Annexure 2

Feasibility Study

In Support of the Funding Proposal submitted to the Green Climate Fund (GCF) by Sri Lanka on "Strengthening Climate Resilience for Subsistence Farmers and Agricultural Plantation Communities Residing in the Vulnerable River Basins, Watershed Areas and Downstream of the Knuckles Mountain Range Catchment of Sri Lanka"

IUCN Sri Lanka Country Office
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Trincomalee
Hamillewa
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A6
Kalpitiya
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Puttalam
Tambuttegama
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Polonnaruwa
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Sri Lanka
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Kataragama
Bentota
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Tissamaharama
Galle
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Mirissa
Matara
0
100 km

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Abbreviations

ADB	Asian Development Bank
CARP	Centre for Agriculture Research Policy
CCS	The Climate Change Secretariat
CEA	Central Environmental Authority
CBO	Community Based Organizations
CEB	Ceylon Electricity Board
CKD	Chronic Kidney Disease
CRIP	Climate Resilience Improvement Project
DAD	Department of Agrarian Development
DMC	Disaster Management Centre
DOA	Department of Agriculture
DOM	Department of Meteorology
DSD	Districts and Divisional Secretariat Division
DWC	Department of Wildlife Conservation
EDA	Export Development Authority
ES	Ecosystem Services
ESIA	Environmental and Social Impact Assessment
ESCAMP	Ecosystem Conservation & Management Project
ESMS	Environmental and Social Management System
FD	Forest Department
FLR	Forest Landscape Restoration
FPIC	Free, Prior, Informed Consent
FSC	Forest Stewardship Council
FWL	Farmers' Woodlots
GAP	Good Agriculture Practices
GCF	Green Climate Fund
GCM	General Circulation Model
GND	Grama Niladhari Divisions (Village level units)
GOSL	Government of Sri Lanka
IAS	Invasive Alien Species
ICRAF	International Council for Research in Agroforestry (The World Agroforestry Centre
ID	Irrigation Department
IFAD	International Fund for Agricultural Development
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal Rate of Return
IUCN	International Union for Conservation of Nature
KCF	Knuckles Conservation Forest
LA	Local Authorities
LDSF	Land Degradation Surveillance Framework
LUPPD	Land Use Policy Planning Department
MASL	Mahaweli Authority of *Sri Lanka*
MDM	Ministry of Irrigation, Water Resources and Disaster Management
MMDE	Ministry of Mahaweli Development and Environment
MOA	Ministry of Agriculture
MOT	Ministry of Technology
MPI	Ministry of Primary Industries
MSME	Micro, Small and Medium Enterprises
NAP	National Adaptation Plan
NBRO	National Building Research Organization

NDA	National Designated Authority
NEX-GDDP	NASA Earth Exchange Global Daily Downscaled Projections
NPV	Net Present Value
NRMC	Natural Resource Management Centre
NRIFAP	National REDD+ Investment Framework and Action Plan
NTFP	Non-Timber Forest Products
NWSDB	National Water Supply and Drainage Board
PES	Payment for Ecosystem Services
PET	Potential Evapotranspiration
RAS	Rural Advisory Services
RDA	Road Development Authority
SAN	Sustainable Agriculture Network
SEA	Strategic Environment Assessment
SGS	Society General Surveillance
SHARED	Stakeholder Approach to Risk Informed and Evidence Based Decision Making
SLM	Environment and Social Impact
SME	Small and Medium Enterprises
SRI	System of Rice Intensification
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNREDD	UN Reducing Emissions from Deforestation and Forest Degradation
WB	The World Bank

Executive Summary

This Feasibility Study confirms the relevance and viability of the proposal submitted to GCF titled "Strengthening Climate Resilience for Subsistence Farmers and Agricultural Plantation Communities Residing in the Vulnerable River Basins, Watershed Areas and Downstream of the Knuckles Mountain Range Catchment of Sri Lanka." The proposed project area is impacted by climate and the vulnerable subsistence farmers are severely affected unless a significant adaptation investment is made available. In addition, the country geography in Sri Lanka require climate smart land management models to ensure long-term sustainability and resilience of upland and downstream agriculture.

The project takes the approach that improved ecosystem services in uplands and enhanced economic and livelihood options to the affected communities will improve the adaptive capacity. The GCF investment along with Government and stakeholder inputs including the affected communities is expected to create a transformational shift in the land use patterns and livelihoods in the area along with climate smart best practices and participatory approaches combined with global and local best practices and technologies.

The project area comprises of two distinguishable management areas, namely the Knuckles upstream area, which is the rain catching area, and the downstream irrigated area. The 166,250-ha upstream catchment has a population of 200,300 females and 183,760 males. This upstream catchment area is the primary source of irrigation water for agriculture and livelihoods in the downstream command area comprising of 506,260 ha, out of which 122,150 ha are covered with irrigated rice. The downstream command area has a population of 489,700 females and 469,440 males. Accordingly, the total project area is home to 1,343,200 people and has an extent of about 672,500 ha. The project expects to work with 306,000 subsistence farmers during the project period, starting with about 70,000 farmers living in the upstream area.

The project results framework consists of three key components covering 18 project activities contributing to the overall climate resilience of the area. The focus of the project is to assist the Government of Sri Lanka (GOSL) in overcoming barriers and constraints that land users face when adapting to climate change by a) assisting people to adopt improved natural resource management, principally in the upstream catchment area while addressing efficient use of irrigation water and food security downstream; b) setting in place sustainable financing to enable people to invest in catchment protection and sustainable land use; and c) providing institutional support to develop appropriate governance mechanisms, information systems and rural advisory services capable of delivering appropriate land use options across the project area. The growth of national and global markets for green products and services as a result of the paradigm shift created by the project, provides key opportunities to make climate adapted land use profitable enough to be sustainable.

This feasibility is arranged as 11 discrete sections. The Section 1 introduces the project and the Section 2 describes the physical, geological, climatic, natural, hydrological, historical and landscape characteristics of the project area. Section 3 introduces the climatic conditions and trends in the country that includes historical findings such as the reduction of rainfall captured by the highlands and changes to diurnal, maximum and minimum temperature regimes, etc. The Section 3 also provides future rainfall and temperature predictions based on downscaled data using RCP 4.5 and RCP 8.5 climate scenarios covering Sri Lanka as well as predictions specific to the project area. It highlights the irrigation water vulnerabilities with decreasing rainfall conditions in the "Yala" agriculture season. The Section 4 describes the socio-economic conditions of the vulnerable population—mainly the subsistence farmers. Socio-economic data related to poverty, land ownership, debts, internet use and government welfare related data are summarized in Section 4. The connection between the ecosystem services improvements and investments on natural infrastructure and land management is evident through the data.

Section 5 summarizes the institutional mechanism in the country for climate management. The relevance of the GCF investment proposed is justified in Section 5, linking the proposed actions to the National Adaptation Plan priorities that indicate project activities are in line with 33 out of the 56 national priority actions.

Section 6 describes the baseline project scenario for the GCF investment with incremental reasoning, paradigm shift potential against the baseline and highlights the way GCF investment is leveraged as co-financing and with complementary development initiatives including potential private sector contributions to the GCF investment. Although the investment project is presented as an adaptation focus project, the type of activities such as canopy structure improvements and land degradation reductions deliver mitigation benefits estimated at a cumulative total of 1.9 million tCO2eq over the six-year project period (7.8 tCO_2eq per ha per annum) with a cost about USD 25 per ton.

Section 7 describes the project results framework including how the Payments of Ecosystem Services (PES) is strategically used to ensure the sustainability of the proposed GCF investment. It links technical inputs to adaptation benefits by minimizing the climate change induced land degradation related knock on effects on livelihoods, agricultural productivity and impacts by sedimentation reducing reservoir capacity. The Section 7 justifies the incentives and investments to adopt sustainable land use practices, erosion controls, rainwater capturing, green income sources with innovative market linkages and the needs to strengthen institutions and advisory services. Section 7 also describes innovative incentives, insurance systems, marketing tools, products developments with area-based brandings including the use of IUCN Green Listing, information portals and monitoring ecosystems to achieve overall project goals and objectives.

Section 8 covers the economic analysis of the project. The analysis delivered that the Internal Rate of Return (IRR) for the base case as 23%. The sensitivity of a 10% increase of base case input values generated an IRR of 20% while a 10% perturbation in benefit reduction provided an IRR of 19%. In the worst-case scenario, where the cost increases and benefit reductions are both applied simultaneously, at 10% on each side of the cost benefit computation, the project was able to deliver an IRR of 16%. The Net Present Value of Benefits are higher than the NPV of costs indicating that the proposed project has a healthy economic analysis with a minimal investment risk.

Section 9 demonstrates the evolution of the project concept starting with the objective of the National Physical Plan to protect the central highlands and to continue the policy dialogue on land health for climate resilience and sustainability. Section 9 describes the stakeholder engagement and validations took place and the value added at each level to arrive at the project result framework, strategies, outputs and actions. Section 10 addresses the environment and social management systems needed to ensure the safeguards towards project sustainability, protection of cultural and indigenous values during and after the project. Section 11 describes the gender dimensions and the gender action plan developed to engage a high number of women involved in household activities with time available for productive engagement with support.

The six-year GCF investment of USD 39.97 million leveraged with 9.20 million USD of Government identified co-financing plus inputs from other complementary development initiatives with stakeholder participation is proven to be feasible and sustainable. The lessons generated and shared co-ordination, information management, early warning in climate smart agriculture, value chain developments and scientific, innovative and participatory approaches could induce a paradigm shift at community level to country level and beyond.

Section 1: Introduction

1.1. Background

This feasibility is to support the funding proposal titled “Strengthening Climate Resilience for Subsistence Farmers and Agricultural Plantation Communities Residing in the Vulnerable River Basins, Watershed Areas and Downstream of the Knuckles Mountain Range Catchment of Sri Lanka”, by IUCN to the Green Climate Fund (GCF). The proposal covers three key adaptation areas in GCF, namely;

a) most vulnerable people and communities
b) health and well-being, and food and water security and
c) ecosystem and ecosystem services.

The rationale behind the approach is that the land use in the upper mountainous areas in Sri Lanka are well regarded for its prime importance in water absorption, retention and distribution to areas within and far away from the mountain zone. The Knuckles mountain region is dominated by tea plantations and forests (natural and plantation) along with other field crops and homegardens. The water absorbed and released are used for power generation, agriculture within the mountain and downstream areas (command area), and for domestic consumption.

The mountainous area, or the upper catchment, is where the water is stored. The command area, or the agricultural area, where this water is being used is impacted by climate by way of shifting seasons, changes in the frequency, intensity and periodicity of rainfall, temperature rise, high winds etc., leading to uncertainties of the primarily agriculture-based livelihoods of the subsistence farmers who own smaller land parcels in the both upstream and downstream of the Knuckles area. These subsistence farmers are not economically and socially capable of meeting the climate challenges. Instead, they continue to degrade the land and exploit the natural resource base for survival. Meanwhile the Government investments on agriculture and irrigation infrastructure are also being challenged by climate induced siltation etc. and the Government is already distributing large sums of money as welfare benefits.

As such, the proposed GCF investment project is aiming at a transformational change in the area to uplift the living standards of the subsistence farmers to a level where they can understand the adaptive measures and take control by participating in a range of climate resilient efforts. The proposed project, therefore, focuses on the upper watershed area of Knuckles that has a massive storage and release potential of water into streams, reservoirs and ground water. The project also seeks to increase the efficiency of water usage in both upstream and downstream agriculture; reduce the land degradation aggravated by the changing climate; and introduce/provide knowledge, innovative financing, technology and marketing approaches to uplift the adaptive capacity of the subsistence farmers in the project area. It also involves initiating extensive changes to the land use and cover to arrest the depletion of the overall water holding capacity, leading to a reduction in the surface runoff of water, which results in higher soil erosion and sedimentation of reservoirs.

The proposed project area, which is a UNESCO heritage site, is enriched with several reservoirs, seasonal springs and waterfalls and many cultural features that provide ample interest to tourists, nature lovers and researchers. Capitalizing these features in a sustainable

manner can provide an additional source of income and create a helpful marketing channel to promote local area products and services.

1.2. Approach

This feasibility study sets out in detail:

- The climate change context in Sri Lanka, including future climate scenarios
- The identification and characteristics of the project locations
- The logic and rationale for the choice of project interventions at the project locations
- "The business-as-usual scenario" for climate-vulnerable land users compared to the scenario with project interventions, in terms of additional benefit streams generated

The methodological approach used in the project combines the ecosystem response with an economic approach to meet climate change challenges by linking climate, life quality and biodiversity. In the process, it is recognized that climate change is one of the underlying drivers of poverty, habitat and biodiversity loss, while the deterioration of ecosystems and their services adversely contribute to the health and wellbeing of vulnerable populations—the subsistence farmers in this context.

The project interventions aim to enrich healthy ecosystems and reinforce the resilience of people and nature to climate change impacts. Research on nature-based solutions by IUCN has shown that ecosystem restoration can contribute considerably to climate change adaptation and mitigation while functioning as a 'biological insurance policy'.

1.3. Project Rational

The impact of climate variability and related impacts are expected to negatively affect the living conditions and livelihoods of smallholder farmers and low-income plantation workers. As such, autonomous on-farm adaptation will not take place due to the low-income category they are already in. This indicates that they will not be able to prioritize investing their already meagre income into measures, such as soil and water conservation, which does not provide short-term returns. Hence, they will end up losing more in terms of income, due to the loss of productivity caused by increased soil erosion (on-site impacts) and crop failures attributable to extreme events. Not addressing economic root causes, along with climate impact will have long-term off-site implications, such as eroded soils depositing in reservoirs and tanks in the area, further reducing the capacity to hold water. Hence, the above scenario outlines the "without GCF project" context.

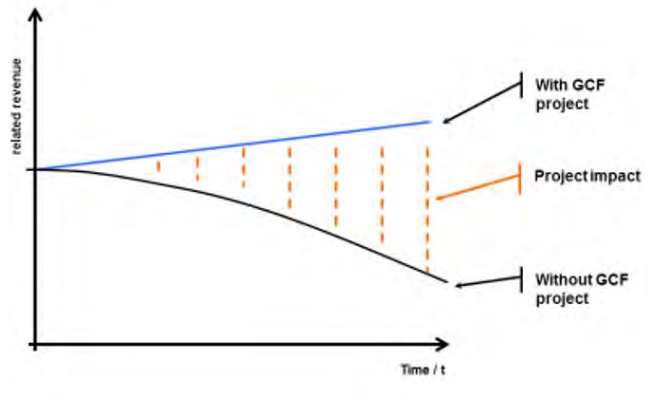


Figure 1: With and without GCF investment

The climate rationale proposed in the GCF project is to assist upstream dwellers (small-scale farmers, unprofitable plantation lands) of the Knuckles range and downstream areas by way

of providing assistance to develop soil and water conservation measures that can be incorporated into their farming practices without any additional financial burden on the farmers. Such investments and interventions will allow them to face climate vulnerability, initially by keeping production at the current level with the changing climate parameters; and in the long-run, by increasing their revenues with improved products and new markets that utilizes a better soil and water conservation induced favorable micro-climate, coupled with other interventions such as enhanced water use efficiency.

To achieve the optimal benefits for the GCF investment, the feasibility report is developed based on the following elements advocated by GCF as best practices.

1) Establishing credible climate science and evidence, robust assessment of exposure, impacts, vulnerability and disaster risks in the context of adaptation;
2) Develop a set of optimal interventions that collectively and comprehensively address underlying climate risks and maximizes sustainable development benefits; and
3) Integrating interventions into the broader national and international policy and decision-making processes for long-term low-emission climate resilient development to meet the commitments under the UNFCCC and related other global agenda.

While focusing on the above three elements, the feasibility report tries to highlight the relevance of the interventions and approaches used to perceive climate impacts and how the project would bring a paradigm shift with the GCF investment, without which the climate vulnerable populations would not have the resources to address the challenges.

The feasibility will document and demonstrate how different stakeholder entities come together and leverage the GCF investment funds to achieve the paradigm shift while pooling additional resources, both cash and in-kind. Stakeholder entities have been selected to match and fulfil the 18 deliverables proposed in the project and the group comprises of Public, Private and People (Community) entities, with specific roles and responsibilities outlined in the feasibility study.

1.4. The Paradigm Shift Potential Considered in the Feasibility

The proposed project is aimed at strengthening the adaptive capacity and reducing the exposure to climate risks of vulnerable “subsistence” farmers in the project area. The support provided by the fund include knowledge tools, equipment, strategies and initiatives that will be used for the benefit of vulnerable households, communities, businesses and public-sector services to respond to climate change and variability. Broadly, the project will involve about 76,000 subsistence farmers at the start and expand to include about 306,000 farmers at the end of the project period with sustainability assured. The participatory co-adaptation of options, information delivery method that incorporates extensive monitoring by both Government and communities at local level and the institutional and regulatory strengthening for climate-responsive planning and development are intended to ensure the sustainability of the GCF investment along with the anticipated paradigm shift.

To incur a paradigm shift, the project will aim to ensure that there is sufficient community ‘buy-in’ to landscape level improvements in water management in the upstream target areas; sufficient farmer uptake of climate adapted practices in both upstream and downstream target areas; sufficient uptake of value chain upgrading options by businesses and other market actors; and introduce modalities for Payment for Ecosystem Services (PES) agreed and fully implemented by the Government (for example the benefit of upstream conservation to

hydropower generation re-routed as an investment to incentivize communities and promote better land management). The sustainability of the shift is further ensured by the mainstreaming of climate sensitive land use planning approaches for each basin, supported by innovative success/experience capturing dashboard mechanisms, going beyond the general socioeconomic benefit monitoring, as observed in standard progress monitoring systems using Key Performance Indicators (KPIs).

Beyond the project and re-investments by the uplifted farmer entities, the different modes of PES modalities introduced, links with global markets based on innovative insurance, and "jurisdictional area-based" marketing and developments are expected to enrich the benefits delivered by the project and feasibility. A system to record the exact income flows or benefits as ecosystem benefits will be documented during the project period, by way of innovative score card systems. Dashboards on life quality, health and wellbeing will add value in highlighting the adaptive capacity and management improvements achieved by the efforts induced by the project's paradigm shift.

Mid-term and final stakeholder evaluation of governance and incentive mechanisms via structured feedback from innovation platforms and scorecard methods would indicate the extent of the paradigm shift, induced by the project, and the contributions by champion communities and public and private sectors. Continuous generation and use of climate information along with marketing and other relevant information would facilitate decision-making and protect the targeted (subsistence) farmers from climate shocks. The information portals will not only provide quantitative and qualitative evaluation of the processes introduced but will also provide a set of mainstreaming tools to be adopted in similar settings.

Figure 2: Landscape of Sri Lanka

1.5. GCF Country Investment Strategy and Country Features

The project is in line with the Sri Lanka strategy for GCF investments that highlight the importance of protecting the Central Highlands, which is also highlighted in the Sri Lanka Physical Plan for 2030[1] and other policy documents discussed in detail in later sections. The investment strategy for GCF applies the fact that Sri Lanka is an island located in the Indian Ocean impacted by climate change.

In terms of physical features, there is no landmass between the southern tip of Sri Lanka and the Antarctic, and the landmass of the island covers a total area of 65,610 km^2 including 2,905 km^2 of inland water bodies. It is located between 5°55' to 9°5' North latitudes and 79°42' to 81°53' East longitudes with a maximum width of 240 km east-to-west and a length of 435 km from north-to-south. Topographic features within the island provides three distinguishable elevations: the Central Highlands, the plains,

[1] National Physical Planning Department. 2016. National Physical Plan, 2016 - 2030 - https://goo.gl/yn5QNq

and the coastal belt. The Highlands are the hydrologic heart of the country where major perennial rivers originate and spread in a cartwheel fashion from the centre to the coast.

Vegetation and land use in the central hills and climate change have a direct and indirect influence over the water availability to the central hills as well as to other areas. The land cover and land management also decide the amount of runoff, recharge and evapotranspiration plus the ability to control temperature regimes. Furthermore, the topography provides a ridge to reef connectivity, linking the coastal areas to the Central Highlands. The coastal belt, about 30 m above sea level, consists of scenic sandy beaches indented by bays and lagoons.

Section 2: The Project Area

The project area covers the upper watershed and downstream areas of the Knuckles Mountain Range. This ecosystem is critical for the sustainability of the country, which is unfortunately impacted by climate change in multiple ways.

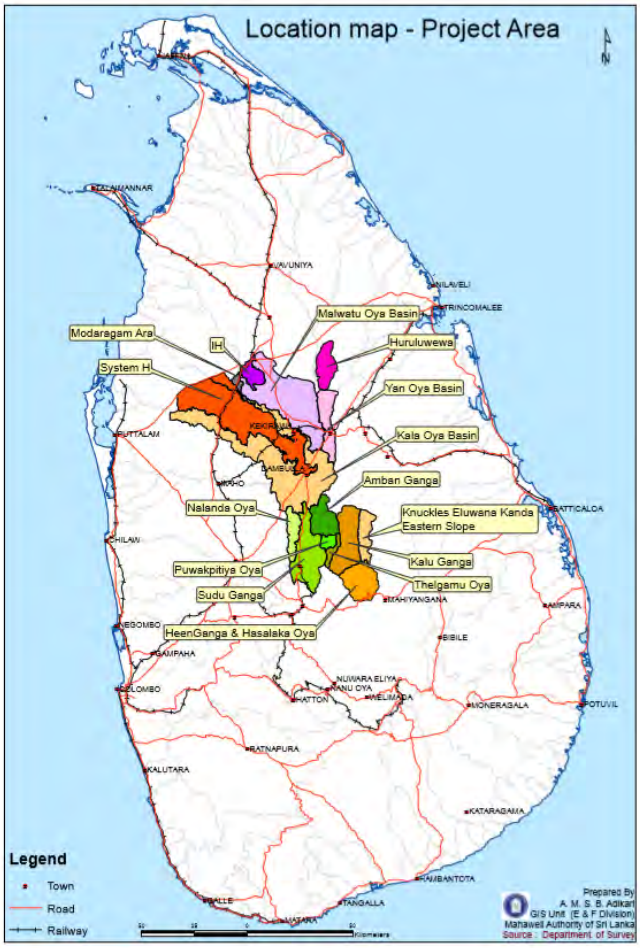


Figure 3: Location Map of the Project Area

2.1. Upstream and Downstream Areas

The project area, for technical and administrative purposes, is divided into two main areas; namely the Knuckles upstream area, which is the rain catching area, and the downstream irrigated area. The 166,250-ha upstream catchment has a population of 200,300 females and 183,760 males. This upstream catchment area is the primary source of irrigation water for agriculture and livelihoods in the downstream command area comprising of 506,260 ha, out of which 122,150 ha are covered with irrigated rice. The downstream command area has a population of 489,700 females and 469,440 males. Accordingly, the total project area is home to 1,343,200 people and has an extent of about 672,500 ha.

2.1.1. Sub-Watersheds

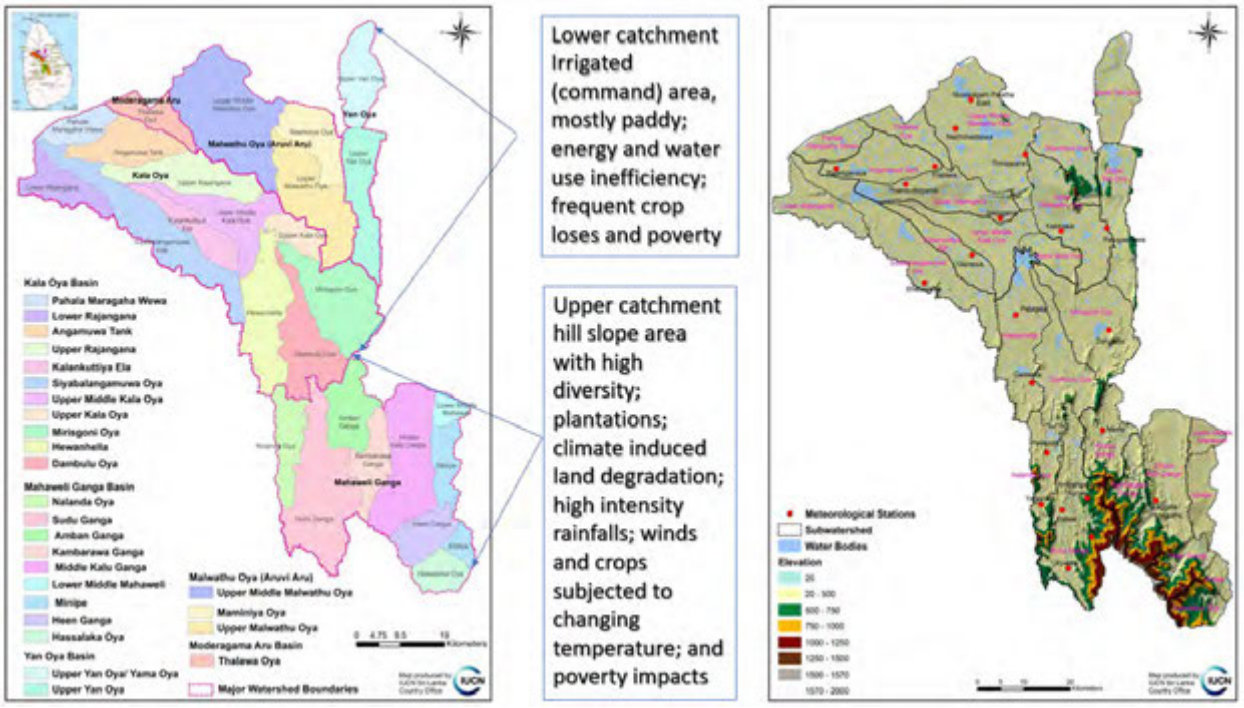


Figure 4: Sub-basins in upstream and downstream areas

The 15 key sub-catchment (watershed) areas within the project area include:

1. Amban Ganga
2. Knuckles Eluwana Kanda Eastern Slope
3. Kalu Ganga
4. Telgamu Oya
5. Heenganga and Hasalaka Oya
6. Sudu Ganga
7. Puwakpitiya Oya
8. Nalanda Oya
9. Kala Oya basin
10. Yan Oya basin
11. Huruluwewa
12. Malwathu Oya
13. Mahaweli Program system 1H area
14. Modaragam Ara and
15. Mahaweli Program system H area

These sub-basins happen to overlap with administrative areas identified as Provinces, Districts and Divisional Secretariat Division (DSD) areas. The DSD areas are further sub-divided into Grama Niladhari Divisions (GND) or village units.

