issues due to poor quality of collected green leaves. Factories reject poor quality leaves to maintain the quality of made tea and under such circumstance tea leaf collectors and community should have to bear the loss.

14.3. Vegetable Cultivations

The GEF-Tea project area is famous for cultivation of vegetables, such as beetroot, leeks, carrot, capsicum and potato etc., and it is an integral part of the smallholder sector. Dispersed largely within the project area, it is characterized by year-round production of vegetables in erodible landscapes with the increasing utilization of agro-chemicals. Thus, it is evident that this system of cultivation is having severe impact on the triple compartments of the environment - land, air and water. Scientific literature discloses how diverse agricultural practices adopted in this vegetable farming system causes adverse environmental impacts. In particular, the erosive cultural practices adopted in the production of potato and vegetables have led to land degradation due to soil erosion, particularly in the hilly areas (UNEP, 2001). The pollution of land and water, loss of biodiversity as well as onsite and offsite effects of soil erosion have both temporal and spatial impacts.

The GEF-Tea project area in Haputale had 252.4 hectares under vegetable cultivation, 203.2 hectares in Hali-Ela, 116 hectares in Ella and 231.9 hectares in Bandarawela under vegetable cultivation in 2015. This is the main income source for many households and provide gives them with an additional income.

Issues related to vegetable cultivations:

- Around 5,000 vegetable farmers are affected by the Uma Oya project due to lack of water for cultivations, the direct result of negative impacts created by the project.
- Vegetable cultivators who are encroaching large plantations and forest, reservations of waterways, grasslands and sensitive areas, do not have land tenure rights and legal land ownership. Therefore, they are not interested in investing and adapting natural resource conservation measures in their farms.
- Encroachment of environmentally sensitive areas for vegetable cultivations i.e. Liyangahawela bean cultivation are carried out within the watershed of the Kirindi Oya catchment and forest reserves.
- Watershed reserves, stream and river buffer zones, forest patches and grasslands within large scale plantations have been encroached by plantation workers and outsiders for vegetable cultivations. In these areas, they do not apply soil conservation measures and their general practices are environmental friendly or show concern for such.
- Considerable social and environmental costs as a result of heavy usage of fertilizers and agro-chemicals. It was reported that in some areas the chemical drift is a serious environmental and health problem because of excessive and frequent spraying of chemicals.
- Farmers complain that the quality of fertilizer is not up to standards.
- It was reported that vegetable farmers knew little or nothing on the use of chemical pesticides in vegetable cultivations. As a result, they tend to buy chemicals based on advice of fellow farmers or chemical vendors, and are used to applying high doses of these chemicals. In addition, they tend to mix different chemicals assuming that it will be more effective. This practice can be detrimental to human health, fauna and microorganisms living around these vegetable farms.
- It was reported that due to *pinus* and *eucalyptus* plantations, water flow has significantly reduced and invasive alien species have increased in agricultural lands which are located near forest plantations.
- Sensitive forests and watersheds which provide water throughout the year has been destroyed by people for settlements and agriculture and as a result it has created a conflict between the old farmers and new farmers on when sharing water resources