2.1.2. Administrative Areas

The project area includes sections of three provinces; namely Central Province (35% of the province area), North Central Province (23% of the province) and North Western Province (25% of the province). The area comprises of Kandy, Matale, Kurunegala and Anuradhapura Districts. These district areas, which comprise of 40 DSDs with a total of 1,084 GNDs, will be covered by the project area.

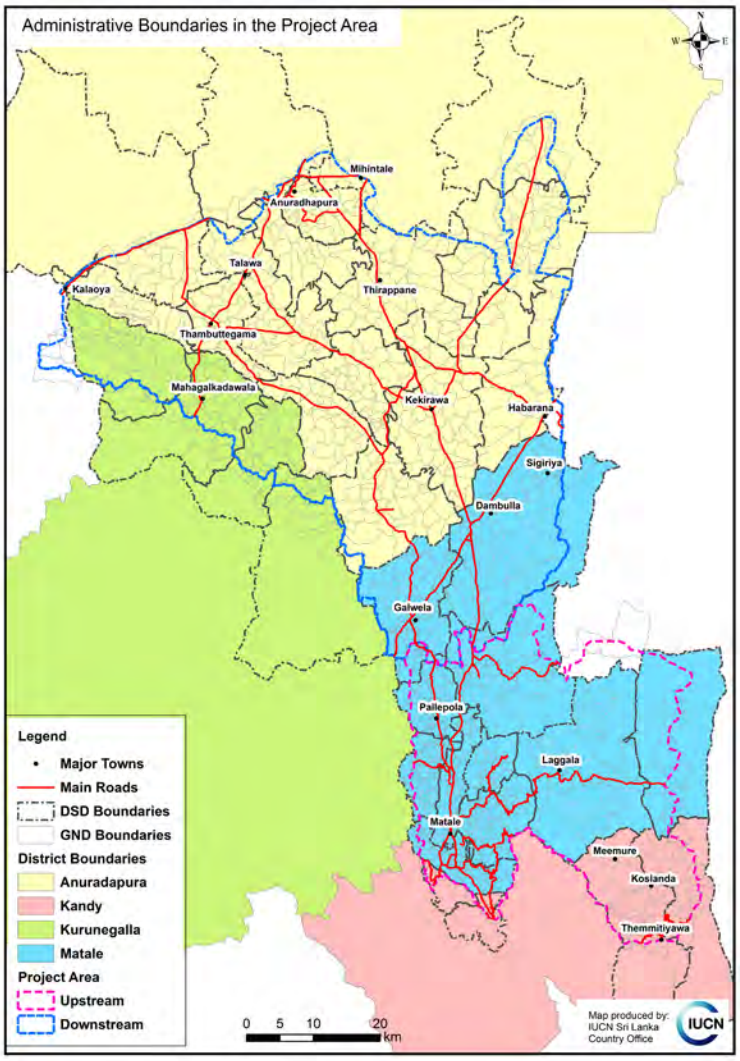


Figure 5: Administrative Boundaries in the Project Area

The service delivery in the project area is managed by 49 local authorities comprising of two Municipal Councils in Matale and Dambulla; three Urban Councils in Anuradhapura, Mihintale and Puttalam; and 44 Pradeshiya Sabhas.

Table 1: Areas and GNDs Under Districts and DSDs

District	DS Divisions (DSDs)	No of GN Divisions	Area (ha)
Upper Catchment			
Matale (16 DSDs)	Ambanganga Koralaya	20	13,684
	Rattota	54	26,001
	Naula	49	67,043
	Pallepola	43	18,400
	Matale	52	18,014
	Yatawatta	54	14,865
	Galewela	10	5,052
	Ukuwela	67	17,869
	Panwila	1	675
	Pathadumbara	7	3,149
	Akurana	7	2,430
	Laggala-Pallegama	37	92,376
	Wilgamuwa	15	50,858
	Elahera	2	21,323
	Dambulla	57	40,062
	Galewela	49	17,814
Kandy (2 DSDs)	Minipe	21	23,085
	Udadumbara	29	35,989
	Total Upper Catchment	**574**	**468,689**
Lower Catchment			
Matale	Naula	03	1,385
Kurunegala (4 DSDs)	Ehetuwewa	19	9,737
	Galgamuwa	28	11,626
	Polpithigama	5	2,705
	Giribawa	33	19,461
Puttalam (1 DSD)	Karuwalagaswewa	4	3,889
Anuradhapura (16 DSDs)	Ipalogama	34	13,446
	Kekirawa	53	34,159
	Galnewa	30	14,022
	Palagala	35	22,696
	Palugaswewa	16	19,787
	Kahatagasdigiliya	9	7,467
	Mihintale	7	3,935
	Nachchadoowa	20	11,927
	Nochchiyagama	22	12,781
	Nuwaragam Palatha Central	7	2,005
	Nuwaragam Palatha East	28	8,827
	Galenbindunuwewa	31	20,301
	Rajanganaya	21	9.615
	Thalawa	39	22,856
	Thambuttegama	27	11,148
	Thirappane	39	27,323
	Total Lower Catchment	**510**	**281,493**
	Total	**1,084**	**750,182**

2.2. Upstream and Downstream Management Areas

While the project output was developed for easy management of the project, the project area was divided into six geographical management units as follows (please see details in the management approach):

- Management Unit 1:
  The five sub-catchments on the east of the target catchment area (Amban Ganga, Puwakpitiya Oya, Thelgamu Oya, Kalu Ganga and Knuckles Ellewana Kanda Eastern Slope). These are well connected to one another and embrace the large DSs of Laggala-Pallegama and Wilgamuwa as well as the larger eastern part of the Naula DS (the rest falls into 3 below).
- Management Unit 2:
  The upland part of the Sudu Ganga sub-catchment area including the Rattota and Ambanganga Korale DSs
- Management Unit 3:
  The lower part of the Sudu Ganga sub-catchment area including Ukuwela, Matale and parts of Akurana and Naula DSs
- Management Unit 4:
  Nalanda Oya sub-catchment area embracing Pallepola and Yatawatta DSs.
- Management Unit 5:
  Heen Ganga and Hasalaka Oya sub-catchment areas in the south, comprising of Ududumbara DS and part of Minipe DS
- Management Unit 6:
  The entire command area

2.3. Characteristics of the Project Area

2.3.1. Water Resources

The water resources of the project area mainly consist of rivers, streams, canals, tanks, water holes and natural ponds. This has enabled paddy cultivation and other crops to flourish despite seasonal weather patterns. Major reservoirs in the project area include Inginimitiya Reservoir, Dambulu Oya Reservoir, Nalanda Reservoir, Bowathenna Reservoir and Moragahakanda Reservoir. However, we are not considering the larger Moragahakanda Multi-Purpose infrastructure project as an integral part of the proposed GCF investment project, as it provides water to a much larger area than that of the downstream area, which is under consideration for this project.

Figure 6: Water resources and water infrastructure in the project area

2.3.2. Soils

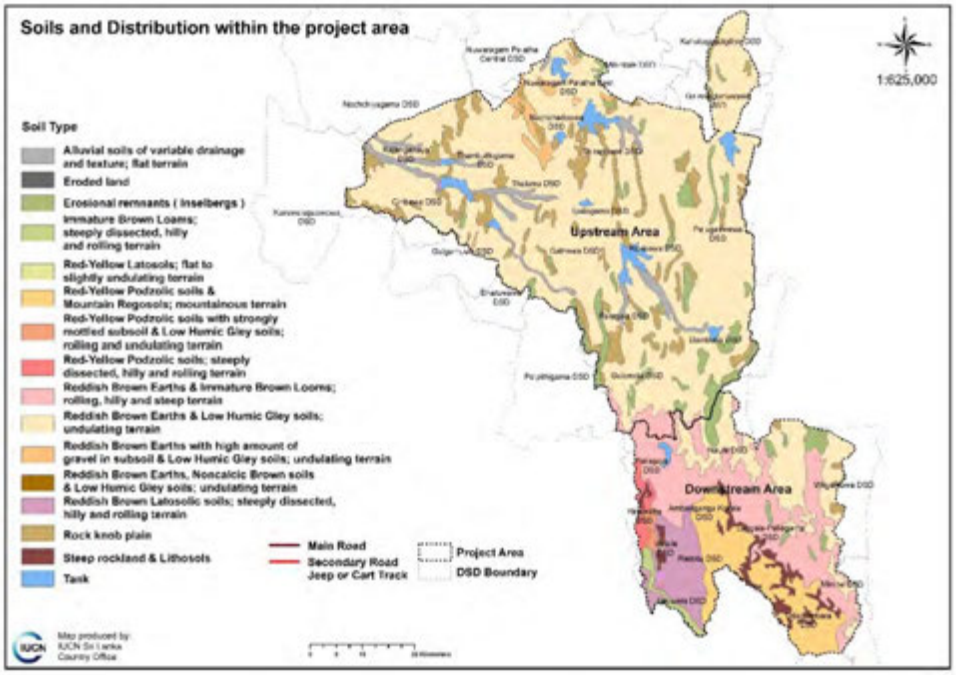
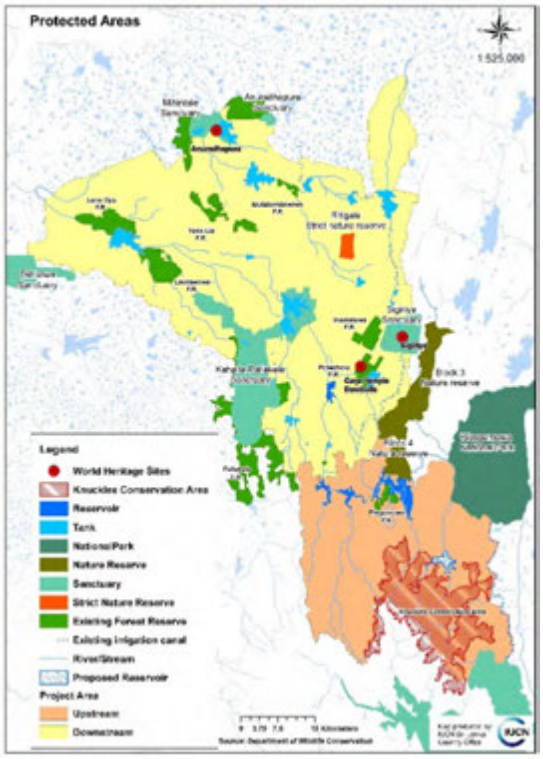


Figure 7: Soils and Distribution within the Project Area

A high variation of soil types is observed in the slope terrains of the upper catchment area while the eastern side of the flat lower catchment area indicate uniform soils consisting of reddish-brown earth soils and humic soils.

2.3.3. Protected Areas



There are 10 Protected Areas managed by the Forest and Wildlife Conservation Departments, spanning 58,057 ha while 27,608 ha fall under the category of existing forest reserves.

Figure 8: Protected Areas

Table 2: Protected Areas

Type	Name	Area (ha)
Downstream Area		
Strict nature reserve	Ritigala	1,301
Sanctuary	Anuradhapura	105
Sanctuary	Kahalla-Pallekele	21,017
Sanctuary	Sigiriya	4,090
Sanctuary	Anuradhapura	1781
Nature reserve		2,194
Total Downstream Area		45,441
Upstream Area		
National park	Wasgamuwa National Park	8,350
Sanctuary	Victoria Randenigala Rantambe	2,995
Nature reserve		1,271
Total Upstream Area		12,616
Total		**58,057**

2.3.4. Existing and Proposed Forest Reserves

There are 40,598 ha of existing forest reserves. Eleven new areas, 15,926 ha in total, are being proposed to be declared as forest reserves. The forest cover of the project area is 65,908 ha out of which 41,912 are dense forests, 21,906 are open forests and 2,090 ha are forest plantations.

Table 3: Existing Forest Reserves

Forest Reserve	Area (ha)
Aluthabendiwewa F.R.	487
Elagomuwa F.R.	922
Inamaluwa F.R.	2,013
Kahala F.R.	3,338
Likolawela F.R.	3,446
Lunu Oya F.R.	3,945
Mihintale F.R.	3,270
Nuwaragam F.R.	2,757
Pallekele F.R.	15,351
Paluwehera F.R.	1,962
Potowa F.R.	52
Wegodapola F.R.	544
Yoda Ela F.R.	2,509
Total	**40,598**

Table 4: Proposed Forest Reserves

Forest Name	Area (ha)
Dambulu Oya P.R.	76
Dotugala P.R.	52
Galkiriyakanda P.R.	1,209
Kala Oya P.R.	5,479
Medaulpotha P.R.	2,374
Moturampatana P.R.	430
Nika Wehera P.R.	6
Pallegama Himbiliyakanda P.R.	969
Pelwehera P.R.	337
Sangapparle P.R.	4,995
Total	**15,926**

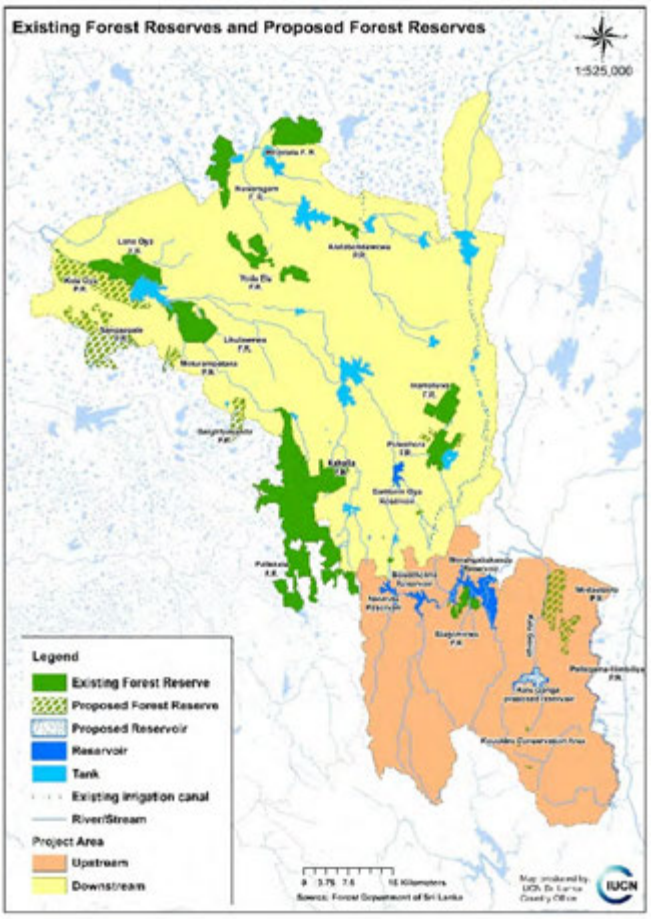


Figure 9: Existing and Proposed Forest Reserves

2.3.5. Land Use

Forests is the main type of land use in the upstream area, varying between dense forests (over 41,000 ha) and open forests (over 21,000 ha). These open forests could be further in-filled to improve the vegetation cover. Most of forest plantations are tea while there are mosaics of sparsely used crop lands that can be used in analog forestry and high value crops.

Table 5: Upstream Land Use

Type	No of Locations	Area (ha)
Dense Forest	128	41,912
Open Forest	380	21,906
Forest Plantation	140	2,090
Grassland	43	125
Scrubland	14,888	62,203
Seasonal Crops	2,266	8,803
Sparely used Croplands	6,207	35,354
Total	**24,052**	**35,354**

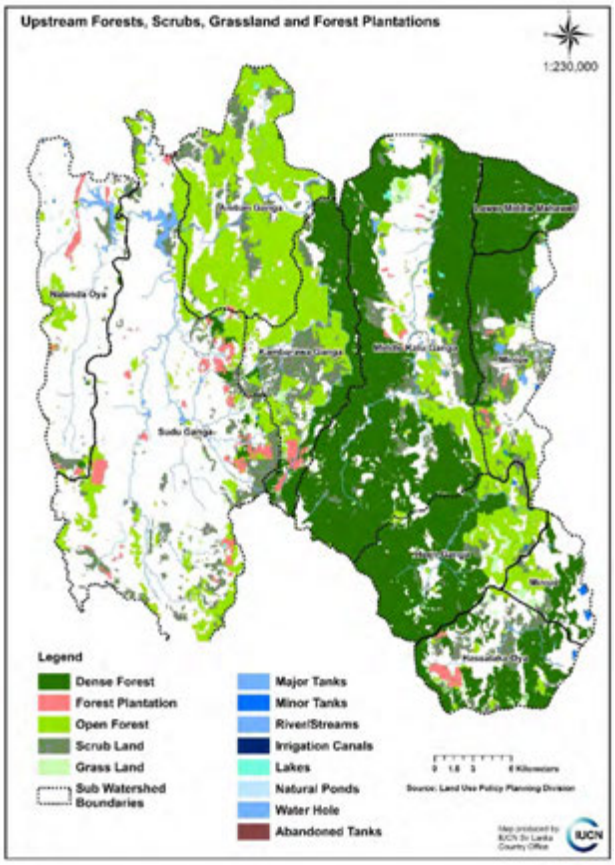


Figure 10: Upstream forests, Scrub, Grassland and Plantations

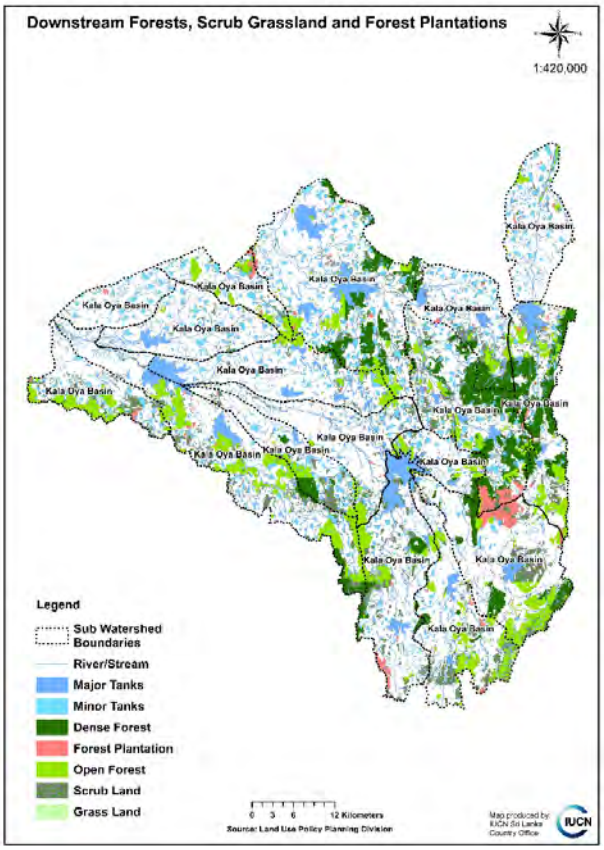


Figure 11: Downstream land use

In the downstream irrigated area, paddy is the predominant type of land use among patches of grasslands and chena.

There are several dense and open forest areas located in the downstream area along with some forest plantations.

2.3.6. Agriculture

The main crop that is cultivated in the project area is paddy, which accounts for 100,411 ha (15%) of the total project area. Paddy cultivation is supplemented by an intricate irrigation scheme consisting of rivers, streams, canals, tanks, water holes and natural ponds.

Many of the farmers in the area are subsistence farmers who rely heavily on Samurdhi benefits, which are provided as compensation for the inadequate harvest that generates an insufficient revenue. This in turn places a heavy burden on the Government. In the downstream area, the major land use is the subsistence irrigated paddy cultivation that is supported by tanks and irrigation systems, which uses the water harvested in the upstream area. There are several abandoned paddy and tanks that can be repaired and put to use. The abandoning of paddy fields could be a result of inadequate water supplies, partly due to silted or defective tanks. As an adaptive measure, the abandoned paddy fields and tanks can be brought back to production to achieve the maximum benefit.

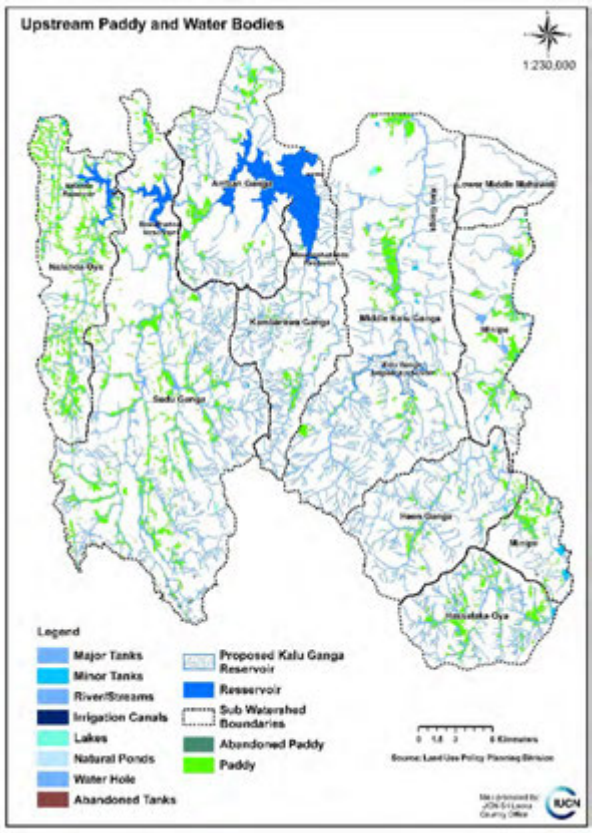


Figure 12: Paddy and Water Bodies – Upstream Area

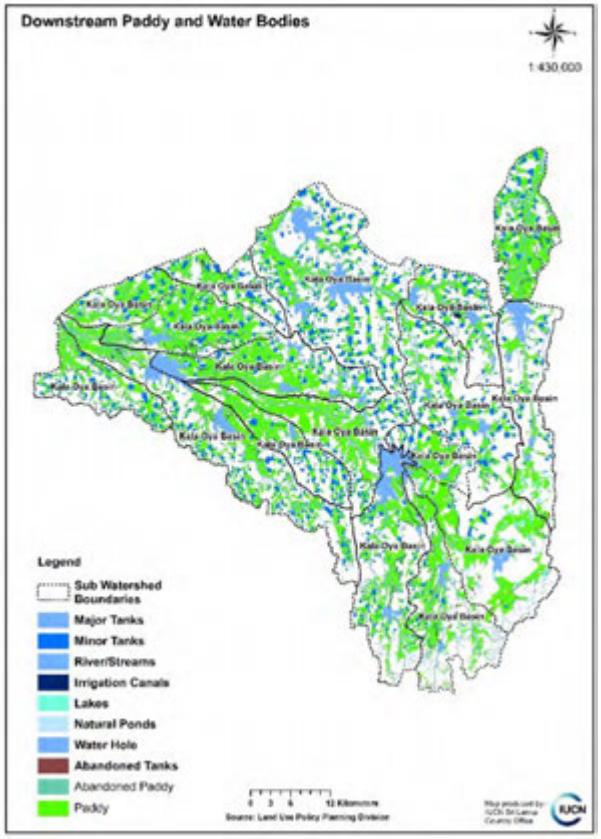


Figure 13: Paddy and Water Bodies – Downstream Area

Table 6: Paddy and Water Bodies – Knuckles and Matale

Land use	No of Locations	Area (ha)
Abandoned Paddy	146	90.30
Abandoned Tanks	32	210.29
Paddy	2,173	8,793.12
Large Tanks	18	784.75
Village Tanks	96	245.31
Water Hole	1	0.32
Natural Ponds	6	7.32
Total	**2,472**	**10,131.41**

Table 7: Paddy and Water Bodies –Downstream Area

Land Use	No of Locations	Area (ha)
Abandoned Paddy	40	277
Paddy	12,868	91,618
Abandoned Tanks	45	115
Large Tanks	113	12,512
Village Tanks	2,384	19,502
Canals	612	752
Irrigation Canals	313	435
Natural Ponds	110	74
River	77	381
Streams	739	1,743
Water Hole	79	31
Total	**17,380**	**127,440**

2.3.7. Tea and Plantations in the Upstream Area

Tea is a major export crop in Sri Lanka and the highland area of the proposed project area has 4,106 ha dedicated for the cultivation of tea. Only a small percentage is considered as abandoned tea, and this could also be cultivated. Forest plantations needs to be re-planted to enhance the ecosystem services with the support of the Forest Department and private owners.

Table 8: Tea and Forest Plantations – Upstream Area

Type	No of Locations	Area (ha)
Forest Plantation	140	2,090
Abandoned Tea	77	317
Tea	260	4,106
Total	**477**	**6,513**

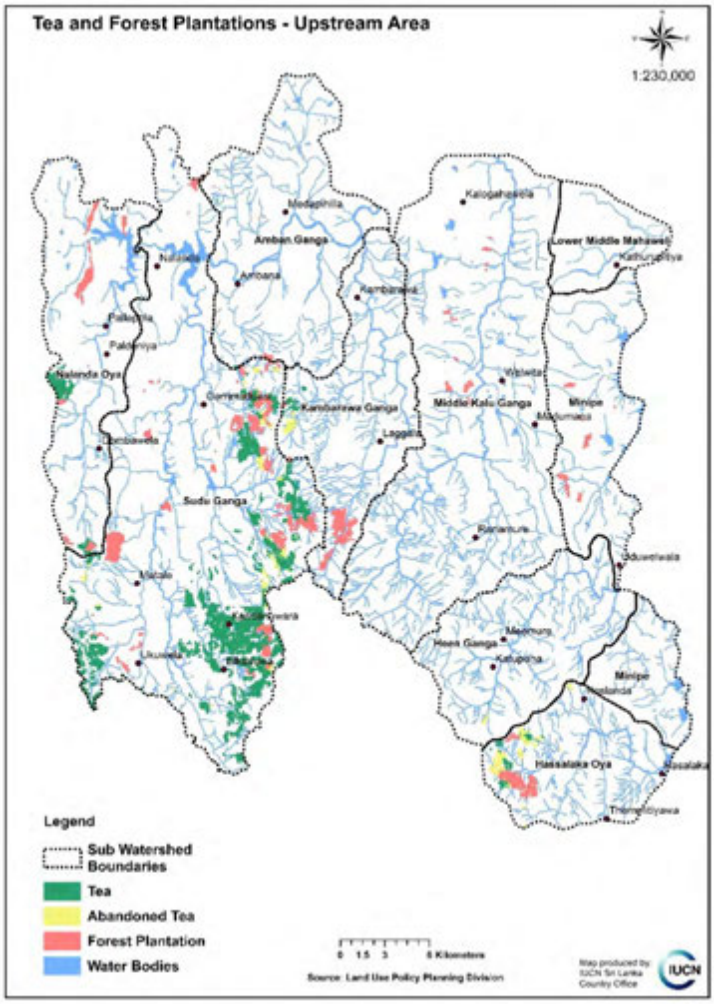


Figure 14: Tea and Forest Plantations – Upstream Area

2.3.8. Other Crops

An area of 7,539 ha is dedicated for seasonal crops in the upper stream/highland region while the extent of sparsely used croplands/chena is 29,269 ha, which comprise a huge area of the land.

Home gardens or homesteads contribute to a large portion (28,457 ha) of the land use area followed by coconut and rubber, which are considered as two major export crops of Sri Lanka. The large portion dedicated to home gardens demonstrates a tendency towards cultivating crops for household consumption, which can easily be employed as an income source in times of excess.

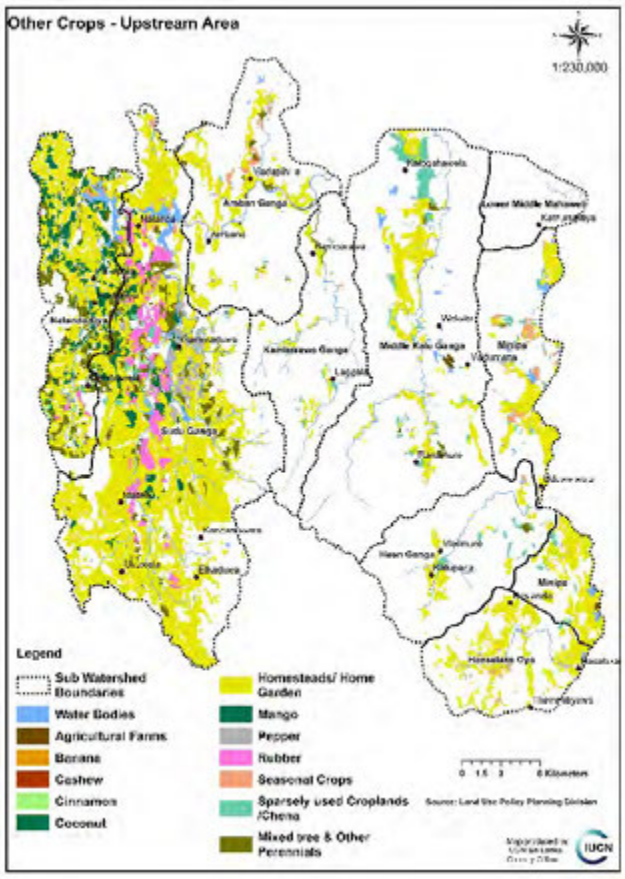
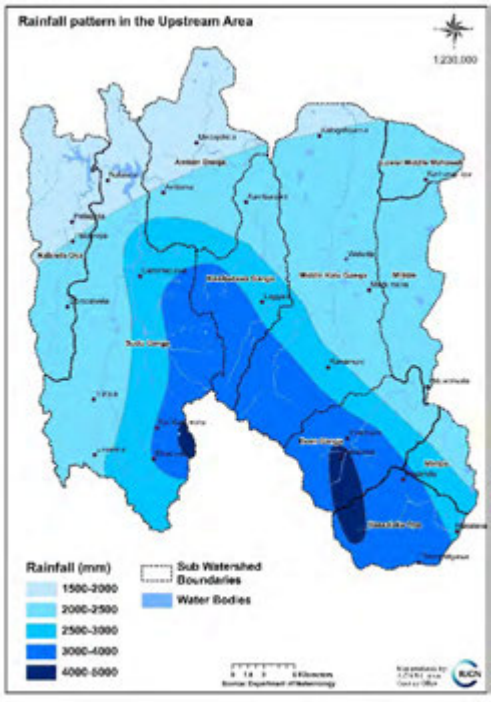


Figure 15: Homegardens, Spice, Coconut and Rubber – Upstream Area

Table 9: Homegardens, Spice, Coconut and Rubber – Upstream Area

Type	No of Locations	Area (ha)
Cashew	3	2
Cinnamon	25	102
Coconut	332	2,713
Mango	1	2
Pepper	141	1,076
Rubber	95	2,251
Homegardens	1,680	28,457
Mixed Tea and Other Perennials	366	3,397
Agricultural Farms	196	749
Total	**2,839**	**38,749**



2.3.9. Rainfall in the Upper Catchment

The upper part of the upper catchment area receives more than 3,000 mm of rainfall per annum. The rainfall in the northern part of the upper catchment is around 1,500 mm per annum. This indicates a wide range of rainfall between 1,500 to 5,000 mm within the upper catchment area, requiring a variety of adaptation management practices to meet climate challenges.

Figure 16: Rainfall in the upper catchment

2.3.10. Agroecological Region Management Zone Concept

Based on the climate and terrain features, Sri Lanka is divided into 46 agroecological regions (Punyawardena, 2007), taking into consideration the monthly rainfall amount (at 75% probability) and the distribution, in addition to the parameters that are considered when identifying climate zones. Figure 17 presents the map of agroecological zones in Sri Lanka.

These agroecological regions have been used extensively to decide the crops and management practices as described in the *Farmers Handbook on Droughts and Floods*[2] where information about agroecological regions are combined with soils, disaster and other relevant information for resilience related planning. The project area covers all three major climatic zones in the country, namely, Wet, Intermediate and Dry Zones and includes five agroecological regions, which are a further subdivision of climatic zones based on the elevation and rainfall.

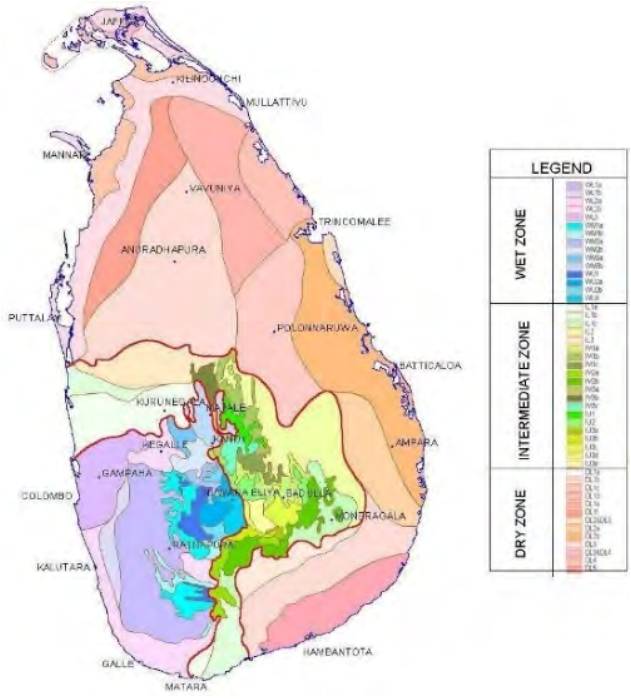


Figure 17: Agroecological Regions of Sri Lanka

Figure 18: Agro-eco regions in the project area

The five agroecological regions are, a) Dry Zone Low Country (DL); b) Intermediate Zone Up Country (IU); c) Intermediate Zone Low Country (IL), d) Intermediate Zone Mid Country (IM); and e) Wet Zone Mid Country (WM). These agroecological regions also provide an indication as to the types of vegetation suitable for economic and conservation purposes in a given region. The areas together combine a variety of climatic conditions that ranges from heavy rains to extreme droughts.

[2] Center for Agriculture Research Policy – CARP (2012). Farmers Handbook on Droughts and Floods https://goo.gl/u88S8k

Table 10: Agro-eco regions, rainfall regimes, soils and crop types

Agro-ecological zone	Annual Rainfall (mm)	Terrain	Major Soils	Typical land use
DL1b	>900	Undulating	Reddish Brown Earth & Low Humic Gley Soils	Rainfed Upland Crops, Paddy, Scrub Mixed Hom0e Gardens, Forest Plantation
DL1c	>900	Undulating	Reddish Brown Earth & Low Humic Gley Soils	Rainfed upland crops, Paddy, Scrub, Natural Forest, Forest Plantation, Sugar Cane
DL1e	>900	Undulating	Reddish Brown Earth & Low Humic Gley Soils	Rainfed Upland Crops, Paddy, Scrub
DL1f	>800	Undulating	Reddish Brown Earth, Low Humic Gley Soils & Grumusol Soils	Rainfed Upland Crops, Paddy, Scrub, Natural Forest
DL3	>800	Flat, Slightly undulating	Red Yellow Latasols (RYL) & Regosol Soils	Cashew, Coconut, Condiments, Scrub, Natural Forest
IL2	>1600	Rolling, hilly, Undulating	RBE, LHG & RBL soils	Mixed Home Gardens, Paddy, Rainfed Upland Crops, Scrub, Sugar cane
IL3	>1100	Undulating	Non Calcic Brown (NCB), Reddish Brown Earth & Low Humic Gley Soils	Coconut, Paddy, Mixed Home Gardens
IM1b	>2000	Hilly, Rolling & undulating	Reddish Brown Earth (RBE), RBL, LHG, Mountain Regesol & Lithisol soils	Natural Forests, Mixed home gardens, Paddy, Grass lands
IM3a	>1400	Hilly, Rolling & steep	IBL, RBL & LHG soils	Mixed Home Gardens, Export Agricultural crops, Paddy
IM3b	>1200	Rolling & undulating	RBL, RBE &LHG soils	Mixed Home Gardens, export Agriculture Crops, Rubber, Vegetables, paddy
IU1	>2400	Mountains, Steeply dissected, hilly & rolling	Red Yellow Podzolic, Mountain Regosol & Lithosol soils	Tea, Export Agricultural Crops, (Cardamom) Natural Forest, Forest Plantation
WM3b	>1400	Hilly, Rolling, undulating & steep	Reddish Brown Latosolic, Immature Brown Loam, Low Humic Gley soils	Mixed Home gardens, Export Agricultural Crops, Tea, Vegetables, Paddy

Section 3: Climatic Features: Country and Project Area

3.1. Climate Seasons in the Country

Two monsoons determine the climate seasonality of Sri Lanka. The seasons are distinguished by the timings of these two monsoons and the transitional periods separating them, termed as inter-monsoons.

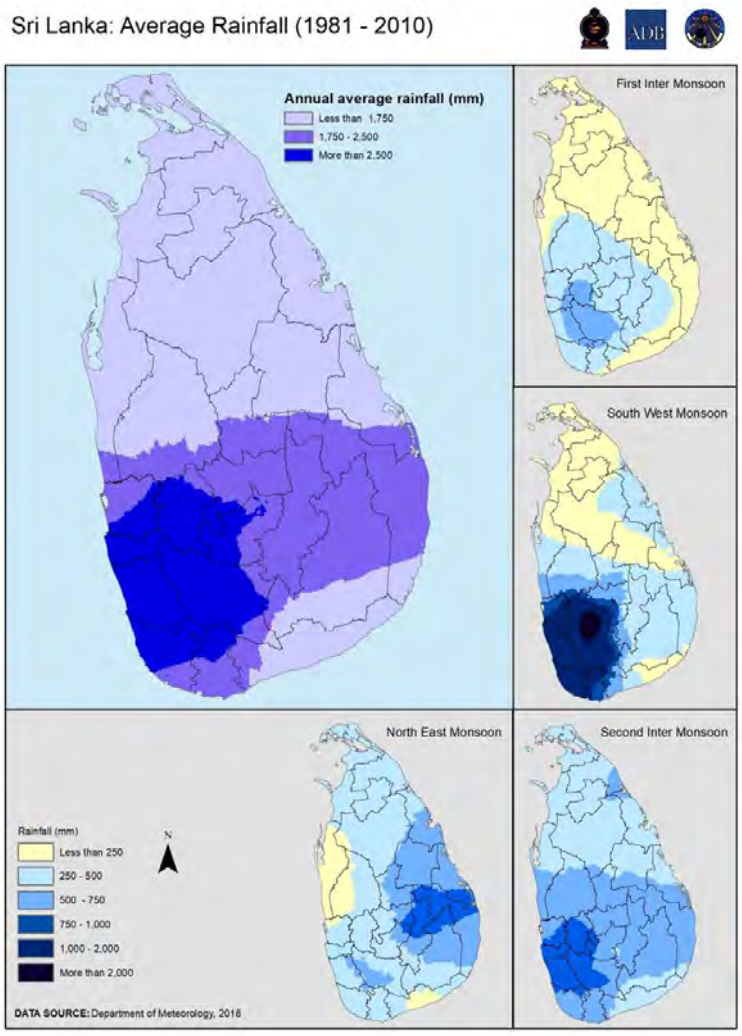


Figure 19: Average Rainfall of Sri Lanka (1981-2010)

Historically, out of the 1,990 mm of average annual rainfall, the Southwest Monsoon occurs from May to September, contributing to 30% of the annual average rainfall in the country while the Northeast Monsoon occurs from December to February also amounting to about 30% of the country's annual average rainfall.

The inter-monsoon periods, namely the First Inter-Monsoon and the Second Inter-Monsoon are from March to April and from October to November and contribute 14% and 30% to the annual average rainfall, respectively.

Traditionally, Sri Lanka's climate is generalized into three climatic zones; the "Wet Zone" in the southwestern region including the central hill country, the "Dry Zone" covering predominantly, the northern and eastern region of the country and the "Intermediate Zone," covering the central hills except in the south and the west.

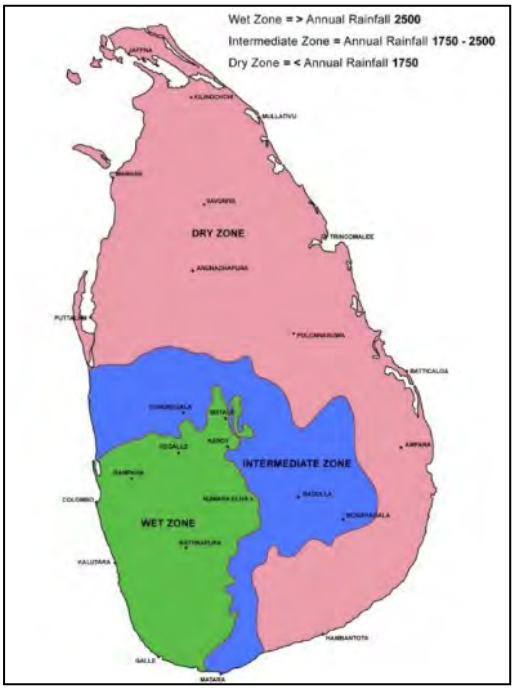


Figure 20: Climate Zones of Sri Lanka

The Wet Zone receives a relatively high mean annual rainfall, which is over 2,500 mm, without pronounced dry periods. The Dry Zone receives a mean annual rainfall of less than 1,750 mm with a distinct dry season spanning from May to September. The Intermediate Zone receives a mean annual rainfall between 1,750 to 2,500 mm with a short and less prominent dry season.

3.2. Climate Data and Recent Trends

Sri Lanka possesses a long series of historical climatic data, especially that of rainfall and temperature, starting from the 1860s. Recent data analysis indicate that the country's average temperature is significantly increasing at a rate of 0.01-0.03°C per year (Premalal and Punyawardena, 2013). It is also evident that the variability of seasonal rainfall during the most recent decade (2001-2010) has increased when compared to the previous decade (1991-2000) in most places of the island, across all three climatic zones, with occurrences of more frequent drought and flood conditions. Overall, the impacts of climate change are widespread, and are likely to create negative socioeconomic outcomes in many sectors within Sri Lanka (Climate Change Secretariat, 2017[3]).

Out of the 400 climate stations maintained by the Department of Meteorology, more than 80% of the stations demonstrated an increasing trend in precipitation indices. Nearly 75%, i.e. 65 of the stations, exhibited a significant increasing trend in the annual total precipitation as well as the number of days above 10 mm rainfall at the 5%-10% level. There is an indication of more Consecutive Wet Days (CWD) in inland areas, and less Consecutive Dry Days (CDD), especially over western coastal areas. In terms of extreme precipitation, more days above 10, 20 and 30 mm (R10mm, R20mm and R30mm), an increase in the annual highest daily amount (RX1day) and an increase in the highest five consecutive days (RX5day) of precipitation were recorded at many stations.

During the *Yala* season, pan evaporation is likely to range between 3 to 8 mm per day depending on the geographical region. Higher values over 7 mm per day are often experienced in dry lowland areas during this period. Meanwhile, a range of 2 to 5 mm per day is generally observed during the *Maha* season across different localities of the island.

[3] Climate Change Secretariat (2017). Climate change policy - https://goo.gl/ZCrXd9

The mean annual temperature in Sri Lanka demonstrates largely homogeneous temperatures in the lowlands and rapidly decreasing temperatures in the highlands. In the lowlands, up to an altitude of 100 m to 150 m, the mean annual average temperature is 27°C. In the highlands, the temperature falls quickly as the altitude increases. The mean annual temperature of Nuwara Eliya at an altitude of about 1,800 m is 15°C. However, during the period of January to mid-February, the diurnal temperature variation around Nuwara Eliya in the central hills is large and thus, ground frost could be observed early in the mornings or nights, about 3-7 days, when the temperature closer to the ground falls below freezing point.

Further, during the period of May to September, if the westerly winds are strong, the leeward area in the east of the Central Highlands and the relatively flat terrain extending to the East Coast experience warm, dry and gusty winds. Such Föhn like winds are locally known as *Kachchan* or *Yal-hulang*. In Föhn conditions, the relative humidity may fall to less than 50% causing vegetation and soil to dry out with possible bush-fire disasters in the Badulla and Moneragala districts. The coldest month with respect to the mean monthly temperature is January whereas the warmest months are April and August. The Figure 21 illustrates the spatial distribution of observed trends for occurrence of warm nights, occurrence of cold nights, diurnal temperature range, annual total precipitation and simple daily intensity. The upward-pointing red triangles show increasing trends, while the downward-pointing blue triangles indicate decreasing trends. Significant changes at the 5% level are indicated by large triangles and 10% level are indicated by small triangles

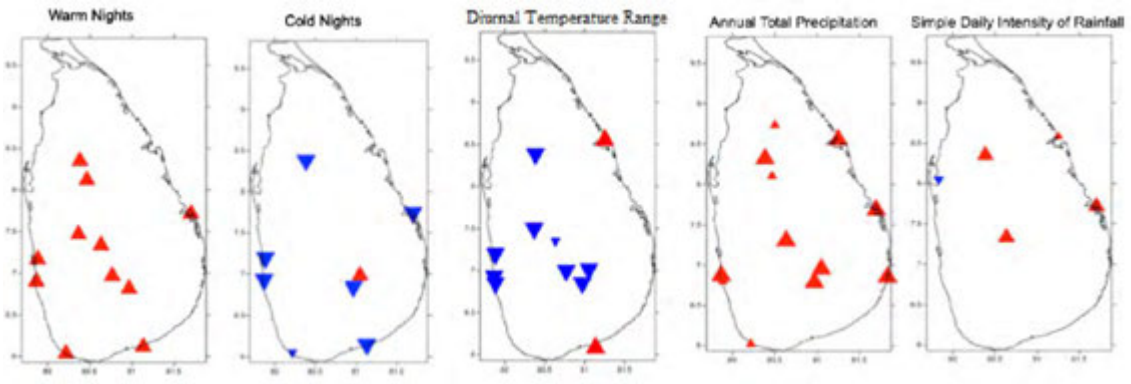


Figure 21: Spatial distribution of climate observations

The difference between maximum and minimum temperatures is decreasing, indicating that the minimum temperature is increasing faster than the maximum temperature. Diurnal temperature range is decreasing, and the decreasing trend is more significant in the *Maha* cultivation season in the dry zone. A significant decrease in the annual occurrence of cold nights and an increase in the annual occurrence of warm nights are evident.

Unlike in the case of temperature, no clear pattern or trend has been observed in precipitation. Department of Meteorology and Dept. of Agriculture records indicate heavy rainfall events have become more frequent in the Central Highlands during the recent period. However, many researchers seem to agree that the variability of rainfall has increased over time, especially during the *Yala* season (Chandrapala 2007b; Eriyagama et al. 2010; Punyawardena et al., 2013b). Moreover, the number of consecutive dry days have increased, and the consecutive wet periods have decreased (Premalal, 2009; Ratnayake and Herath, 2005). Some studies suggest that changes in the distribution can even lead to the shifting of agroecological boundaries (Eriyagama et al., 2010; Mutuwatte and Liyanage, 2013).

Emerging evidence from various sources suggest that climate change could alter natural systems connected to the water cycle, eco systems and biodiversity of the country (Eriyagama et al., 2010; Marambe et al., 2012; Weerahewa et al., 2012). This could lead to the decline of various ecosystem services that are indispensable to the welfare of the human population.

The intensity and the frequency of extreme events, such as floods and droughts have increased during recent times (Imbulana et al., 2006; Ratnayake and Herath 2005; Premalal and Punyawardena, 2013; Punyawadena and Premalal, 2013). Areas of high rainfall intensities and the locations of landslides show a strong correlation (Ratnayake and Herath, 2005). In summary, climate influence (rainfall and temperature) on the hydrology and ecosystems of the country and potential/suggested mitigation measures are described by different authors as follows:

a) The rainfall captured by the highlands from the South-West and North-East monsoons has changed - climate influence can be mitigated by strengthening the canopy structure;

b) Extent of rainfall harvested by the highland landscape and landforms – it is necessary to enhance the rainwater harvesting and take measures to increase the availability of groundwater, water available for services including drinking and water to be provided as surface or groundwater for agriculture and enterprises;

c) Temperature gradient from lowlands to highlands due to altitude and wind regimes and the shifting patterns of temperature (ambient, minimum and maximum daily temperatures) due to climate change;

d) Sea level rise and impacts on surface and groundwater in the coastal areas – manage ground water extractions and ensure the ground water levels are safely above sea level.

This requires a major change in the way the highlands and upper catchments are managed. For example, the highlands and upper catchments should be used for maximum rain capturing, harvesting of rainwater (surface and ground) and as a reserve to ensure adequate supply of water for multiple users.

3.3. Downscaled National Level Climate Forecasts[4]

NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) dataset (Nemani et al, 2015) is comprised of downscaled climate scenarios for the globe that are derived from the General Circulation Model (GCM) runs, under CMIP5 (Taylor et al. 2012) and across two of the four greenhouse gas emission scenarios, RCP 4.5 and RCP 8.5. NEX-GDDP data for 6 GCM climate models (25-kilometer (km) grid resolution) were used to develop figure climate projections. The Representative Concentrated Pathways (RCP) RCP 8.5 and 4.5 scenarios from of the IPCC AR5 2013, representing futures under high emission and moderate emission, respectively, were adopted, with three time periods. Figure 22 provides the multi model ensemble of change in Annual rainfall, relative to 1975-2005 for moderate emission scenario (RCP 4.5) (upper) and high emission scenario (RCP 8.5) for time periods (2020-2040) (left), (2040-2060) (middle), (2070-2090) (right).

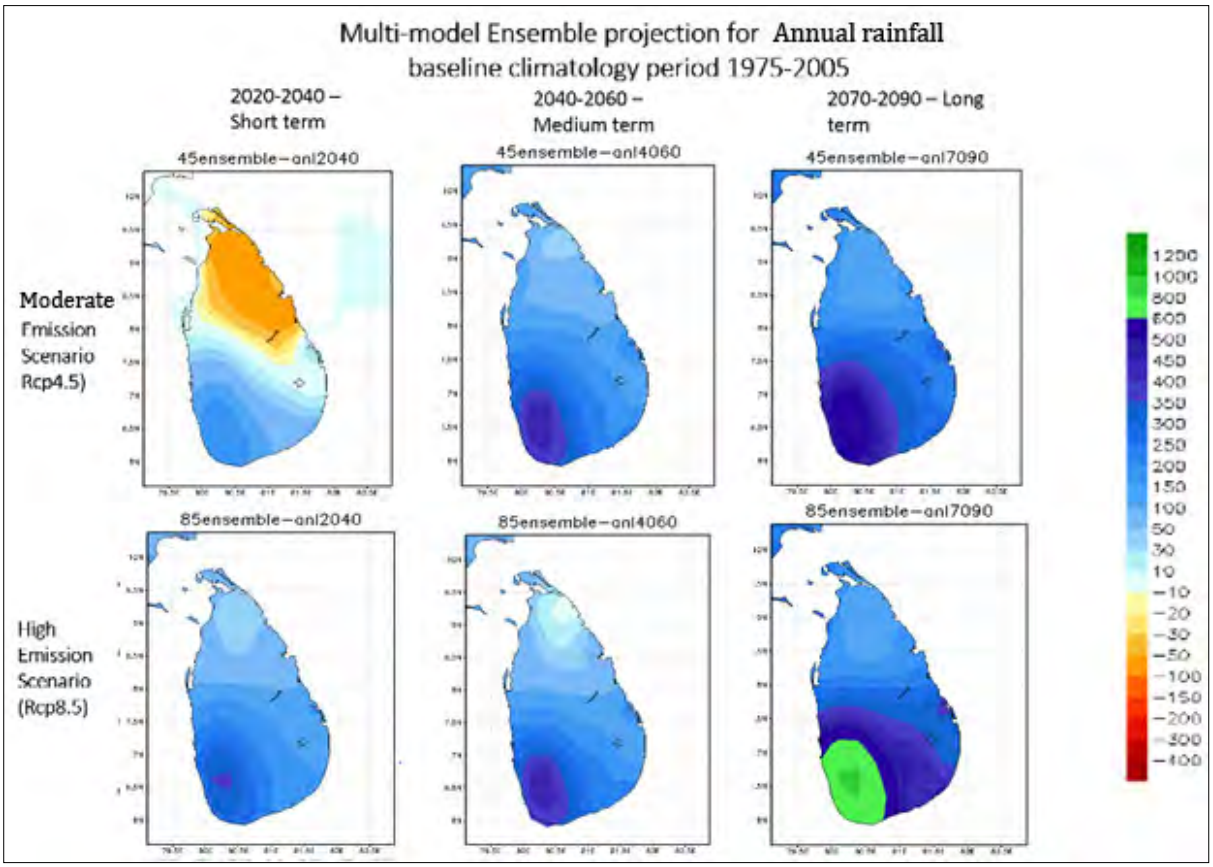


Figure 22: Multi model ensemble of change in Annual rainfall

Similarly the temperature projection is illustrated in the Figure 23 as the multi model ensemble of change in maximum temperature (left) and minimum temperature (right), relative to 1975-2005 for moderate emission scenario (RCP 4.5) (upper) and high emission scenario (RCP 8.5) (lower) for time periods (2020-2040), (2040-2060), (2070-2090).