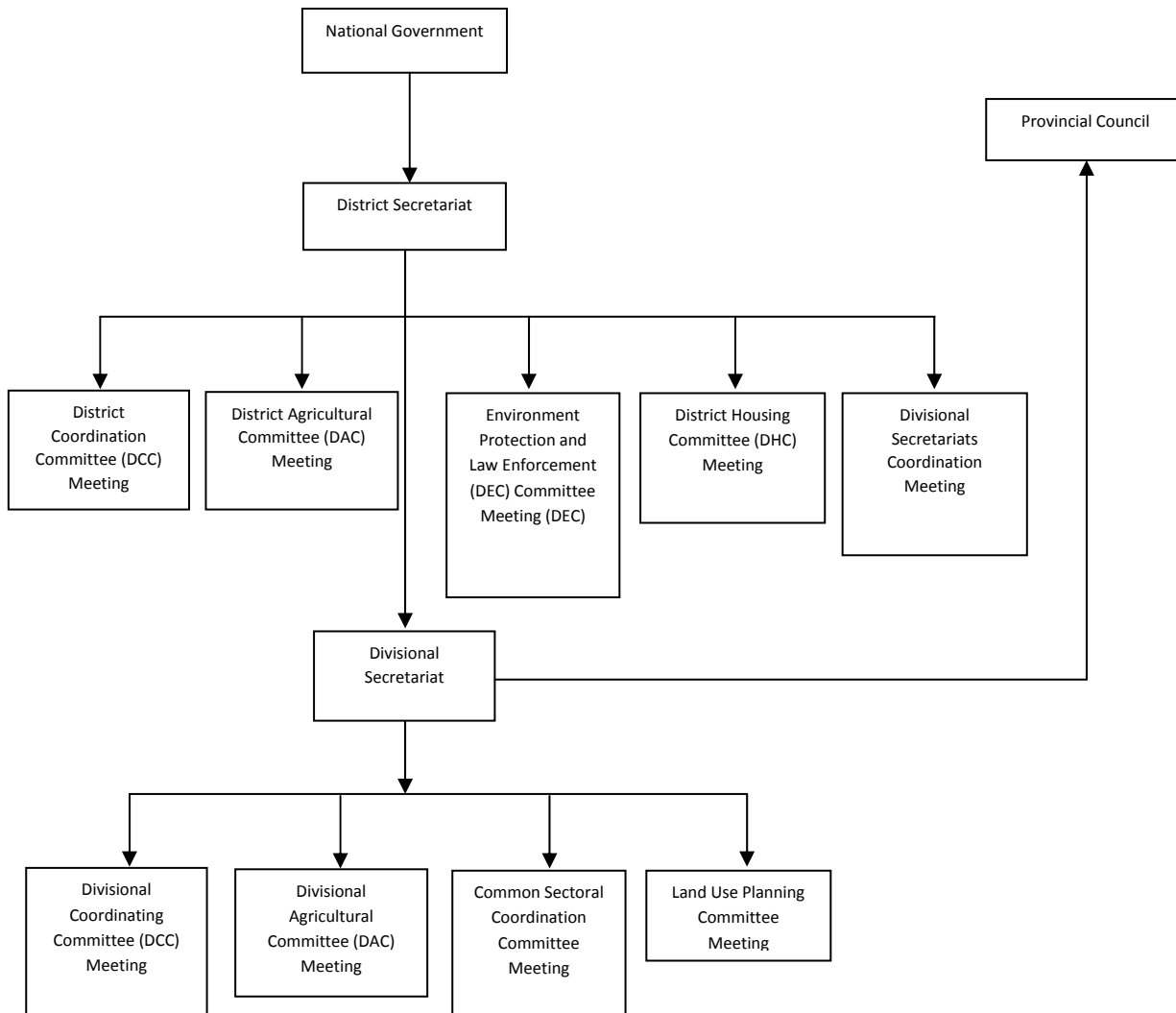
- Vegetable farmers hardly use PPE (proper protective equipment when applying chemicals to vegetable plots).
- The project area is within the headwater areas of important rivers in the country. Excess accumulation of contaminants in the soil, transport of pollutants with sediments and subsequent release into water sources is a serious concern (Wijewardena, 1998).
- Water quality can seriously deteriorate through agriculture with the application of fertilizers and manure used in large quantities, more than the recommended levels (Rajakaruna et al., 2005).
- Agricultural runoff, which comes from non-point sources, consists of pesticides, nutrients, suspended solids and organic material. Soil erosion and sedimentation of water bodies is another adverse effect due to improper agricultural activities (Dayawansa, 2006).
- Heavy use of fertilizers and pesticides in the area, much more than recommended levels, and their impacts on the environment specifically, on water resources.
- Farmers' knowledge on environmental effects and impacts (externalities) such as agro-chemical pollution and its cost on agriculture is less understood. Inherently non-quantifiable, these externalities have received little consideration at decision making forums, thus not being addressed in sectoral policies too.
- The erosive cultural practices adopted in the production of potato and vegetables have led to land degradation due to soil erosion, particularly in the hilly areas (UNEP, 2001)
- High cost of inputs such as seeds, fertilizers, chemical pesticides and labor etc., are issues faced by vegetable farmers.
- Low price for vegetable crops and exploitation by middlemen is also reported as key issues faced by vegetable cultivators in study area.