[4] Shiromani Jayawardena, Thanuja Dharshika and Roshan Herath. 2017: Observed Trends, Future Climate Change Projections and Possible Impacts for Sri Lanka *NeelaHaritha Climate Change Magazine of Sri Lanka* 2:144-151

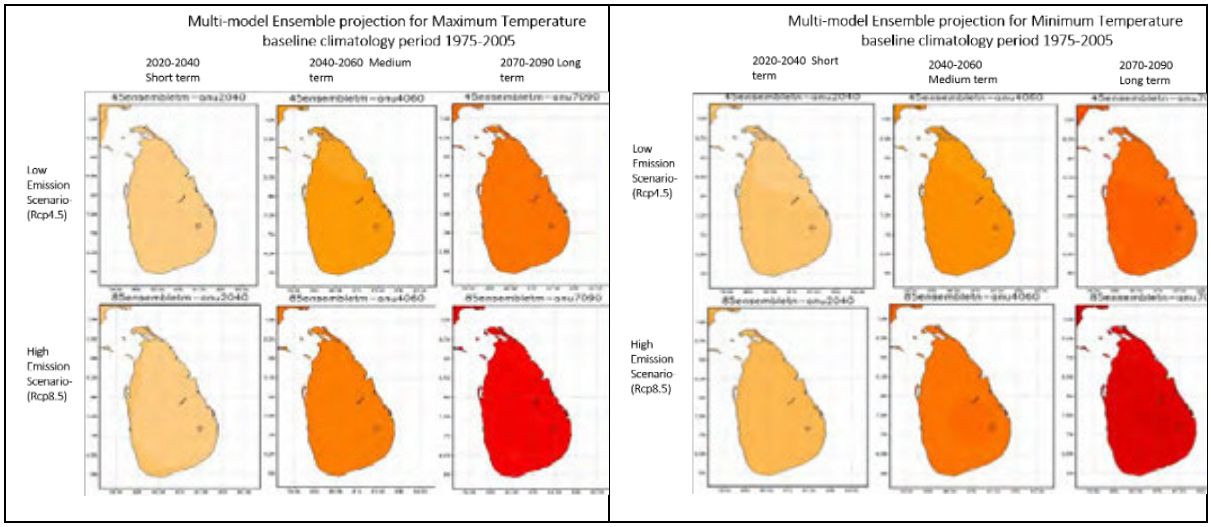


Figure 23: Multi model ensemble of change in maximum and minimum temperature

The downscaled predictions for the monsoons and inter-monsoon period are presented next as they are connected to the agriculture seasons.

The Figure 24 depicts the multi model ensemble of change in Southwest-Monsoon (SWM) rainfall, relative to 1975-2005 for moderate emission scenario (RCP 4.5) (upper) and high emission scenario (RCP 8.5) for time periods (2020-2040) (left), (2040-2060) (middle), (2070-2090) (right).

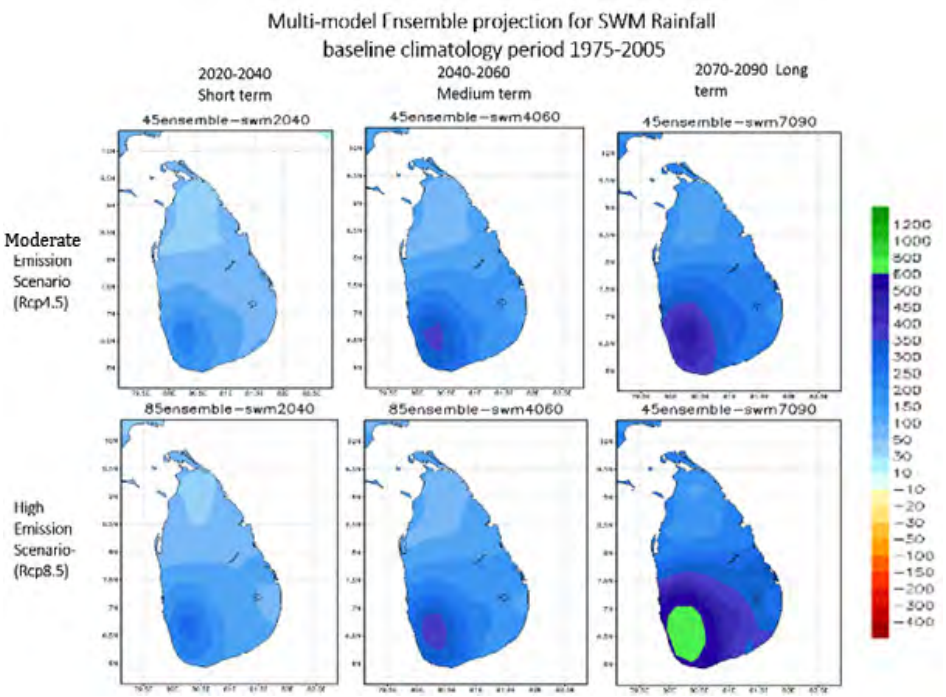


Figure 24: Multi model ensemble of change in South-West monsoon

Northeast Monsoon rainfall anomaly is negative for short-term, medium-term and long-term projections and a negative trend is observed under moderate emission scenario RCP 4.5. The Northeast Monsoon rainfall anomaly is slightly positive in the short-term projection 2020-2040, and negative thereafter for medium-term and long-term projections under the high emission scenario—indicating a negative trend for high emission scenario RCP 8.5. A significant decreasing anomaly is significant over the dry zone. Figure 25 describes the multi model ensemble of change in Northeast-Monsoon (NEM) rainfall, relative to 1975-2005 for moderate emission scenario (RCP 4.5) (upper) and high emission scenario (RCP 8.5) for time periods (2020-2040) (left), (2040-2060) (middle), (2070-2090) (right).

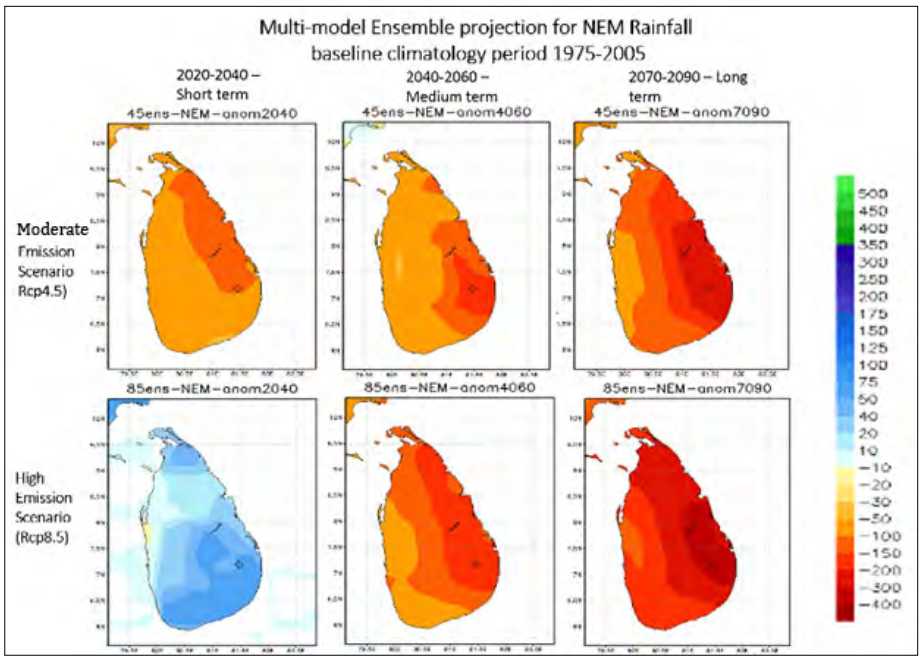


Figure 25: Multi model ensemble of change in Northeast-Monsoon (NEM) rainfall

The First Inter Monsoon rainfall anomaly is negative in 2020-2040, slightly negative in 2040-2060 and positive except Northeastern parts under moderate emission scenario RCP 4.5. The First Inter-Monsoon rainfall anomaly is negative in all three-time frames with no significant trend under the high emission scenario RCP 8.5. Figure 26 illustrates the multi model ensemble of change in First Inter-Monsoon (FIM) rainfall, relative to 1975-2005 for moderate emission scenario (RCP 4.5) (upper) and high emission scenario (RCP 8.5) for time periods (2020-2040) (left), (2040-2060) (middle), (2070-2090) (right).

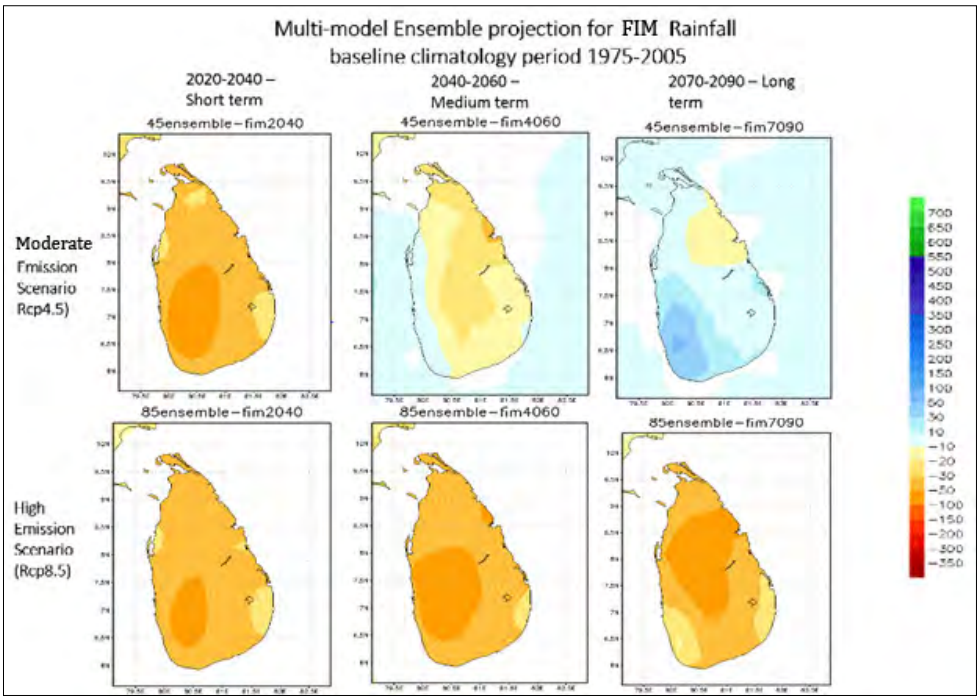


Figure 26: Multi model ensemble of change in First Inter-Monsoon (FIM) rainfall

The Second Inter-Monsoon rainfall anomaly is negative in the dry zone, and positive in the wet zone in 2020-2040. In addition to this, the seasonal rainfall anomaly is increasing under RCP 4.5. The Second Inter-Monsoon rainfall anomaly is positive and increasing under RCP 8.5 scenarios with a significant increase in the positive rainfall anomaly over the South-Western and South-Eastern parts. Figure 27 describes the multi model ensemble of change in Second Inter-Monsoon (SIM) rainfall, relative to 1975-2005 for moderate emission scenario (RCP 4.5) (upper) and high emission scenario (RCP 8.5) for time periods (2020-2040) (left), (2040-2060) (middle), (2070-2090) (right).

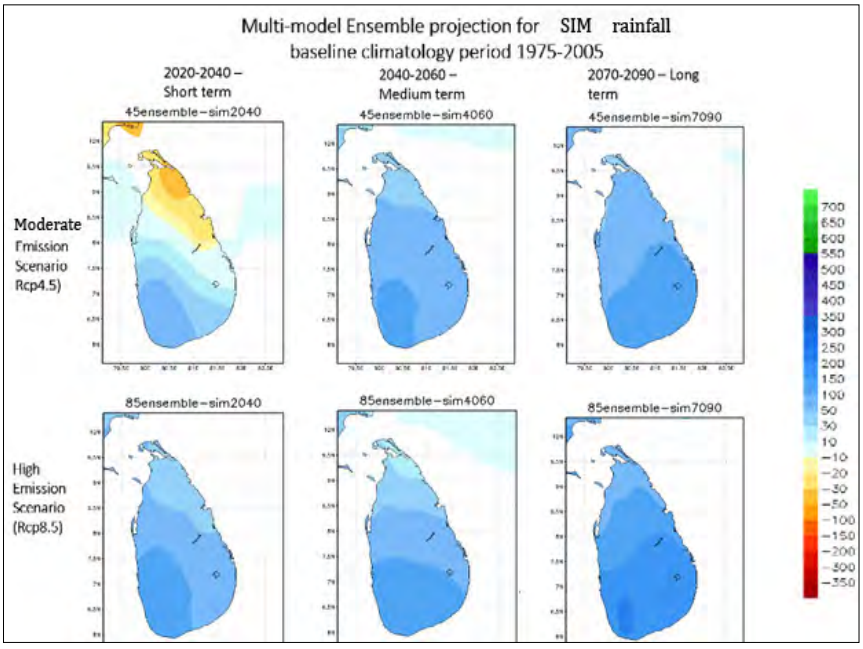


Figure 27: Multi model ensemble of change in Second Inter-Monsoon (SIM) rainfall

3.4. Shifting Climate Zones

According to the records of the Dept. of Meteorology, processed during the ADB funded study to CCS, a shifting of the climate regions from 1960 to 2010 is indicated, making the project area drier with the dry zone in the project area expanding and the wet zone being changed to the intermediate zone.

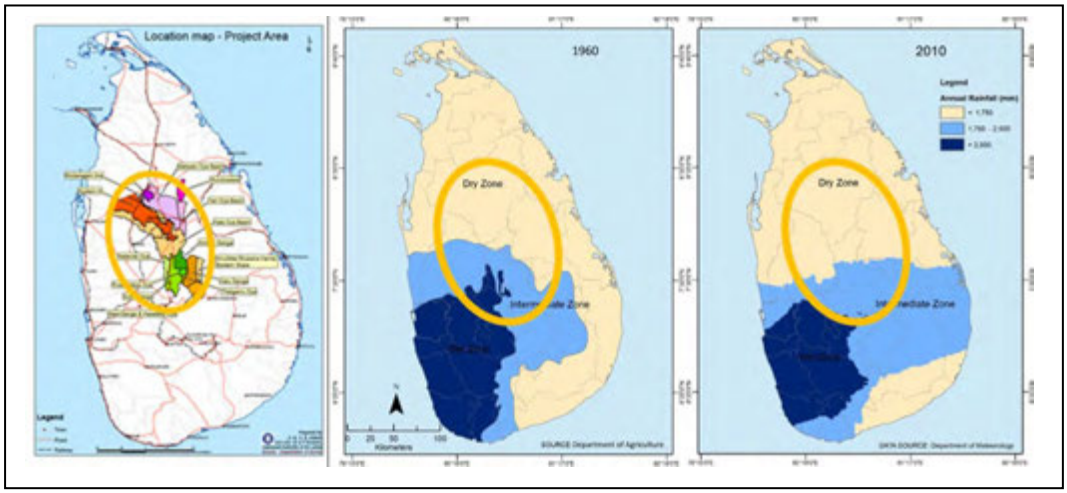


Figure 28: Shifting of the climate zones with respect to the project area

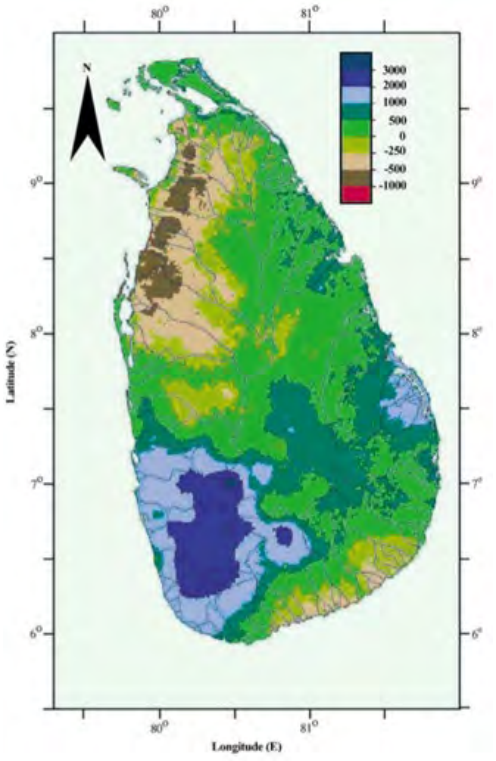


Figure 29: Water availability deficit in Sri Lanka

Change in the historical pattern and seasonality of rainfall not only impact drought, which directly affects the growth of rice along with the maturation and harvest. Intense rains in harvesting season in 2018 destroyed the harvest of mature rice in fields and hampered the farmers. This shifting of the climate zones will further aggravate the existing water deficit in the area as presented by Bastiaanssen and Chandrapala (2003)[5].

the project area falls between -500 mm in the lower catchment to + 500 mm area in the upper catchment. With climate zones shifting the project area is moving to the water deficit area that require intensive rainfall harvesting in both upper and lower catchments and enhance rain/cloud capture in the upper catchment.

[5] [5]Bastiaanssen, W.G.M and L. Chandrapala. 2003. Water balance variability across Sri Lanka for assessing agricultural and environmental water use. Agricultural Water Management 58: 171-192

3.5. Potential Climate Related Vulnerabilities

Climate change is impacting Sri Lanka through changes in rainfall, temperature and wind. As detailed above, temperatures are increasing while rainfall is becoming more variable with rain falling in a smaller number of more intense events that are more erosive.

The people and economy of Sri Lanka are heavily dependent on water for irrigation, domestic and industrial use and electricity generation. Rainfall in the wet and intermediate climatic zones of the country is collected in an intricate series of reservoirs and delivered to the dry zone agricultural lands and this water is also used for electricity generation as a by-product. This water collection and delivery system are threatened by reservoirs silting up at alarming rates.

Climate change has been aggravating rainfall disparities across the country, resulting in increased impact of flooding and landslides in the wet zone, increasingly frequent and severe droughts in the dry zone and an overall reduction in water availability through a combination of changes in precipitation and evaporative losses due to higher temperatures and wind speeds.

The highland catchments of Sri Lanka also include key biodiversity hotspots as well as important agricultural and forest production areas that are threatened by land degradation accelerated by climate influence. The need to adapt to shifting climatic patterns including changes to flowering times of key export crops are highlighted. Recently, it has been recognized that there is an immediate need to restore and sustainably manage land in the upper watershed areas to control sediment flow and rehabilitate failing parts of the water storage and distribution network, including making efficient use of water in agricultural production.

Cropping indices (the mean number of crops harvested per year) is <1 in some areas in the highlands as well as in downstream areas, where land use is predominantly rice irrigated with water stemming from highland catchments. This is associated with many farmer families and estate workers facing food insecurity (the national prevalence of malnourishment stands at 22%). Modelling studies of the impact caused by climate change on water requirements in paddy irrigation reported that climate change impacts on wet season paddy production were positive in the extreme south of the country, but negative across most of Sri Lanka[6].

Therefore, there is a need for different adaptation strategies for the two regions. This signifies that possible adaptation and mitigation measures need to be explored to safeguard rice production to ensure food security in the future. Using national rice statistics and estimates of intensification, it was found that improvements in rice production can feed 25.3 million Sri Lankans (compared to a projected population of 23.8 million people) by 2050[7]. However, to achieve this growth, the focus should be on the water and input use efficiency, combining climate challenges. This approach also provides for an opportunity to control overuse and misuse of agrochemicals and reduce the environmental impact of agriculture, while still allowing around a 30% increase in production of major cereals (maize, wheat and rice) through better water management.

[6] De Silva, C.S. E.K. Weatherhead, J.W. Knox, J.A. Rodriguez-Diaz 2012. Predicting the impacts of climate change—A case study of paddy irrigation water requirements in Sri Lanka. Agric. Water Manage. (2007), doi:10.1016/j.agwat.2007.06.003

[7] Davis Kyle Frankel , Jessica A. Gephart Thushara Gunda 2016. Sustaining food self-sufficiency of a nation: The case of Sri Lankan rice production and related water and fertilizer demands. Ambio 2016. Volume 45, Issue 3, pp 302–312

A national climate vulnerability study[8] with a district resolution suggests that the greatest overall vulnerability is in the dry zone areas (see maps below) where fewer rain days coupled with higher temperatures and PET lead to drought, reduced crop yields and higher risk for farmers, while some of the districts most sensitive to climate change comprise key highland catchments. Accelerated degradation of climate sensitive highland areas impact downstream irrigated agriculture, through reduced water yield and storage. Figure 30 indicates the sensitivity (Left) and vulnerability (Right) to climate change by districts. In terms of climate vulnerability, the highly sensitive upper catchment area is in the intermediate zone (Matale ranks 20 out of 25 districts nationally in terms of sensitivity) while its water irrigates the highly vulnerable downstream areas. (principally in Anuradhapura and Kurunegala districts that rank 18 and 19 out of 25 districts in terms of climate vulnerability).

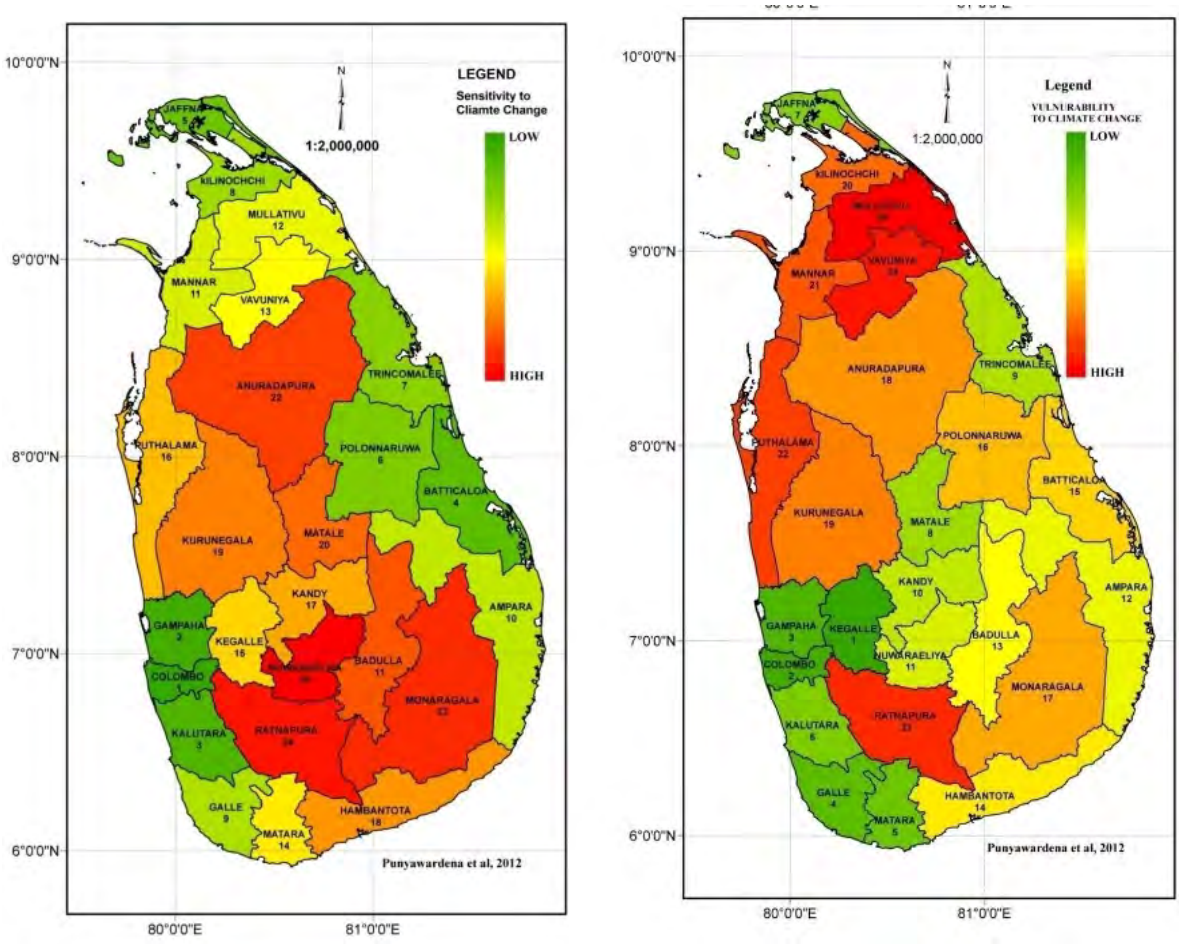


Figure 30: Sensitivity and vulnerability to climate change by districts

The agricultural productivity in downstream areas of Sri Lanka's dry zone is vulnerable to a combination of increasing seasonality of rainfall, resulting in fewer rainy days and longer intervals between them (described above) and increased temperatures. There is agreement amongst GCM predictions that temperatures will rise across the country between now and 2050, exacerbating drought through increasing potential evapotranspiration (PET). Of relevance to the project area is a likely decrease in rainfall during rice and maize growing periods in the *Maha* season (January) and during rice and maize sowing periods in the *Yala*

[8] Punyawardena R, Dissanaike T and Mallawatantri. A. 2013. Spatial variation of climate change induced vulnerability in Sri Lanka. An analysis of the components of vulnerability at district level. Peradeniya: Department of Agriculture. ISBN 978-955-674-139-1

season (May) that are likely to depress yields and increase irrigation water demand (see graphs below). It was already shown above that the largest increase in rainfall seasonality is predicted in downstream agricultural areas where drought is a recurring problem. Other studies with five GCMs (Jayawardena *et al.* 2017[9]) also suggested that precipitation for the South-West Monsoon was expected to increase, but that precipitation for the North-Eastern Monsoon was expected to decrease which would further exacerbate problems of high rainfall in highland catchments and drought in the dry zone.

3.6. Potential Climate Impacts

3.6.1. Droughts

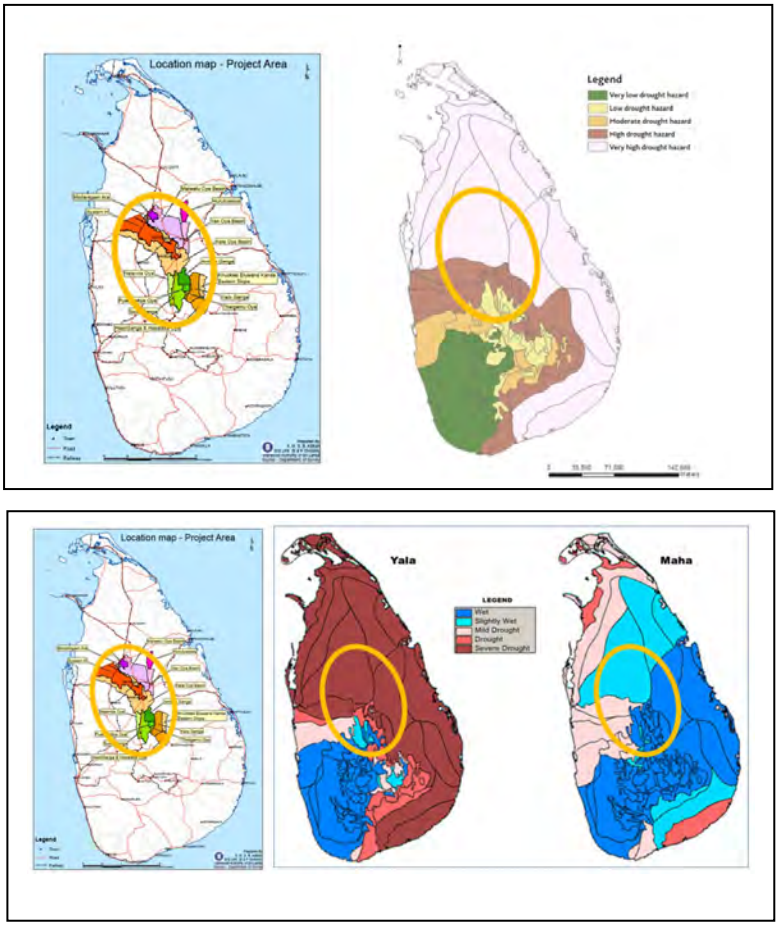


Figure 31: Drought – average and seasonal in the project area

The project is in a drought prone area in Sri Lanka and most of the project area falls within the very high and high drought hazard areas[10].

In terms of seasonal vulnerability (two agriculture seasons *Yala* and *Maha*), the highest drought impact is felt during the *Yala* season[11].

Droughts impact agriculture in many ways. Firstly, the impact of delayed rains and early season droughts are experienced. They delay field operations; delay sowing or prompts untimely sowing of seeds; results in poor germination while low crop stand and weak seedlings increase the susceptibility to pests. The second effect is the late season or terminal drought that impacts the vegetative phase of the crop growth. The most obvious effect of water stress attributed to drought conditions during this period is the reduced leaf expansion. Visible injury of water stress is seen in the form of wilting. Paleness and dryness of leaves is also seen during prolonged drought conditions. Leaf abscission is often noticed due to the accumulation of Abscisic acid under prolonged drought conditions. Reduced growth of crops

[9] Shiromani Jayawardena, Thanuja Dharshika and Roshan Herath. 2017: Observed Trends, Future Climate Change Projections and Possible Impacts for Sri Lanka *NeelaHaritha Climate Change Magazine of Sri Lanka* 2:144-151
[10] Hazard profiles of Sri Lanka – Drought (UNDP, 2012) - https://goo.gl/8okLu6
[11] Farmers Handbook on droughts and floods (Center for Agriculture Research Policy, 2012) - https://goo.gl/u88S8k

can also be seen due to the reduction in cell volume and water potential. Apart from this, poor seed/ pod/ fruit settings will also be observed.

Drought impact severity in the project area for paddy cultivation, irrigation and dwellings is highlighted by the ADB funded (to be published, 2018) vulnerability assessment.

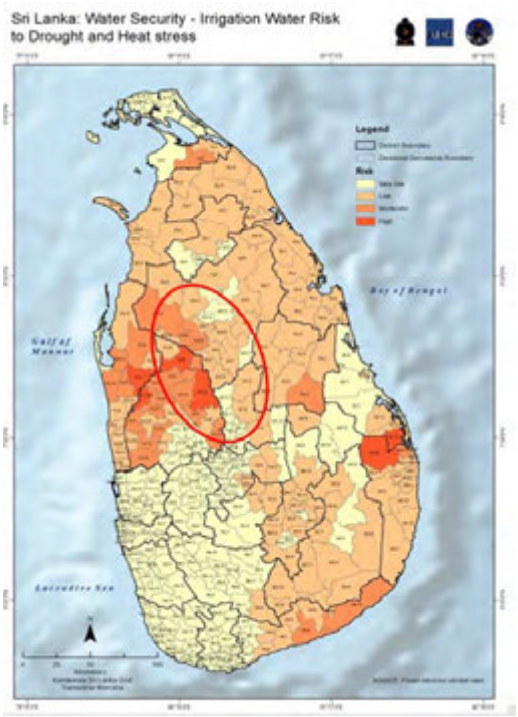


Figure 32: Irrigation Water Risk due to Drought and Heat Stress

Drought impacted over a million people (1,041,690) in Sri Lanka in 2017 and 855,307 in 2016 mainly through the failure of irrigated rice in dry zone farming areas. Across Sri Lanka, official estimates put the 2017 aggregate rice output at 2.5 million in 2017 tons (1.7 million tons, milled basis), which is 43% less than the output in 2016 and 41% lower than the mean of the previous five years. The decrease is the result of a severe drought at the end of 2016 and early 2017, which compromised water availability for irrigation for the 2017 main *Maha* and secondary *Yala* season crops, resulting in a considerable decrease in what was planted, widespread crop losses and reduced yields. harvests of other crops, including maize, various pulses, chilies and onions, mainly grown under rain fed conditions were also heavily reduced due to the drought.

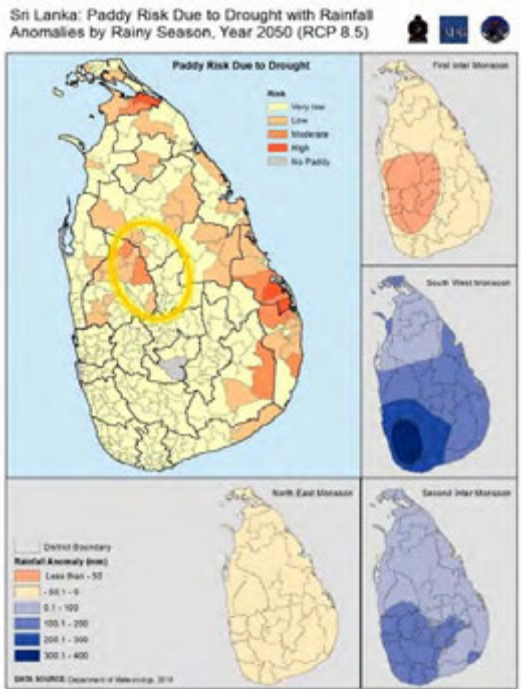


Figure 33: Paddy Risk due to Drought RCP 8.5

The highland rice farmers and the downstream farmers in the project area are mostly subsistence farmers. This is due to the fact that unlike other dry zone farmers who have the opportunity to grow two crops per year, as a result of past Government investments to develop large scale water storage and irrigation systems, the rice farmers in the project area are unable, on average, to complete one crop per year on all of their paddy land (cropping intensity (CI) is <0.8). Rice is grown primarily for household consumption and CI<1 result in no surplus to sell. Climate change threatens the ability of farmers to grow enough rice for their annual household consumption and many have no other income source to broker their food security. Most farmers in these areas are paid a Government social welfare protection allowance (Samurdhi) that is provided with food in kind as support to all subsistence farmers.

Highland farmers in the Knuckles area cultivate paddy using rainwater and by tapping stream water from mountain springs. Extended dry periods in 2015, 2016 and 2017 affected maturation of the rice crop, as required water was not available at the critical point in the plant life cycle. The choice of planting short duration rice varieties (3 months – "Bala wee") or long duration rice varieties (5 months – "Mawee") is made at the beginning of the season based upon what rainfall has occurred at that time of planting. Many farmers choose long duration rice varieties, which provide a higher yield, banking on the weather being consistent with their expectations from the rainfall at planting time. Mahaweli irrigation system managers are pressurized by the farmers who cultivate long duration varieties, to distribute water to maintain adequate availability for downstream for longer periods. These are the issues which need urgent requirements; a) to build new village tanks to restore, b) improve capacity of existing village tanks and ponds for upstream farmers, c) to reduce sedimentation of reservoirs to improve water holding capacity alongside managing downstream demand for irrigation.

3.6.6.1. Drought Impacts in the Command Area

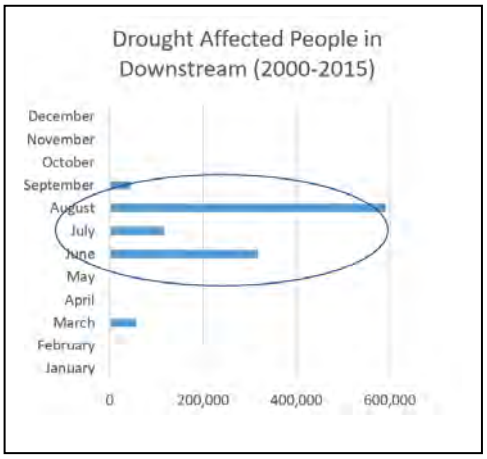


Figure 34: Total monthly drought affected 2005-15

The number of drought-affected people in the downstream area is high in the *Yala* season (June to August) as per the statistics based on the national disaster event "DesInventar" database of the Disaster Management Center as indicated by the total affected by drought between 2000-2015.

These high numbers of drought affected people are also linked to the rainfall[12] in the upstream and downstream areas, during June to August that corresponds to the *Yala* Season, despite current irrigation facilities in the downstream (tanks and cascades that collect water from the catchment areas in the upstream).

Also, it is noted that the rainfall received in the upstream area during the May to August period is not properly captured (low infiltration), partly increasing the vulnerability to drought in the *Yala* season both in upstream and downstream areas. Poor water management systems in the watershed and siltation caused the reduction of water capacities of manmade irrigation schemes in the downstream area can further aggravate the climate impacts. The actions proposed by the GCF project to increase the interventions in the upstream to avoid land degradation and sustainable water infiltration without creating landslide risks could be justified under this climate change argument while improving the water use efficiency in the downstream areas.

Based on a field experiment[13] carried out in the Kurunegala area (downstream project area), the rice production has demonstrated a declining trend and the estimated reduction is about 20% in mid-century (average across 20 GCMs) due to climate change. Extrapolation to the

[12] "Rainfall Distribution in Sri Lanka in Time and Space: An Analysis Based on Daily Rainfall Data" by T.P. Burt and K.D.N. Weerasinghe.
[13] S.P. Nissanka. 2109. Climate change impact on future rice yield and food security of Sri Lanka. Personal communication

national level resulted a shortage of 28% in the rice requirement causing a severe threat to food security. These findings highlight the importance of adaptation and policy level interventions to develop appropriate safeguards.

Breakdown of the water use in rice paddy include the following parameters.

Transpiration = 1. 5 – 9. 8 mm/day
Evaporation = 1. 0 – 6. 2 mm/day
Percolation = 0. 2 – 15.6 mm/day
Total water losses = 5.0 – 20.4 mm/day

The water requirement for different field operations in rice paddy included Nursery = 40 mm; Land preparation = 200 mm; and Field irrigation = 1,000 mm, with a Total water requirement = 1,240 mm/cropping season.

Nissanka (2019) used Climatic data from 1980-2010 (30 years) as the baseline to downscale 20 GCMs (CMIP5-RCP8.5) in mid-century (2040-2069) for the comparison of simulated future predicted yields using the DSSAT model. Model was calibrated based on the crop management and yield data of randomly selected representative 104 paddy farmers who cultivated rice varieties of Bg-300 (3 months old) and Bg-357 (31/2 months old), from three regions; namely Rajanganaya, Nikaweratiya and Batalagoda from one of the major rice cultivating district of Kurunegala (comes under dry and intermediate agro-climatic zones of Sri Lanka) – in the downstream project area. During 2012/2013 growing seasons (Minor (May-September) and Major (Oct-February) results indicated that Average annual temperature increase in the mid-century range from 10C (GCM-ILXA) to 2.30C (GCM-IMXA) with the predicted yield reduction range from 6.5% to 22% in the major rice growing season while the temperature increase range from 1.20C (GCM-ILXA) to 2.60C (GCM-IAXA) with the yield reduction range from 16% to 39% in the minor seasons respectively.

Effect of temperature increase was severe for the longer duration rice variety than the short duration variety. These outcomes highlight the urgent need of making appropriate policy level interventions to ensure that there is a sustainable rice production to meet the country's growing demand.

3.7. Potential Evaporative Losses

Potential Evapotranspiration (PET) characterizes the micro-meteorological conditions that is also influenced by the climate change, in terms of evaporative power or demand. It is the maximum evaporation rate, which the atmosphere is capable of extracting from the field with given surface/canopy properties.

The PET depends on the environment factors present including the climate change influence (rainfall, temperature, wind speed etc.) and the state of moisture (season, type of tree cover etc.) in the object (tree or soil surface). Knowledge of the PET can therefore be helpful for planning the adaptation interventions, such as changing the canopy shape, canopy cover, irrigation tank rehabilitation, surface changes, water use efficiency improvements etc.—many of the elements involved in the proposed GCF investment project.

The Penman (1948)[14] approach—one of the most widely used estimation tools for PET is based on a combination of the energy balance and aerodynamic transport conditions. It uses the following key variables (all of which are influenced by climate change and can also be influenced by adaptation measures):

1. Saturated vapour pressure,
2. Mean vapour pressure in air,
3. Mean wind speed at 2 meters above ground or canopy,
4. Net radiation, and
5. Air Temperature.

Actual evapotranspiration from a field generally constitute a fraction of PET often ranging between 60% to 90%, determined or measured through "Pan Evaporation" techniques. There are empirical mechanisms to arrive at the evaporation from bare soil or canopy using PET, which is normally about 0.8 to 0.9 times that of PET in the given location, in tropical environments. The surface roughness (cover type on the ground or canopy structure and leaf characteristics) is one factor that contributes to the rate of evapotranspiration—again

Table 11: Evaporation loses from different crops

Land cover	Area (km^2)	Evaporation (mm per year)	Evaporation (Mm^3)	Evaporative depletion (%)
Tea	2,569	1246	3,201	3.8
Rubber	2,295	1341	3,078	3.7
Coconut	2,945	1335	3,932	4.7
Paddy	7,815	1226	9,581	11.4
Moist monsoon forest	2,923	1263	3,692	4.4
Sub-montane forest	796	1240	987	1.2
Dry monsoon forest	10,613	1407	14,933	17.8
Lowland rain forest	1,796	1319	2,369	2.8
Sparse forest	4,772	1247	5,951	7.1
Riverine dry forest	534	1348	720	0.9
Mixed vegetation	28,325	1245	35,434	42.0
Total	65,383	1279	83,806	99.8

important for planning and implementation of adaptation measures.
At the national scale, the evaporation depletion of canopy types does not vary much and stay within the ranges of 1,200 mm to 1,400 mm per annum Bastiaanssen and Chandrapala (2003). However, the total volume that evaporate depends on the green cover where the highest contribution to evaporation losses are from mixed vegetation, dry monsoon forests followed by paddy.

In this GCF investment, detailed studies and monitoring of the PET changes as a result of project interventions will be tracked and documented.

3.8. Intense Rain and Damages

High intensity rainfall, apart from damaging community infrastructure such as bridges, buildings and roads, is also a strong threat to agricultural infrastructures, as they get damaged under flood situations. This may range from washing away of dikes in paddy tracts and

[14] Penman, H.L. 1948. Natural evaporation from open water, bare soil and grass. Proc. R. Soc. London Ser. A 193, 120-146.

damages to canals in irrigation systems, *anicuts* in diversion schemes to breaching of earth filled dams of both minor and major tank categories. This will be an additional burden to farmers and the government and could result in certain agricultural lands being abandoned for several seasons until rehabilitation work has been completed.

Sand filling is often observed after flood water is drained off naturally. Piled up sand and silts along with large quantities of debris are a common sight in paddy tracts in the flood plains of Sri Lanka. Before the re-start of cultivation, these materials have to be removed with a high cost of labour.

Tree crops, such as coconut, palm and fruit trees, will hardly be impacted by floods, unless fast moving flood water up-roots them. Damage to annual crops will have greater variability from recoverable damages to complete crop devastation depending on the type of crops and the age at which submergence occurred. If crops have been completely washed away, farmers are compelled to find seed materials for the next attempt. Even though there is a slim chance of finding the required seed materials from the area itself, the most probable outcome would be the unavailability of the preferred variety or age class that farmers look for. Ultimately, all these will lead to a high cost of cultivation, reduced crop production and loss of anticipated farm income with subsequent negative impacts on livelihood.

Current land use practices in the upper catchments are vulnerable to high intensity rainfall and winds and the crops are subjected to changing temperature and rainfall regimes, impacting the quality of lives of subsistence farmers. These farmers are already pressurized due to poverty. Without significant measures to empower them, in order to have a reliable water supply for day to day activities as well as agriculture and value addition of produce, they will be subjected to extensive impacts of climate change. Living in the margins of poverty, these subsistence farmers do not understand climate risks, connections between soil-water-climate linkages and possibilities for them to beat the climate risk by working with information, technology and markets. Introduction of adaptation measures require working in several parallel areas including better investments to enhance the income of communities, technologies to reduce harvest losses and predict climate variability to adjust crop selection and cultivation patterns and connect the impacts of temperature changes including diurnal fluctuations to the changes in fauna, flora and temperature impacts on the water cycle.

Irrespective of the magnitude of the flood, any added fertilizers will wash away from the agricultural fields with moving flood water, especially from paddy tracts. This will lead an increase in the cost of cultivation of the crop as the farmer would have to re-apply them. Meanwhile, some paddy tracts are to be benefited from minor scale floods as they will deposit very fertile silts in these tracts. The same process results in soil erosion and siltation of tanks and reservoirs. During a flood, rivers will carry large masses of soil and plant debris and deposit them downstream. These deposits reduce the flowing capacity of the river resulting in overflows and meandering of the river, and erosion of the riverbank with subsequent siltation of the downstream.

One of the most significant impacts of floods in rice growing areas is the reduction of seed paddy production for the following season. If the harvesting time of the crop coincides with unusual rain spells, seed paddy production cannot be done. It will not only affect the farmers' current income but also leads into severe shortage of seed material for the next season too with a subsequent web of negative impacts.

These impacts lead to the high cost of cultivation, reduced production both in terms of quantity and quality with subsequent loss of farm income affecting the livelihood of the farming community. It will also affect other service providers of the area who supply necessary inputs for cultivation and other day to day needs such as groceries, transport etc.

3.9. Soil Quality Deteriorations

Loss of soil carbon, often associated with unsustainable agricultural practices and exacerbated by erosion of topsoil is now seen as a global problem undermining soil health, water retention and fertility. There are two key issues for this project. Firstly, climate induced erosivity of rainfall results in removal of topsoil that is high in carbon contributing to reduction of soil carbon in the catchment while reducing reservoir capacity through sedimentation. Secondly, reduction in soil organic carbon is associated with lower water retention capacity of soil, exacerbating flashiness of catchments unable to hold water when it rains.

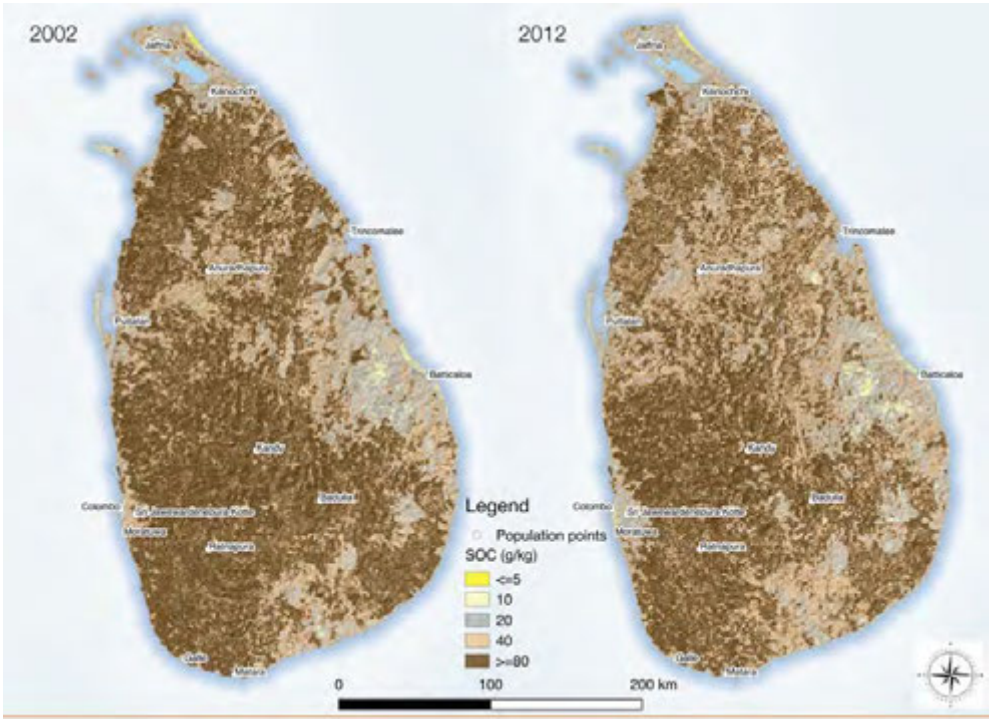


Figure 35: Soil organic carbon observations in 2002 and 2012

Satellite image analysis spanning across 2002 and 2012 based on MODIS (source: ICRAF) above indicates considerable reduction in soil organic carbon in Sri Lanka, particularly in the upstream catchment areas in the project area. Land degradation has pernicious knock on effects on livelihoods where it is associated with reduced agricultural productivity.

Immediate effects on local food security are evident and documented above, but causation may be more complex. For example, an intersection of low labour productivity and minimum wage legislation aggravated by land degradation and climatic variability pressures on the plantation sector in Sri Lanka, leading to abandonment of degraded estates or a shift to out-grower schemes where estate workers are allocated areas to manage themselves. The land is generally owned by government and are on long term leases to estate companies who then enter into contractual relationships with smallholder farmers. The nature of these relationships

condition incentives to adopt sustainable land use practices and may leave workers with neither sufficient income to buy enough food to feed their family nor fertile land on which to cultivate.

There is a clear link between erosion in upstream catchments and irrigation supply to downstream agriculture through sedimentation reducing reservoir capacity.

3.10. Vegetative Cover, Soil Organic Carbon and Erosion Potential

Recent ICRAF simulations indicate that most of the project area has a high fractional vegetation cover yet include some degraded areas that are impacting the sediment delivery potential. The simulation established the relationship for the project area between the increase in the vegetative cover and potential reduction in erosion and the soil organic carbon build up.

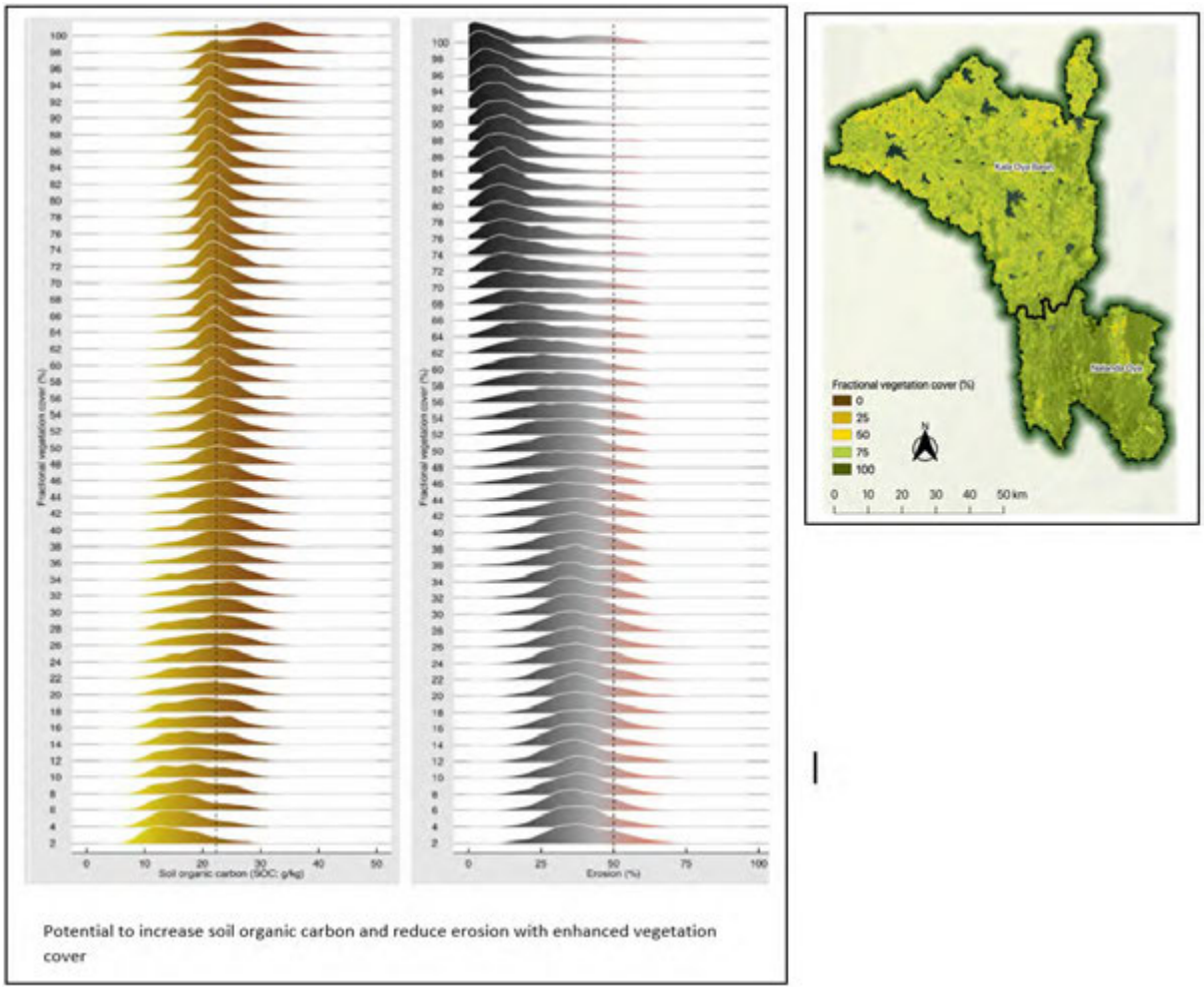


Figure 36: Potential to increase soil organic carbon and reduce erosion with enhanced vegetation cover

3.11. Simulation of Sediment Deliver Potential, Cropping and Management Factors

Due to the lack of flow and sediment deliver measurements in the project area, an attempt is made to compare the relationship between erosion potential and changes to the cover and management factor in the Universal Soil Loss Equation. The work conducted at the Rajarata University based in the project area (Anuradhapura), indicate the simulation capacity at the University given the base information. As an example, a smaller catchment named “Kambarawa Ganga” sub watershed was selected to demonstrate the impacts of soil erosion and sediment load using the Revised Universal Soil Loss Equation (RUSLE).