15. Stakeholder Consultation & Stakeholder Participation in NRM

A number of stakeholders who play a role in natural resources management in Lipton's Seat tea landscape were identified and 9 key stakeholders were interviewed to gather data and information on threats to the environment and livelihoods of the communities; major social, economic, environmental or political factors that enable or add to the persistence of these threats; major opportunities to help mitigate these threats; stakeholder initiatives that focus on designing and implementing sustainable NRM; interest in engaging in a new multi-stakeholder planning process to address some of the threats and root causes; what capacity and expertise would you bring to such a collaborative landscape planning process. Please refer the Annex I for the report on the stakeholder consultation.

16. Policy, Legal and Institutional Framework for NRM

16.1. Provincial and District Administrative Structures and coordination mechanisms



17. Conclusions

17.1. Conclusions

The Sri Lankan tea industry has continued to play a key role in the growth of the national economy while contributing to generate income and employment to the Sri Lankan workforce in the past 150 years. However, today the Sri Lankan tea industry faces several external and internal issues and challenges which are determinant factors for ensuring sustainability of the industry. Expansion of agriculture, especially tea and vegetables, population growth and expansion of settlements have changed land use patterns over the last century and has converted rich forest, grasslands and aquatic ecosystems causing irreversible damage to the environment.

Complex and diverse land relations, with a wide variety of laws, traditional practices and institutions in operation and also lack of property rights and tenure rights have contributed to land degradation

overtime. Topography of the GEF-Tea landscape and weather patterns, such as high rainfall, are also key factors that contribute to land degradation. The GEF-Tea project area is located within high-risk areas and landslides, cutting failure, earth slip and rock falls are common incidents in the area which have created social, economic and environmental issues. Responsible authorities of the government (CEA, LUPPD, NBRO, GSMB) have identified these areas, but have not taken adequate action to relocate the settlements, infrastructures and amenities and to stabilize unstable land, due to various reasons. At present the exploitation of natural resources and development activities such as metal quarries, sand mining, road constructions and settlements etc. in hilly areas, contribute to increase the risks of landslides in the project area.

Land degradation in Sri Lanka due to soil erosion and declining soil fertility is continuing irrespective of interventions made during the last few decades. The consequences of this problem on food security and resultant poverty are further exacerbated by ever present climate change implications. The GEF-Tea project area, Lipton's Seat landscape has been identified as an area with high soil erosion. Bad land use patterns in large tea estates, smallholdings, vegetable cultivations and poorly managed government owned land primarily contributed to increase soil erosion and as a result, reduced soil fertility, adding an additional cost to the agriculture industry to maintain soil fertility in agricultural lands.

Poor planning and lack of public consultation in planning development project are the main reasons for the failure of this project. The symptoms are such that this damage is likely to be permanent and irreversible environmental damage and will lead to disaster for thousands of households in the project area.

A little or effort have taken to educate and mobilize communities on climate change adaptation mechanisms by responsible government agencies.

Direct tapping of water from watersheds and natural springs, diversion of rivers and streams for agricultural purposes, excessive use of chemical fertilizers, pesticides and weedicides, dumping of waste and diversion of sewage into water sources and sedimentation have deteriorated the quality of water and quantity of water for downstream users. If the current pattern continuous, there will be future conflicts among different communities when sharing water resources.