Figure 37: The location of the Kambarawa Ganga sub watershed in the project area

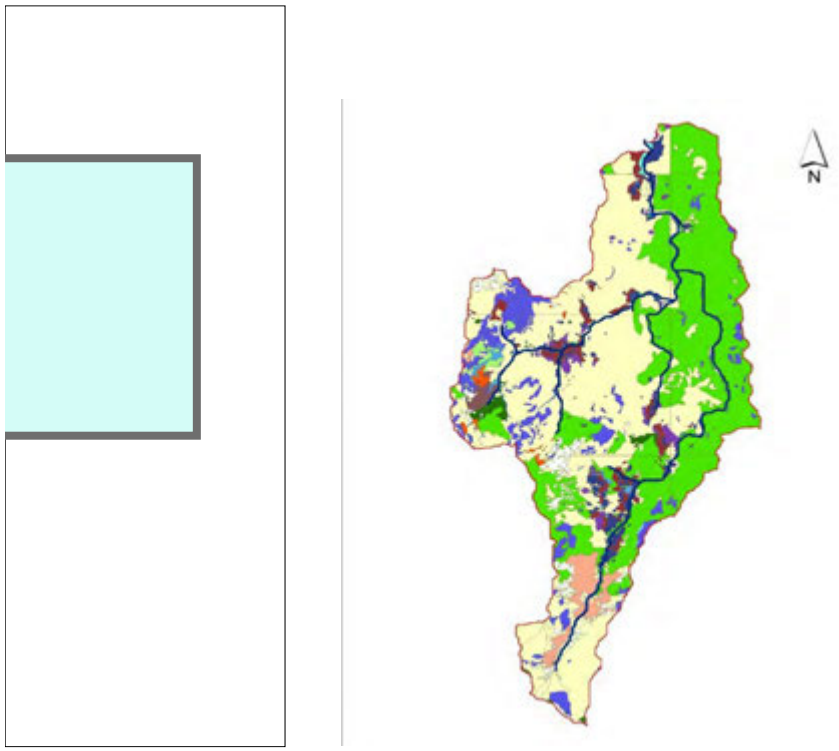


Figure 38: Land use types of Kambarawa Ganga sub watershed

RUSLE (Renard et al., 1997) can be expressed as

$$A = R * K * L * S * C * P$$

Where,

A = Average annual soil loss per unit area (t ha-1yr-1)
R = Rainfall-runoff erosivity factor (MJ mmha-1 h-1yr-1)
K = Soil erodibility factor (t ha h MJ-1 mm-1)
L = Slope length factor
S = Slope steepness factor
C = Cover and management factor
P = Support and conservation practices factor

Rainfall-runoff erosivity factor was determined from the average annual rainfall value using below correlation developed for Sri Lanka by Premalal (1986).

$$R = (972.75 + 9.95 \times F) / 100$$

Where,

R = rainfall runoff erosivity factor (MJ mm ha-1 h-1 year-1)
F = Average Annual Rainfall (mm)

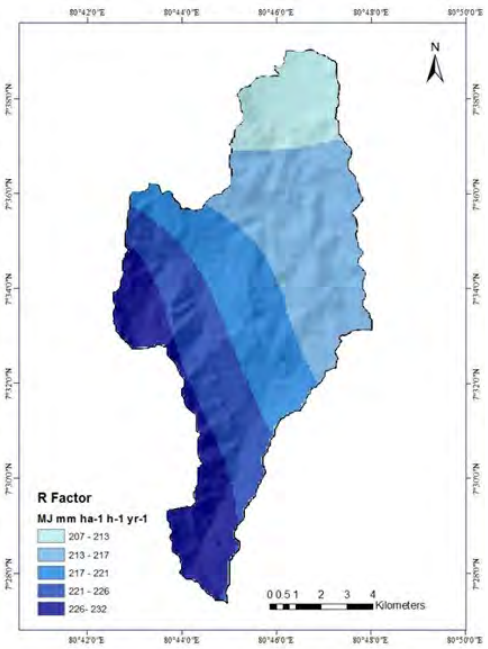


Figure 40: Kambarawa Ganga sub watershed -- R factor

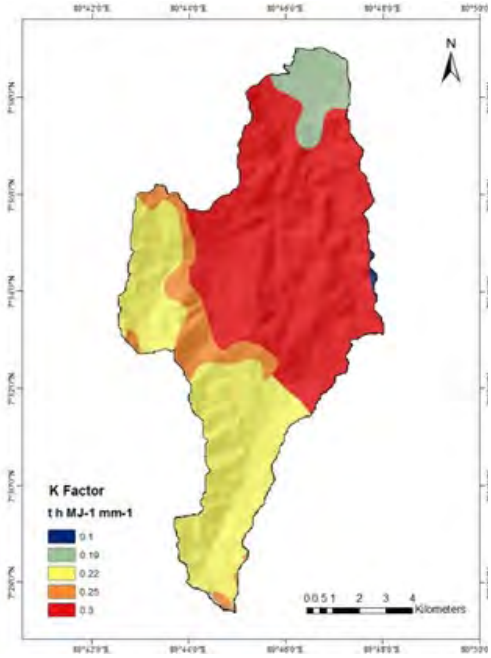


Figure 39: Kambarawa Ganga sub watershed - K factor

R factor map is shown in the figure after spatial interpolation. The LS factors were also derived using the DEM of the basin and it is shown in the figure. Soil erodibility map was generated from the soil map of the sub basin by assigning soil erodibility (K) values taken from the literature.

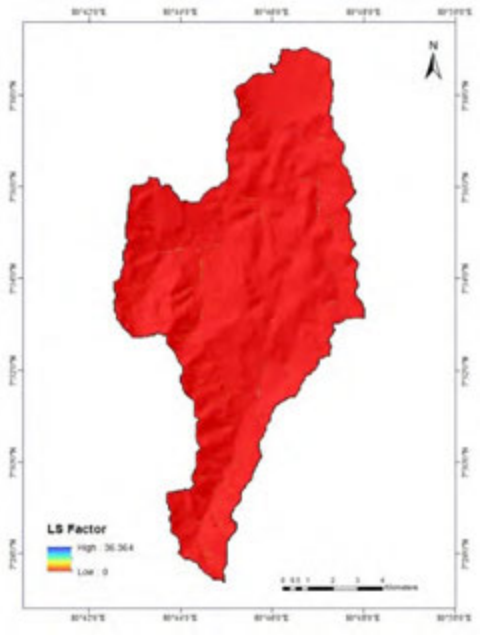


Figure 41: Kambarawa Ganga sub watershed - LS factor

Considering the present land use pattern of the basin/ present land use map, C and P factors were given to the model considering the past studies and then the C and P factor map was generated.

By overlaying all the factors, the project assesses the present soil erosion status of the river basin and is computed to range from 0 to 66 t ha-1 yr-1. Out of these, R, C and P factors are dynamic factors. R factor varies with the magnitude and the intensity of the precipitation. R factor would generally worsen with the climate change as high rainfall intensity events are projected to increase. However, due to the non-availability of projected rainfall data, we assume that the R factor is also a constant.

The dynamic factors, C and P were considered as the factors to be influenced by project intervention in terms of land use as outlined in the table below. The new C and P factors presumably represent the cover – C and practices – P, after project interventions.

Table 12: Crop factor and Practice factor differences before and after land use changes

Land use type	C value	P value	Project intervention expected	New C	New P
Abandoned paddy	0.43	0.15	No change	0.43	0.15
Abandoned tea	0.57	0.35	Filling the gaps and soil conservation	0.5	0.25
Bare land	1	1	Analog forest or plantations	0.45	0.7
Dense forest	0.5	0.1	No change	0.5	0.1
Distorted surfaces	1	1	Converted to forests	0.45	0.7
Forest plantation	0.45	0.7	No change	0.45	0.7
Grass land	0.51	1	Soil conservation	0.51	0.8
Homegarden	0.51	0.25	Soil conservation and crop selection	0.41	0.25
Lakes	0.2	0	No change	0.2	0
Marsh	0.3	1	No change	0.3	1
Mixed tree and other perennials	0.73	1	Soil conservations	0.73	0.8
Natural ponds	0.2	0	No change	0.2	0
Open forest	0.5	0.3	No change	0.5	0.3
Paddy	0.43	0.15	No change	0.43	0.15
Playgrounds	0.73	0	No change	0.73	0
Areas with exposed rocks	0.1	0	No change	0.1	0
Seasonal crops	0.73	1	Improved agronomic practices	0.73	0.6
Scrub land	0.6	1	Analog forests	0.45	0.7
Streams	0.2	0	No Change	0.2	0
Chena	0.8	0.4	No change	0.8	0.4
Tea	0.57	0.35	No change	0.57	0.35
Unutilized lands	1	1	Analog forest	0.45	0.7

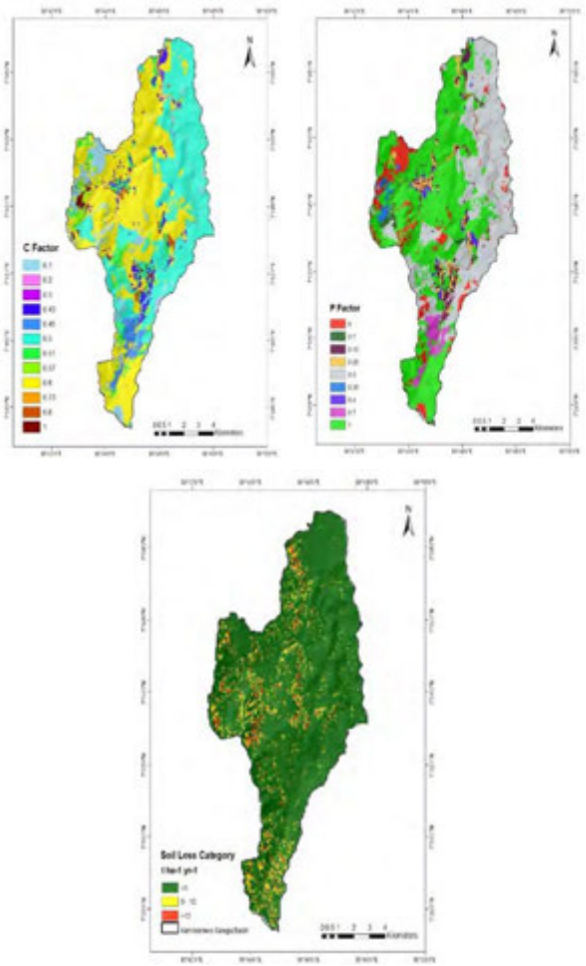


Figure 42: Present C P and erosion of the Kambarawa Ganga sub watershed

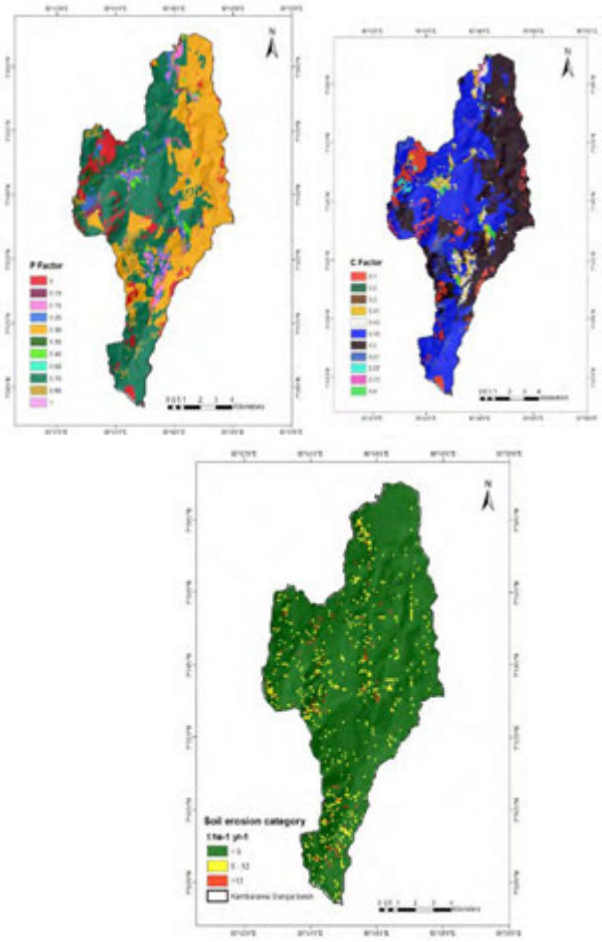


Figure 43: Modified C, P and predicted erosion of the Kambarawa Ganga sub watershed

RUSLE assessment for new C and P factors representing the project interventions reduced the erosion rates from 0 to 21 t ha-1 yr-1 with compared to the erosion rates between 0 – 45 t ha-1 yr-1 corresponding to the present land use, indicating the potential reduction of erosion.

3.12. Health and Climate Risks

Figure 43 highlights the health risk due to drought along with average annual rainfall and anomalies (Left); and health sector risk due to drought with average annual daytime temperature and anomalies (Right).

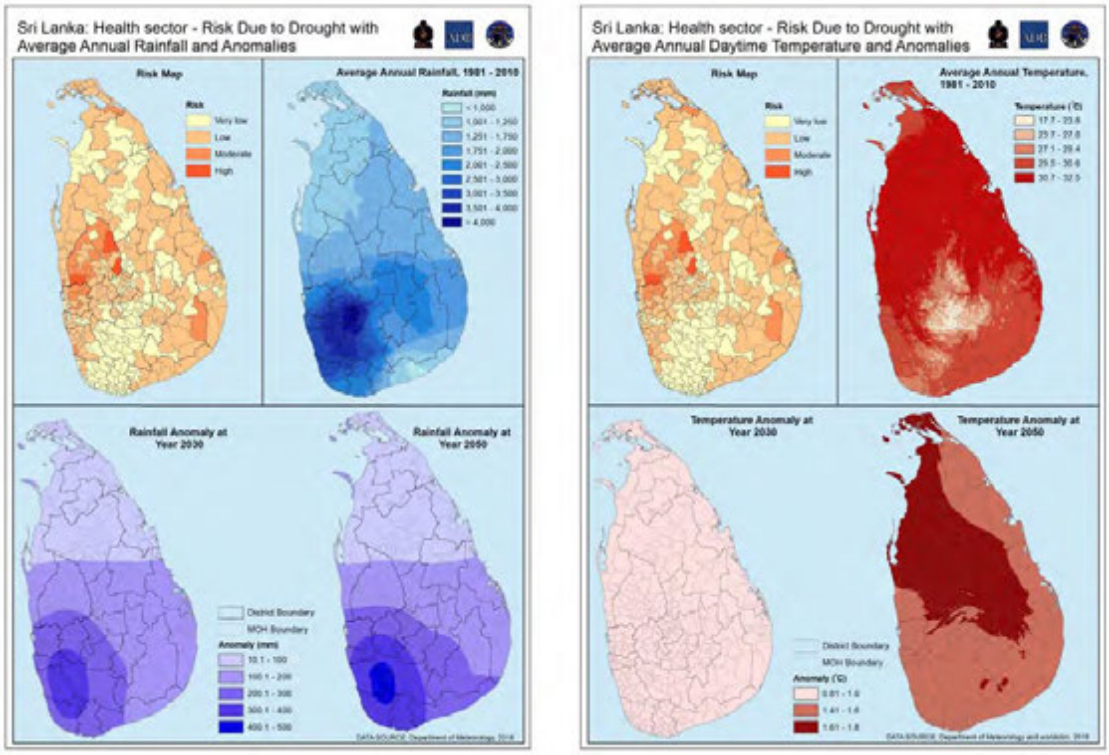


Figure 44: Health risk due to drought

3.13. Project Area Related Climate Forecasts

3.13.1. Climate Stations in the Project Area

The project area has several weather stations maintained by the Dept. of Meteorology.

Division	District	Latitude	Longitude	BIO12	Climate
Rajanganaya	Anuradhapura	8.1797	80.1858	1184	dry
Galgamuwa	Kurunegala	8.0156	80.2586	1263	dry
Thambuttegama	Anuradhapura	8.1502	80.3218	1267	dry
Ehetuwewa	Kurunegala	7.9655	80.3592	1318	dry
Thalawa	Anuradhapura	8.1840	80.3791	1332	dry
Galnewa	Anuradhapura	8.0182	80.4519	1358	dry
Nachchadoowa	Anuradhapura	8.2548	80.4192	1365	dry
Nuwaragam Palatha East	Anuradhapura	8.3088	80.4494	1377	dry
Ipalogama	Anuradhapura	8.0868	80.5070	1389	dry
Thirappane	Anuradhapura	8.2058	80.5562	1406	dry
Kekirawa	Anuradhapura	8.0630	80.6266	1458	dry
Palagala	Anuradhapura	7.9053	80.5378	1465	dry
Palugaswewa	Anuradhapura	8.0685	80.7160	1511	dry
Galewela	Matale	7.7779	80.5694	1590	dry
Dambulla	Matale	7.8764	80.7200	1616	dry
Naula	Matale	7.6888	80.7075	1802	intermediate
Pallepola	Matale	7.6461	80.5985	1833	intermediate
Matale	Matale	7.5385	80.6286	1874	intermediate
Yatawatta	Matale	7.5493	80.5878	1910	intermediate
Ukuwela	Matale	7.4289	80.6407	1947	intermediate
Laggala-Pallegama	Matale	7.5571	80.8122	2064	intermediate
Ambanganga Korale	Matale	7.5614	80.6774	2339	intermediate
Rattota	Matale	7.4881	80.6861	2397	intermediate

Figure 45: Weather stations in project area

The eight locations in the upland catchment area, (Naula, Pallepola, Matale, Yatawatta, Ukuwela, Laggala-Pallegama, Ambanganga Korale and Rattota) have an intermediate climate with annual precipitation between 1,750 and 2,500 mm. The locations in the lowland areas are all in the dry climatic zone of Sri Lanka.

An extensive area specific climate assessment was carried out to understand the climate changes in the project area by Dr. Roeland Kindt, Senior Ecologist, World Agroforestry Centre, Nairobi in 2018[15] and the study is attached as the climate annex to the GCF Funding Proposal. Kindt (2018) produced projections for low, medium and high emission scenarios in the form depicted in Figure 37. For example, the projected monthly precipitation for a medium

[15] https://goo.gl/YSsYdG

emissions scenario (RCP 4.5) in Fig. 36 shows the predicted changes in precipitation for January (right) and May (left) for project locations (see map above) sorted by annual precipitation. Red circles indicate the baseline precipitation and blue circles indicate precipitation predicted for the 2050s.

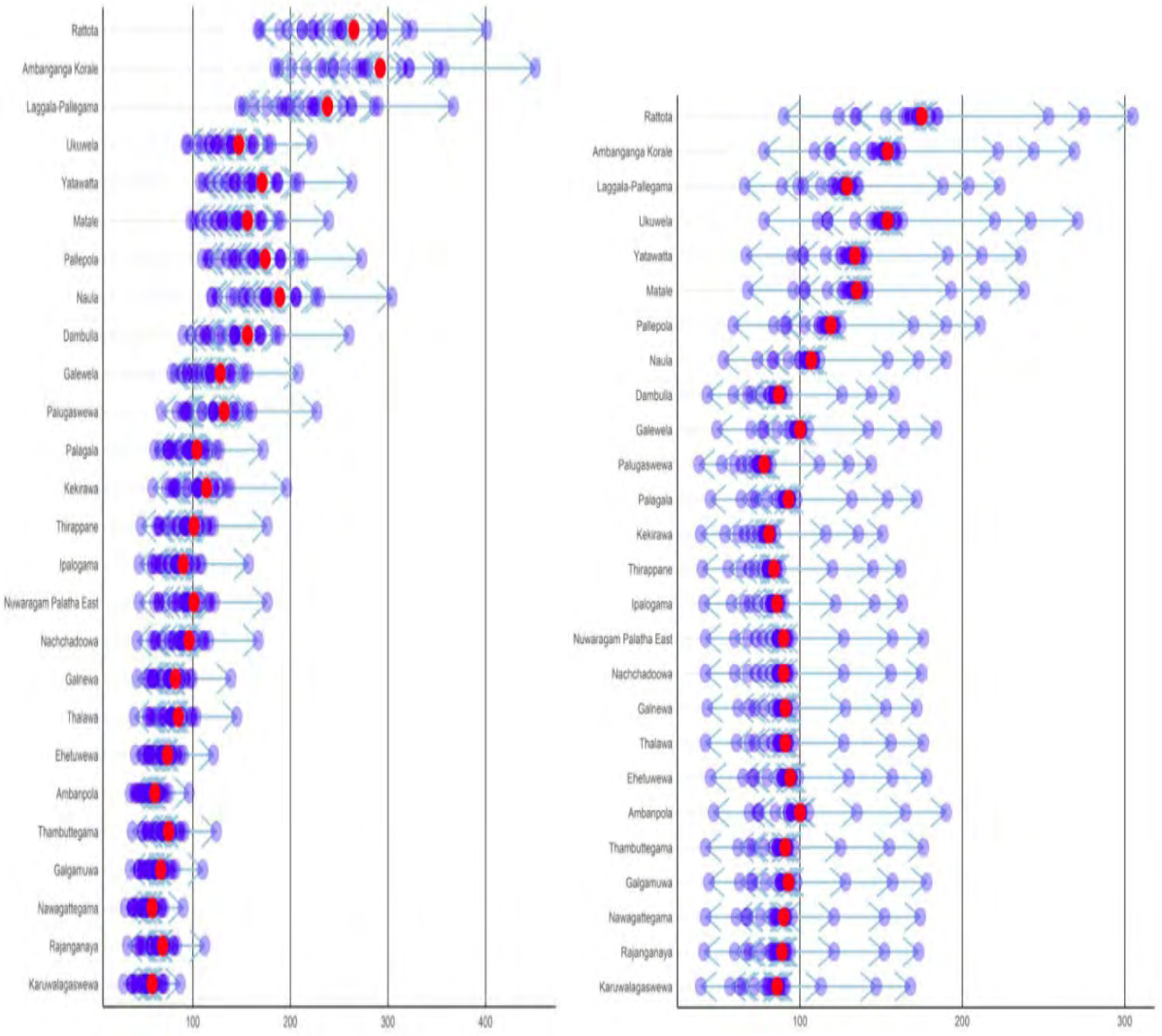


Figure 46: Model precipitation predictions

The prediction data in Kindt (2018) is used to develop spatial maps for the three scenarios and provided in the next section (Figures 38 and 39) for RCP 4.5 and RCP 8.5, respectively.

3.13.2. Projected Monthly Precipitation for a Medium Emissions Scenario (RCP 4.5)

The main seasons important for the cultivations are April – May (sowing period during *Yala* season); June – July (growing period during *Yala* season); October – November (sowing period during *Maha* season) and December – January (growing period during *Maha* season).

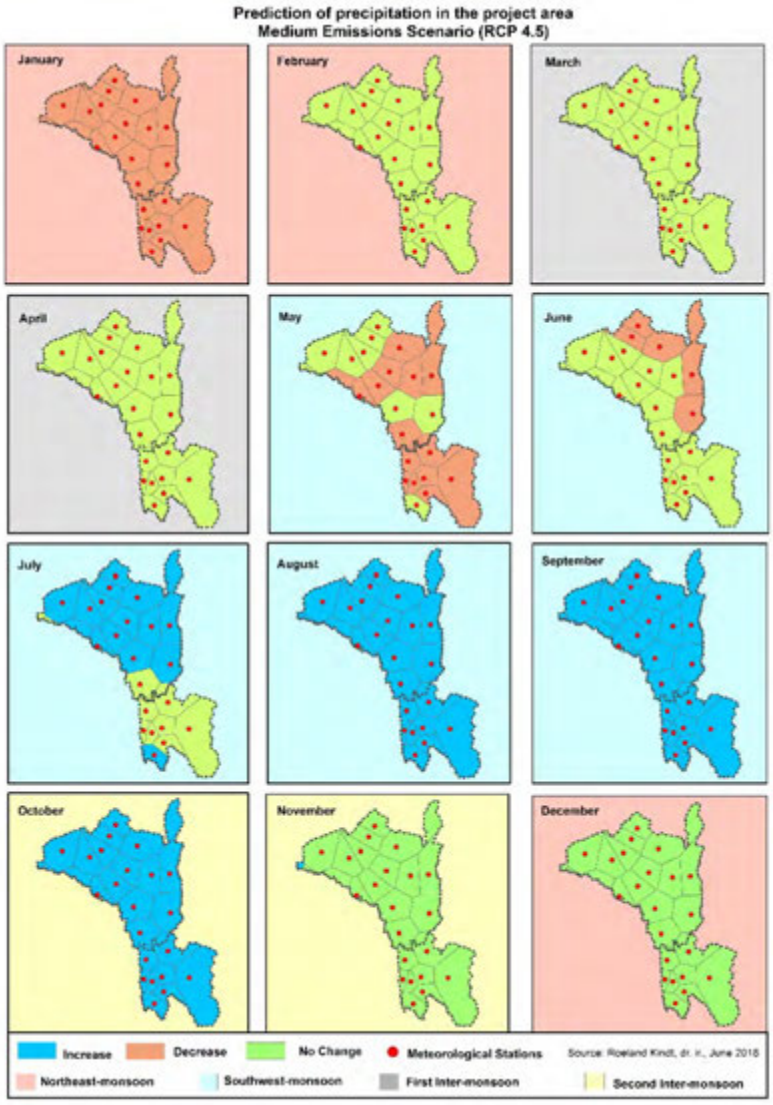


Figure 47: Predicted precipitation in the project area RCP 4.5

The *Yala* season corresponds to the South-west Monsoon which occurs from May to September (light blue background in the figure), whereas the *Maha* season corresponds to the North-east Monsoon which occurs from December to February (brown background in the figure). The precipitation in the Maha (February as per RCP 4.5) is likely to decrease, which would influence the rice and maize growing periods during the *Maha* season. In most locations, including upland and lowland project areas, the May precipitation is projected to decrease in the rice and maize sowing periods of the *Yala* season.

Precipitation during July (the growing period during the *Yala* season) is projected to increase. However, absolute magnitudes of precipitation increases are relatively small and therefore, lowland locations will continue to receive relatively small amounts of precipitation (a pattern important for planning irrigation schemes). In the case of the month of October (sowing period during *Maha* season), the precipitation in is projected to increase, where there was no consensus among models, it is possible that this lack of consensus agrees with interannual variability that has been reported to increase. The higher precipitation expected for August to October is relevant for planning flood and erosion controlling measures, especially in highland areas.

3.13.3. Projected Monthly Precipitation for a High Emissions Scenario (RCP 8.5)

Predictions using the high emission scenario demonstrated no evidence for precipitation decreases in the month of January during the *Maha* season with compared to a decrease of rain in RCP 4.5.

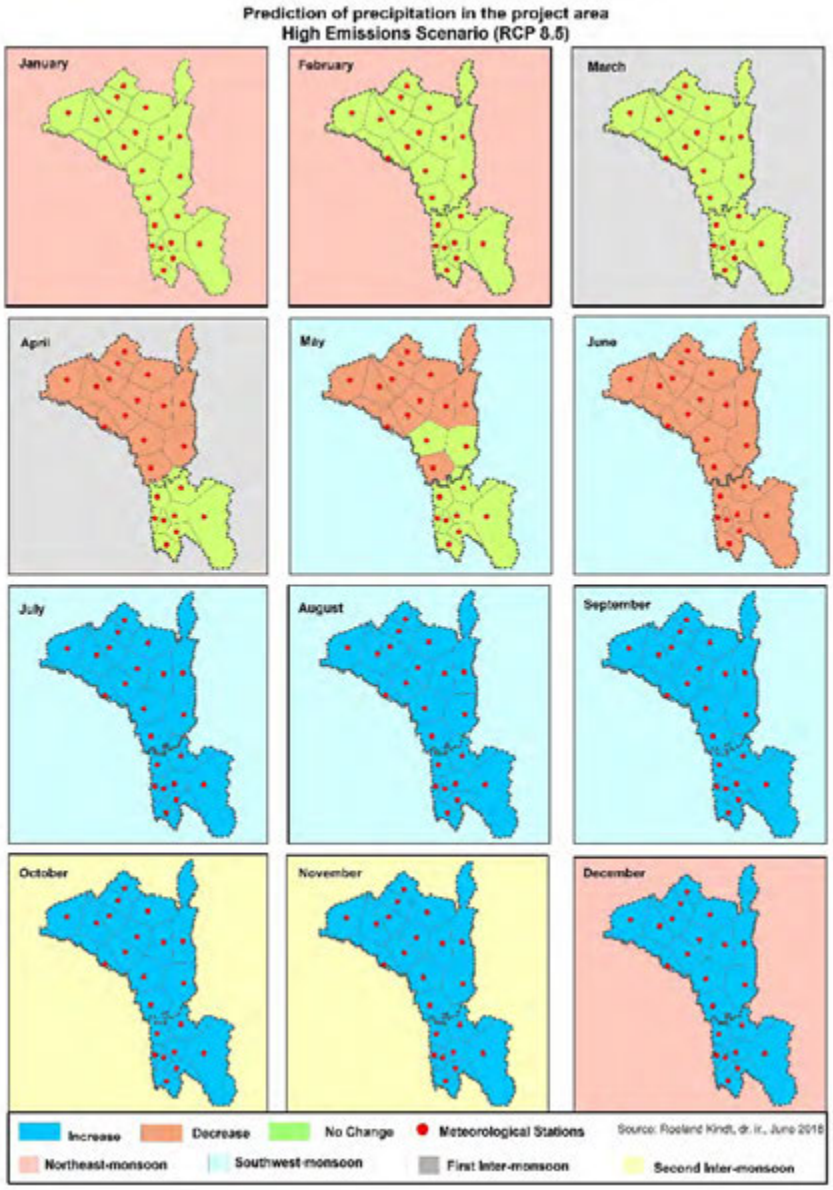


Figure 48: Predicted precipitation in the project area RCP 8.5

In April and May, precipitation is projected to decrease in lowland areas under RCP 8.5. In the month of June, precipitation is projected to decrease but in July it is likely to increase. Between October to December, precipitation is likely to increase that include the sowing and growing periods in the *Maha* season. The likely increases in precipitation also justify investments in infrastructure to control flooding and erosion events.

3.14. Climate Analysis based on Moisture Index Approach

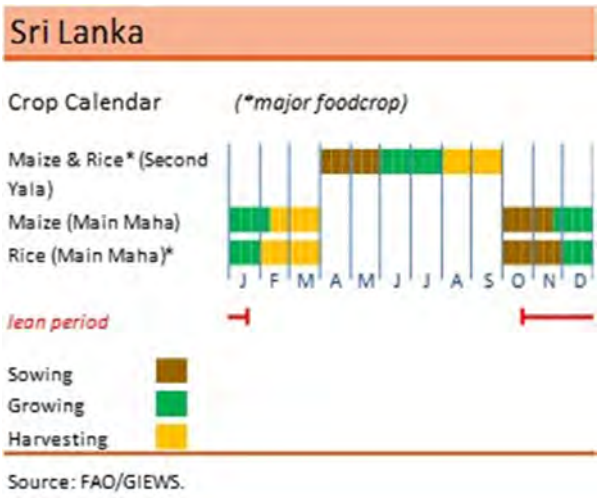


Figure 49: Sri Lanka Crop Calendar

The growing season in the country as per FAO is divided into two main seasons *Yala* and *Maha* with *Maha* being the main season.

Special attention is given in the moisture analysis for the months where the major food crops of rice and maize are sown and grown according to the FAO's Global Information and Early Warning System.

Yala and Maha could be further described as: April – May (sowing period during *Yala* season), June – July (growing period during *Yala* season), October – November (sowing period during *Maha* season) and December – January (growing period during *Maha* season). The *Yala* season corresponds to the South-West Monsoon of May to September, whereas the *Maha* season corresponds to the North-East Monsoon of December to February. To deal with uncertainties in projecting future climatic changes, analyses focused on consensus among General Circulation Models (it is generally recommended to treat the different GCM projections as equally likely and to adopt ensemble [consensus] approaches).

In checking for consensus among models, the likelihood scale recommended for the Fifth Assessment Report of the IPCC (Mastrandea *et al.* 2011) was adopted. As such, results were reported as likely in cases where at least 66% of the models showed the same trend and as unlikely in cases where at most 33% of models showed the same trend.

Data on baseline and future (2050, the average of 2041-2060) monthly precipitation were downloaded from WorldClim 1.4 at resolution of 2.5 arc-minutes (no downscaled results for future climates are available yet from WorldClim 2). Future data sets correspond to CMIP5 data for the Representative Concentration Pathway 4.5, which is a medium emissions scenario and the scenario for which most (i.e., 19) future General Circulation Model data sets were available from WorldClim.

Monthly moisture index (the product of P PET^{-1} where P is precipitation and PET is potential evapotranspiration; this index is also known as the aridity index) were obtained after calculating the monthly PET with the *envirem* package through its *monthlyPET* function. Input data layers of minimum, maximum and mean monthly temperatures were obtained from WorldClim 1.4, whereas monthly extra-terrestrial solar radiation was obtained from the CGIAR CSI. Processing and mapping of geospatial data sets were done with *R 3.5.1*.

Comparison of the future and baseline monthly moisture indices shows that there is a likely decrease of the moisture index for the project area in January and May and for a part of the area in June (figures 50 and 51). These trends follow trends in precipitation, but as a result from the general increases in PET, larger sections of the project area are expected to experience decreases in the moisture index in May and June.

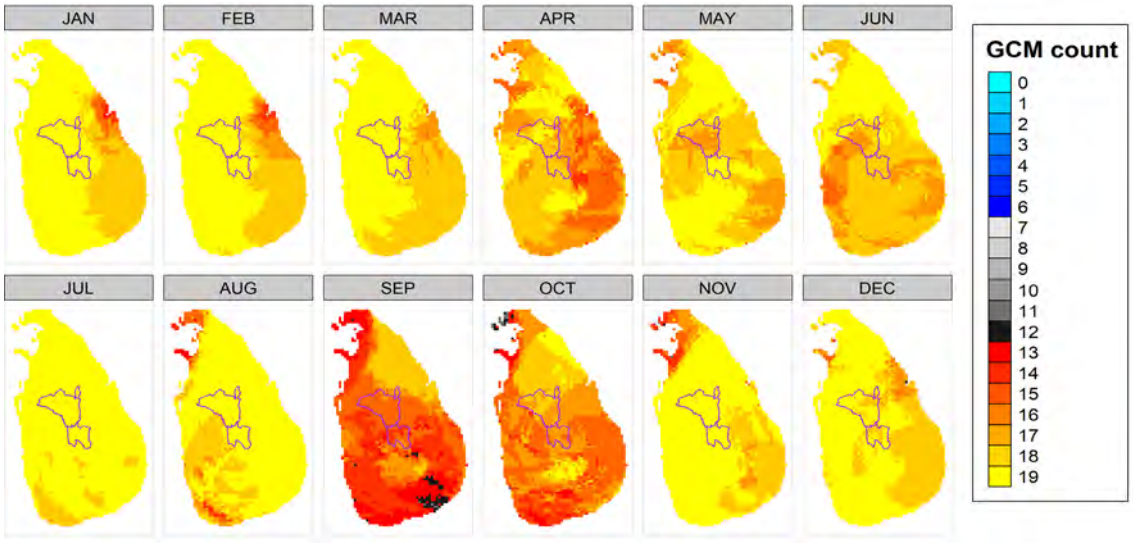
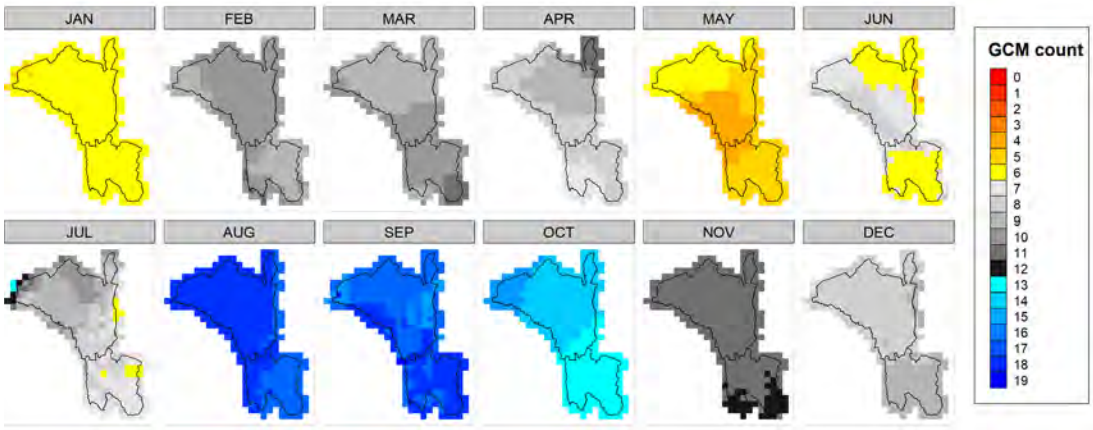


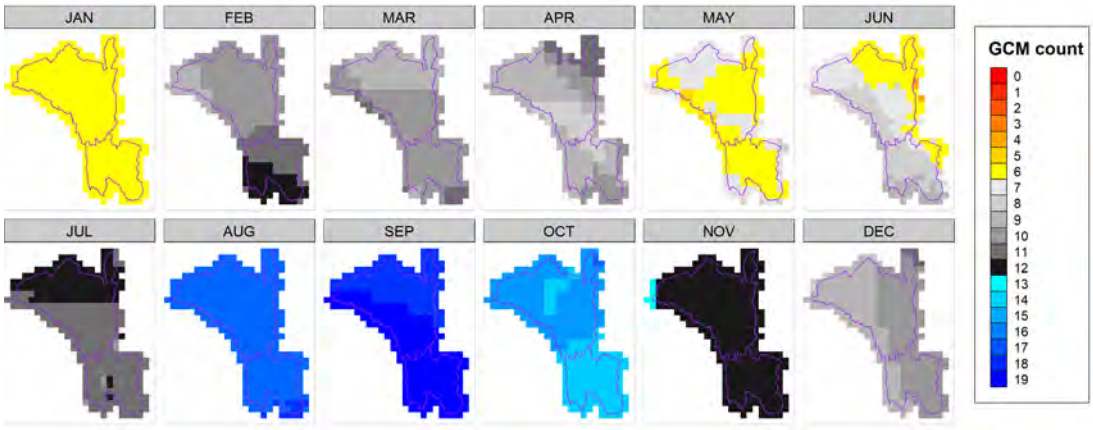
Figure 50: Counts of General Circulation Models that project monthly increases for Sri Lanka in moisture index, precipitation and potential evapotranspiration by the 2050s for RCP4.5 compared to the baseline centred on 1975. The major changes in the colour schemes correspond to the likelihood scale recommended for the Fifth Assessment Report of the IPCC.

From August to October, the project area is likely to experience increases in the moisture index and precipitation.

(a) Moisture Index



(b) Precipitation



(c) Potential evapotranspiration

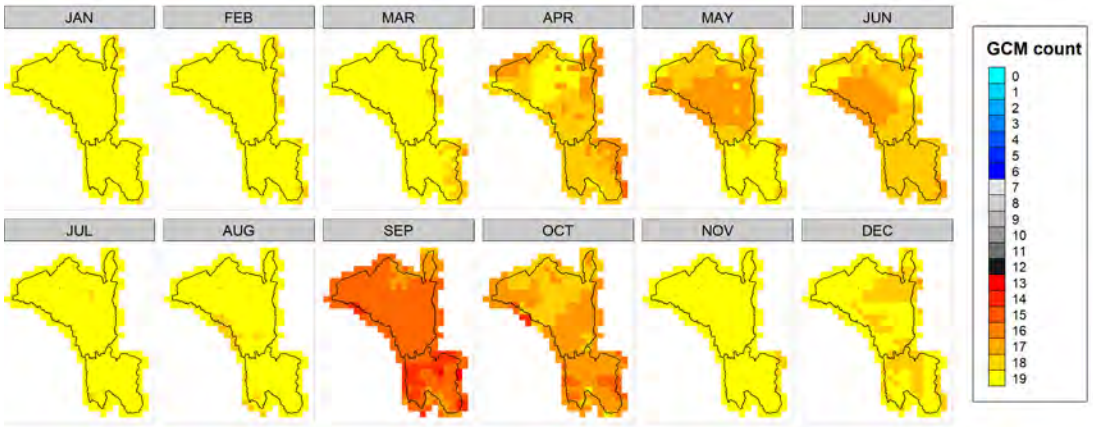


Figure 51: Counts of General Circulation Models that project monthly increases for the project area in moisture index, precipitation and potential evapotranspiration by the 2050s for RCP4.5 compared to the baseline centred on 1975. The major changes in the colour schemes correspond to the likelihood scale recommended for the fifth Assessment Report of the IPCC.

The next series of maps focuses on the months with likely changes in the moisture index.

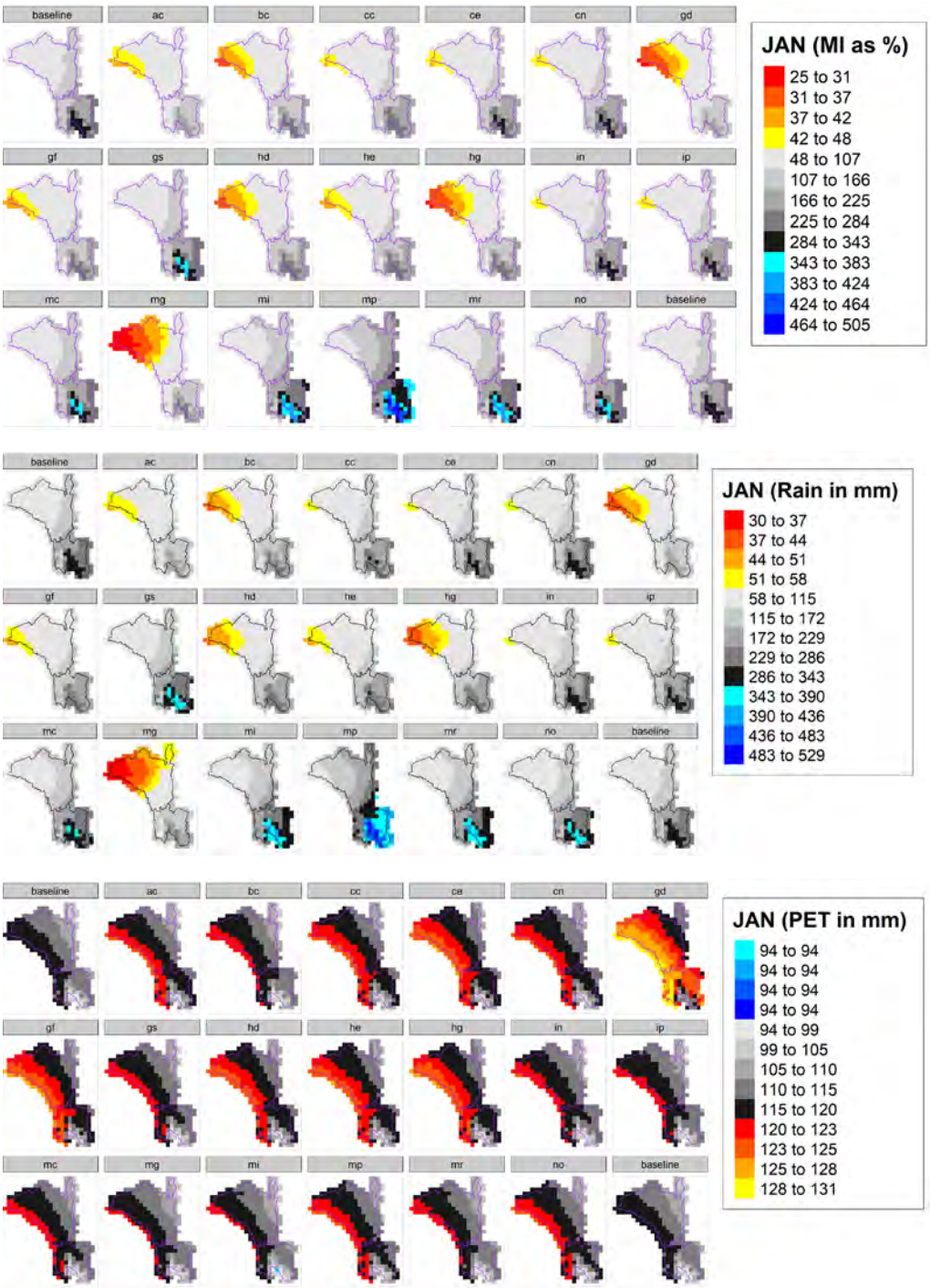


Figure 52: Projected mid-21st century changes (RCP4.5) for the project area in January in moisture index (top), precipitation (middle) and PET (bottom)

Figure 52 shows that the January moisture index will decrease beyond baseline conditions (baseline conditions were coloured in greyscale) in the north-western part of the project area, within the downstream area. Although there was consensus among the GCMs on a general decline in moisture index, some models depicted an opposite trend of increasing values and values beyond the baseline range in the upland areas.

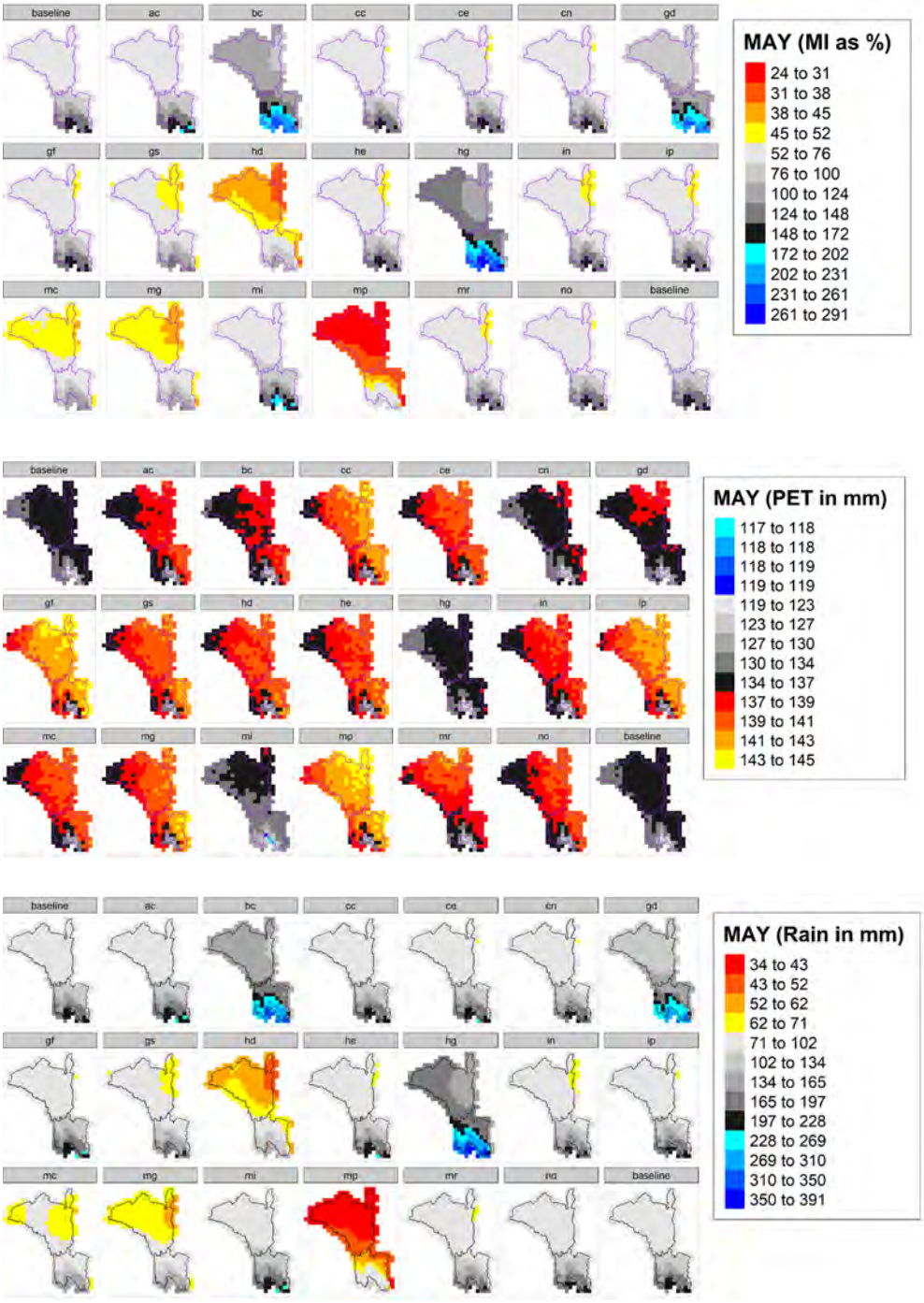


Figure 53: Projected mid-21st century changes (RCP4.5) for the project area in May in moisture index (top), precipitation (middle) and PET (bottom)

Figure 53 shows that although the moisture index is likely to decrease in May, values lower than the baseline conditions are especially likely in the north-eastern section of the downstream area. However, there were four GCMs (hd, mc, mg and mp) that projected moisture index conditions that were beyond the baseline in most of the downstream area. Some GCMs project increases in moisture index beyond baseline conditions in the uplands.

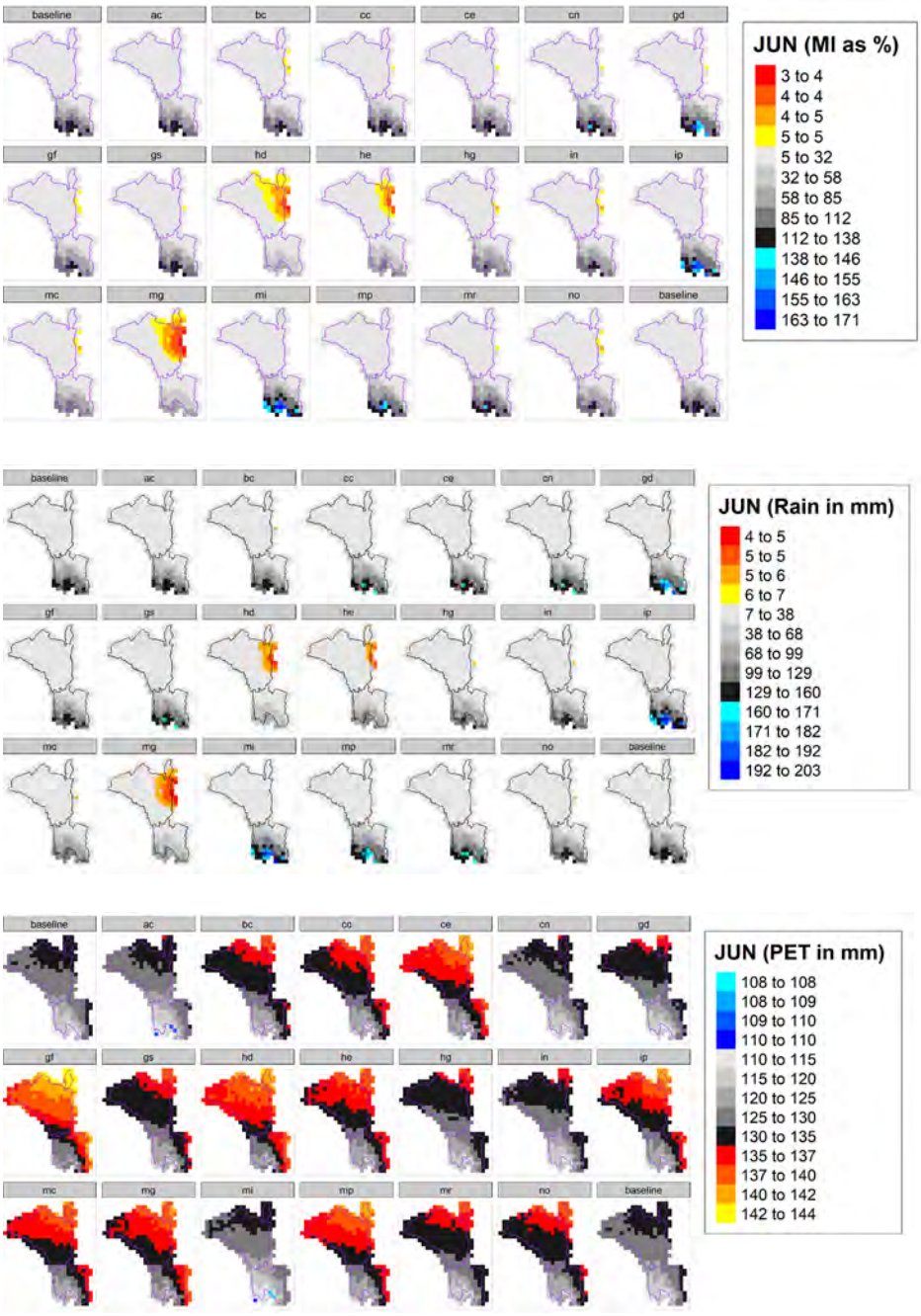


Figure 54: Projected mid-21st century changes (RCP4.5) for the project area in June in moisture index (top), precipitation (middle) and PET (bottom)

Figure 54 shows that a limited number of GCMs project decreases in the June moisture index beyond baseline conditions. However, with a minimum moisture index of 5 percent in the baseline climate, there was not much scope for further decrease in the moisture index. The same situation occurs for the rainfall, with a minimum of 7 mm in the baseline climate.