Over the last few decades the extents of natural forests, grasslands and watersheds have shrunk considerably. Human pressure on ecosystems and habitats is very high and if this trend continues, it will be detrimental for biodiversity in the project area. The Lipton's Seat landscape does not have large areas of natural forests, but rather patches of natural forests that exist on the tips of hills, on steep slopes and scarps in many locations. Those areas are not properly protected and human influences as exploitation and encroachments continue to take place. There is the risk of endangered and critically endangered flora and fauna species found in the study area becoming extinct within the project area due to reduction in natural forest cover. Therefore, there is a need for immediate action to demarcate and declare existing natural forests as protected areas and implement a management plan to conserve these forests. There are issues with forest plantations in the area.

Ethno botanical use of forest plant species is an under-researched area. There is a need to undertake a comprehensive study to assess the ethno botanical uses of plant species in the project area.

Extraction of mineral resources as granite, sand and soil takes place in large scale in the project area and has caused environmental and social issues. One of the main observation is that it can increase the risk of landslides in the project area. There is an immediate need to reassess the status of metal quarries and propose a plan to minimize the negative impacts these quarries cause.

The condition of housing in the plantation sector is very low and many estate workers and their families are deprived of their basic needs. Therefore, priority should be given to uplift housing standards and the provision of other basic needs of plantation communities.

There is not adequate data available on the quality of surface water and ground water in the project area. Frequent checking of water quality is a must, as most of people use surface water for their day to day needs. Health related data and information is not available and health sector officials and government officials at GN levels should be encouraged to maintain records on health-related issues in the area as vector borne diseases are common in the area. However, there is no data to assess this.

Regional Plantation Companies operate on the basis of maximizing profits, and therefore investment on replanting, soil and ecosystem conservation and improvement of living conditions of plantation communities are of less priority for them. There is a trend of adopting sustainable agricultural practices in some of the RPCs and also attempts are made to work with smallholdings and to get sustainable agriculture certifications by adopting sustainable agricultural practices.

Plantations which have awarded with RA certification continue to show improvements in social and environmental conditions within their plantations. However, it is still questionable whether they are doing this with a genuine effort to conserve ecosystems, protect natural resources, and uplift the social status of plantation workers, and to improve overall quality of operations or as a means to find good markets and high price for their products and earn high profit margins.

Also, it should be noted that the high non-worker population in the estate sector is a major burden for the RPCS. Tea smallholders in the project area face several issues such as marginalization of tea lands, low productivity, fluctuation of price of green leaf, lack of labour, high cost of inputs and poor transport facilities. A collaborative effort is needed to improve the condition of tea smallholdings in the project area. Since the project area is well known to produce vegetables and potatoes, cultivation of these crops in an unsustainable manner is a serious threat to the environment, natural resources and people's health. There is an immediate need to take measures to force vegetable and potato farmers to follow sustainable agricultural practices.

Climate change is an area which is less researched and poorly discusses at the policymaking level. There are no proper programmes on ground to mobilize communities to adopt and practice climate change adaptation measures and mechanisms.

Complicated institutional arrangements for natural resources management and inadequate capacity within all relevant institutions to address issues related to natural resource management are well documented. Sri Lanka has a comprehensive set of laws and policies to ensure sustainable management of natural resources and ensure sustainable agricultural practices. However, these laws fail as institutions mandated to enforce them have low capacity when it comes to enforcement.

Incidents of poor coordination efforts among officers in different mandated agencies continue to be reported from all parts of the country. In addition, there is reluctance among officials in government

agencies to cooperate with civil society organizations, NGOs and researches, to work together to protect the environment and provide access to data and information.

Overall, it is evident that natural resources management in the GEF-Tea project landscape is poor and has resulted in serious environmental, social and health issues in the area. The sustainability of agriculture, the dominant land use, employment and income source in the project area is at a risk.

Therefore, adequate attention, effort and resources need to be allocated to deal with current issues and holistic, inclusive and integrated approach is needed to manage natural resources in the GEF-Tea Lipton's Seat project area.