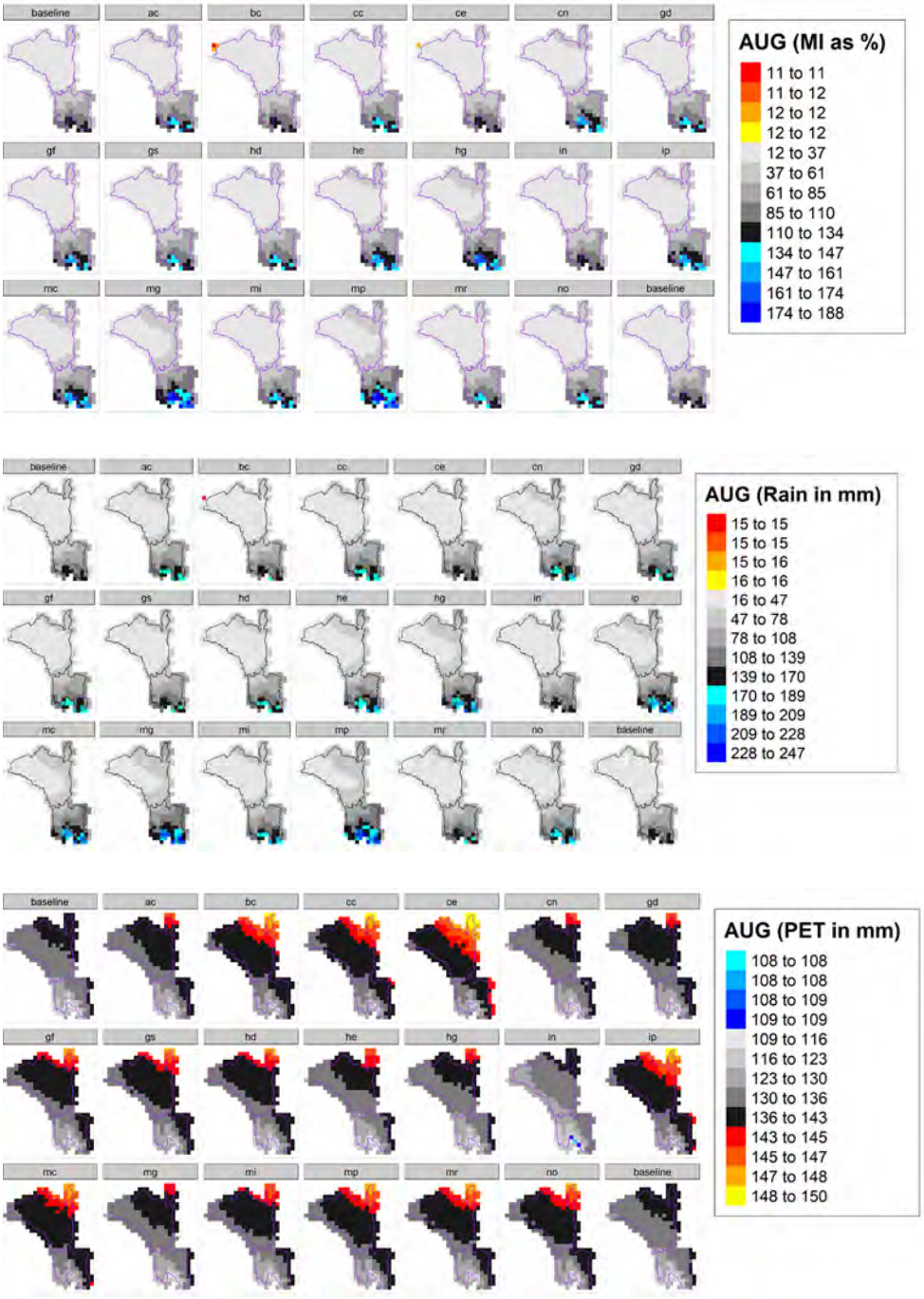


Figure 55: Projected mid-21st century changes (RCP4.5) for the project area in August in moisture index (top), precipitation (middle) and PET (bottom)

Figure 55 shows that the most significant increases in August moisture index will be experienced in the extreme south of the upstream area. This trend follows increases in rainfall, for which there is strong agreement among the GCMs.

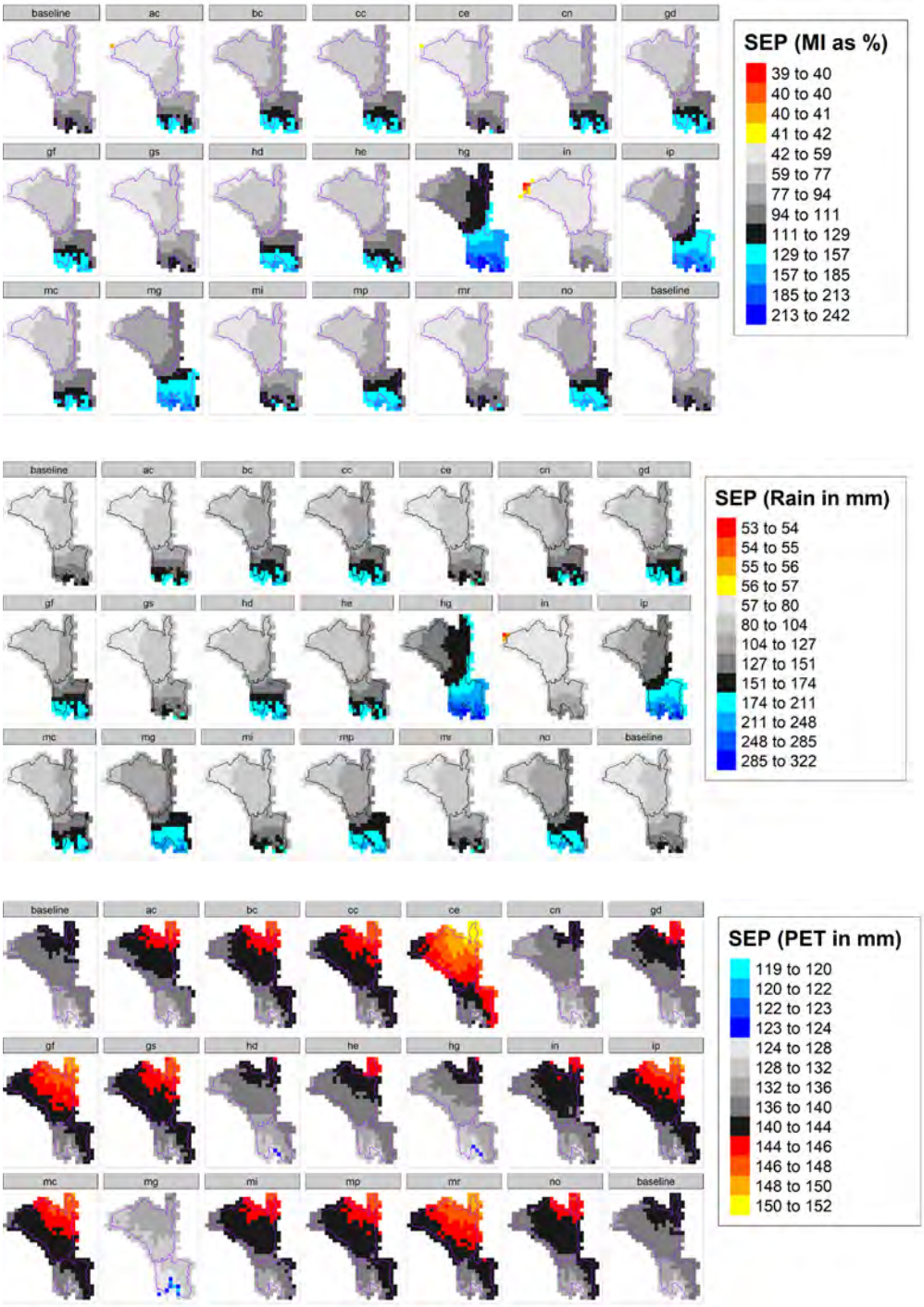


Figure 56: Projected mid-21st century changes (RCP4.5) for the project area in September in moisture index (top), precipitation (middle) and PET (bottom)

Figure 56 shows that in September, a large number of GCMs project that a significant section of the upland area will experience moisture index values beyond the baseline range.

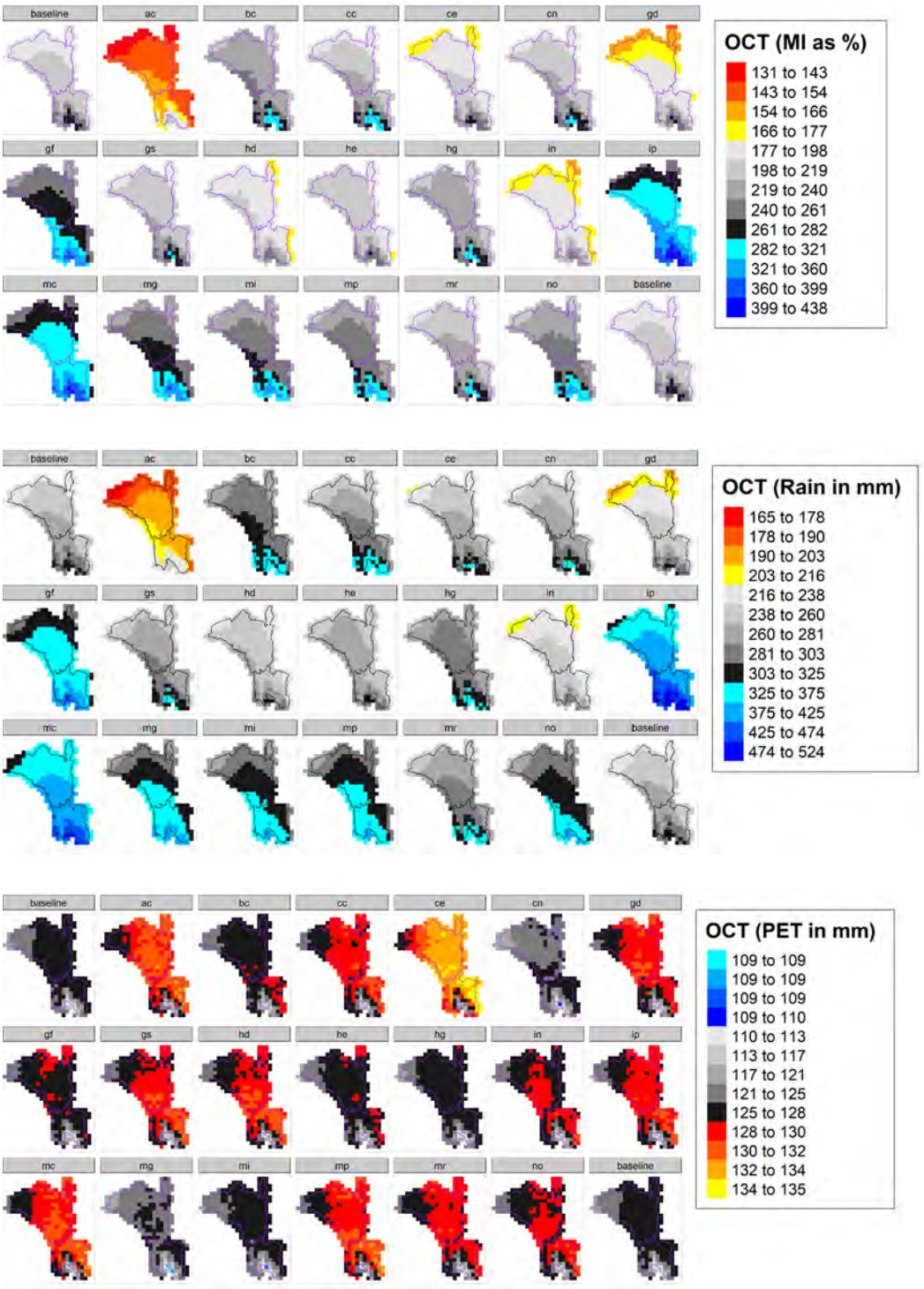


Figure 57: Projected mid-21st century changes (RCP4.5) for the project area in October in moisture index (top), precipitation (middle) and PET (bottom)

Figure 57 shows that although there was model consensus (likely changes) on an increase of moisture index values in October, changes outside the baseline range will be experienced mainly in the upland areas. Some GCMs (ce, gd, in and especially ac) project an opposite trend of a decreasing moisture index in the north. However, even decreasing values beyond the baseline range are above 100 percent.

3.14.1. Projected Changes in Monthly Precipitation Volumes

Total volumes of precipitation and PET were obtained for the project area after re-projecting the relevant geospatial layers to the equal-area Mollweide projection *via* the raster:: projectRaster function. The balance between future and baseline precipitation volumes were obtained by extracting and summing precipitation values from all raster cells that covered the project area. The final total volume was adjusted to compensate for differences between the actual areas of the downstream (3,345.0382 km^2) and upstream areas (1,477.154 km^2) with the area covered by the sampled grid cells (3,299.872 and 1,575.423 km^2, respectively).

In an alternative procedure, differences between precipitation volumes also considered the changes in PET and calculated the precipitation difference that would result in the same moisture index in the future and the baseline conditions for each GCM. Calculations for this alternative procedure were as follows, as shown here for GCM hd for the month of January for the downstream area.

- In the baseline climate, total P and PET were 16,210 mm and 17,558 mm respectively, resulting in a moisture index of 0.9232.
- In the future climate, total P and PET were 11,394 mm and 18,318 mm respectively, resulting in a moisture index of 0.6220.
- To return to the baseline moisture index, there is a future precipitation deficit of 701 mm: (16,210 + 701) / 18,318 = 0.9232
- The precipitation deficit of 701 mm corresponds to a volume of 15,139 million litres by multiplying the precipitation deficit with the adjusted size of a grid cell (~ 21.5809 km^2)

Table 13 shows that, for the downstream area, there are likely precipitation deficits in January and May with 13 GCMs projecting deficits. There are likely precipitation surpluses from August to October, with respectively 16, 18 and 15 GCMs projecting surpluses.

When also considering the maintenance of moisture indices (Table 14), the number of GCMs projecting deficits increased from 13 to 14 for May. Likely precipitation surpluses remained from August to October, although the number of GCMs that projected surpluses changed to 17, 16 and 14, respectively.

Table 15 shows the projected changes in moisture indices for the downstream area, estimated from total P and PET. The same months identified for Table 14 showed likely changes: January and May with likely decreases, and August to October with likely increases.

Tables 16 to 18 show volumes for the upstream area. The same months can be identified with likely decreases (January and May) and likely increases (August to October) as for the downstream areas. However, June was also identified as a month with likely decreases in the moisture index (13 GCMs, Table 18) and volumes when also considering the maintenance of the baseline moisture index (13 GCMs, Table 17).

Table 13: Projected changes (future – baseline) in precipitation volumes for the downstream area. Statistics are in million litres. Negative values are highlighted. GCMs are sorted by annual baseline precipitation

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-103,922	-37,204	-116,367	-227,771	-96,415	-21,030	6,202	11,337	47,850	-7,175	-65,869	-208,290
ce	-29,316	15,495	-89,319	-84,679	-2,918	0	-5,844	-290	11,945	1,791	27,787	-18,344
gd	-125,360	83,076	123,670	136,755	121,541	2,035	7,215	6,690	56,565	-76,540	-227,137	-221,556
in	-18,818	-5,828	-56,131	74,460	-23,763	-8,018	-3,642	-213	-29,165	-56,804	-9,857	65,149
he	-58,102	-4,837	2,140	-116,761	-9,976	-16,349	5,554	26,122	55,141	42,927	175,756	-89,935
ac	-90,704	15,132	176,865	44,454	6,948	5,184	-32,769	20,316	386	-189,046	254,082	-135,688
cc	-29,714	-51,604	-27,148	-4,086	3,069	62	-1,110	12,866	72,485	60,266	53,883	15,473
cn	-28,640	8,406	-7,561	98,356	-1,219	3,530	-1,903	24,547	59,207	25,033	-19,731	-23,404
hg	-116,683	-57,871	-16,711	-24,203	263,053	-3,473	14,120	37,778	227,864	117,161	-46,340	-240,513
gs	20,346	-26,148	19,508	-17,248	-41,332	1,498	6,643	10,934	8,992	57,672	50,348	131,584
gf	-61,180	23,497	23,384	-47,747	-406	-3,897	4,525	9,317	57,765	272,176	210,008	-221,386
mg	-168,712	-96,370	-23,755	141,320	-69,921	-21,552	4,190	45,631	123,893	205,675	186,302	124,900
mr	62,843	65,369	-11,748	-38,103	-14,825	3,569	9,255	6,844	15,592	80,272	101,082	235,013
mi	74,006	31,867	91,668	8,407	15,579	9,902	9,923	11,812	24,869	183,059	50,854	191,125
bc	-96,076	-37,931	-86,529	385,265	203,223	-4,882	1,415	-3,756	75,487	143,049	208,083	-61,574
mc	42,832	40,841	36,300	-51,186	-59,523	-7,616	17,883	34,650	55,751	385,701	-23,803	321,480
no	23,661	139,980	272,811	111,867	-10,458	-4,706	0	19,452	110,259	167,092	-81,572	70,519
ip	-31,264	-32,073	21,070	16,643	-12,880	10,569	-16,306	27,559	150,270	419,464	333,785	83,338
mp	242,658	97,403	216,206	-5,852	-154,889	7,845	3,745	47,785	88,415	205,686	283,964	33

Table 14: Projected required changes (future – baseline) in precipitation volumes for the downstream area to maintain the baseline moisture index (see methods). Statistics are in million litre. Negative values are highlighted.

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-119,061	-43,835	-124,263	-249,840	-104,650	-24,159	3,301	8,582	49,485	-27,236	-97,961	-256,126
ce	-46,404	6,036	-94,737	-86,050	-11,256	-2,737	-11,790	-6,297	-2,700	-42,432	-15,348	-59,208
gd	-154,365	71,567	116,045	126,140	117,684	1,206	6,496	4,468	53,424	-101,501	-268,055	-264,704
in	-25,937	-11,209	-69,768	73,105	-30,547	-8,429	-3,116	2,736	-33,269	-71,891	-19,301	64,379
he	-73,078	-12,723	-3,334	-133,378	-17,596	-18,648	16	24,687	53,719	34,250	140,346	-115,163
ac	-99,633	14,467	175,534	33,636	1,720	5,334	-42,550	18,533	-4,681	-218,528	261,000	-139,073
cc	-42,476	-57,457	-34,142	-21,680	-7,899	-1,835	-5,420	8,337	64,678	38,647	23,474	-10,250
cn	-39,770	6,413	-11,906	104,126	-1,056	3,512	-6,078	23,556	62,242	37,664	-36,831	-40,056
hg	-133,967	-66,916	-24,438	-31,119	264,254	-4,391	9,999	37,060	231,606	110,842	-81,347	-273,438
gs	12,859	-32,417	12,531	-31,202	-50,436	-45	3,161	7,520	1,185	37,346	32,736	110,441
gf	-80,058	10,617	10,211	-83,546	-14,869	-7,651	-1,197	6,297	47,429	258,410	186,444	-264,400
mg	-170,415	-99,178	-28,230	138,683	-78,884	-23,981	1,076	44,536	136,573	215,912	180,258	114,970
mr	57,731	62,364	-15,454	-48,308	-23,549	2,029	6,208	3,270	4,381	58,417	84,585	227,330
mi	72,348	30,522	90,159	7,009	17,809	10,160	7,661	9,230	18,972	182,775	39,629	189,477
bc	-101,963	-43,777	-92,885	377,828	199,148	-6,541	-3,286	-8,589	69,381	133,152	195,764	-72,865
mc	35,345	36,313	28,055	-67,522	-67,770	-10,096	12,490	30,220	47,222	359,168	-39,364	305,002
no	13,577	135,713	268,657	96,017	-17,223	-6,553	-5,287	15,657	104,985	150,727	-110,032	49,376
ip	-37,129	-36,283	14,093	5,246	-25,181	8,182	-21,611	22,598	141,787	400,886	315,155	66,063
mp	232,715	89,442	208,792	-24,622	-169,647	5,111	-1,383	44,068	81,387	181,585	270,830	-17,007

Table 15: Projected changes (future – baseline) in moisture index for the downstream area, calculated from total precipitation and PET for the project area. Negative values are highlighted

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-30.12%	-9.36%	-23.22%	-47.20%	-22.49%	-5.27%	0.75%	1.85%	10.69%	-6.34%	-24.88%	-70.04%
ce	-11.68%	1.27%	-17.86%	-16.85%	-2.42%	-0.60%	-2.60%	-1.33%	-0.55%	-9.60%	-3.85%	-16.33%
gd	-37.62%	14.95%	21.71%	24.30%	25.67%	0.27%	1.50%	0.97%	11.34%	-23.49%	-67.39%	-72.79%
in	-6.71%	-2.41%	-12.77%	14.32%	-6.60%	-1.93%	-0.72%	0.62%	-7.03%	-16.83%	-5.03%	18.64%
he	-18.49%	-2.70%	-0.63%	-25.43%	-3.79%	-4.13%	0.00%	5.39%	11.47%	8.08%	35.51%	-32.35%
ac	-25.64%	3.18%	33.59%	6.48%	0.37%	1.24%	-9.11%	4.04%	-0.99%	-50.31%	69.37%	-40.13%
cc	-10.82%	-12.32%	-6.40%	-4.13%	-1.68%	-0.41%	-1.21%	1.78%	13.49%	8.98%	5.97%	-2.88%
cn	-10.17%	1.40%	-2.25%	20.65%	-0.23%	0.81%	-1.36%	5.17%	13.51%	9.12%	-9.52%	-11.37%
hg	-33.69%	-14.14%	-4.57%	-6.03%	58.62%	-1.00%	2.24%	8.15%	50.42%	26.22%	-20.59%	-76.11%
gs	3.32%	-6.94%	2.35%	-5.98%	-10.81%	-0.01%	0.71%	1.62%	0.25%	8.69%	8.45%	31.18%
gf	-20.05%	2.20%	1.87%	-15.42%	-3.13%	-1.65%	-0.26%	1.36%	9.80%	60.60%	47.81%	-72.72%
mg	-44.76%	-21.57%	-5.34%	27.10%	-16.91%	-5.30%	0.24%	9.76%	30.77%	52.11%	47.18%	32.91%
mr	15.02%	13.55%	-2.93%	-9.31%	-5.05%	0.46%	1.40%	0.70%	0.90%	13.57%	21.87%	65.24%
mi	19.00%	6.68%	17.24%	1.37%	3.96%	2.36%	1.74%	2.00%	3.99%	43.55%	10.31%	54.79%
bc	-26.46%	-9.39%	-17.45%	73.20%	43.40%	-1.46%	-0.73%	-1.82%	14.56%	31.37%	50.86%	-20.82%
mc	9.13%	7.83%	5.24%	-12.88%	-14.57%	-2.23%	2.77%	6.44%	9.83%	82.97%	-10.19%	86.60%
no	3.48%	29.31%	50.88%	18.33%	-3.72%	-1.46%	-1.17%	3.35%	22.10%	35.24%	-28.06%	13.94%
ip	-9.64%	-7.84%	2.64%	1.01%	-5.34%	1.81%	-4.79%	4.80%	29.51%	93.48%	81.28%	18.74%
mp	59.72%	18.99%	39.08%	-4.68%	-35.70%	1.12%	-0.31%	9.45%	17.03%	42.07%	70.30%	-4.83%

Table 16: Projected changes (future – baseline) in precipitation volumes for the upstream area. Statistics are in million litre. Negative values are highlighted. GCMs are sorted by annual baseline precipitation

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-62,072	-211	-56,736	-86,108	-61,942	-48,715	8,430	10,108	54,358	-24,486	-17,198	-62,376
ac	-123,840	18,138	22,978	8,410	9,632	-3,339	-38,929	16,569	19,388	-95,951	107,824	-121,404
ce	-28,270	19,646	-53,863	-47,724	-133	264	-5,233	-1,299	9,934	6,852	23,535	-10,311
in	-15,485	-3,184	-36,207	29,177	-12,045	-11,259	-1,490	-3,594	-23,595	-38,109	-6,904	39,076
he	-56,665	4,945	7,170	-46,250	-2,688	-30,958	-176	23,945	33,472	-15,157	53,323	-44,490
cc	-42,920	-50,134	-15,333	1,377	-765	2,616	-2,652	14,670	46,469	44,592	23,335	18,515
gd	-129,795	74,132	88,135	105,326	91,300	12,296	11,555	10,107	47,994	-21,270	-97,246	-152,408
cn	-19,793	4,335	-8,959	55,128	-8,881	3,376	-6,347	21,988	34,437	15,290	-18,619	-22,803
hg	-75,281	-27,820	-9,514	-29,820	149,655	-14,497	8,309	33,407	151,285	32,730	-30,173	-127,387
gf	-67,929	7,972	11,883	-21,360	5,069	-5,900	2,329	18,330	51,348	137,809	111,988	-142,228
gs	34,625	-13,772	16,613	254	-25,718	2,255	4,429	8,527	3,290	22,446	33,969	69,816
mg	-110,144	-82,963	-19,899	60,246	-46,753	-39,102	2,343	52,771	84,335	110,264	73,139	125,457
bc	-89,935	-44,886	-49,633	180,700	118,076	-6,978	-5,281	-268	46,696	49,827	110,239	-43,681
mr	70,182	69,133	-1,182	-17,079	-13,499	5,387	10,547	7,862	10,664	38,072	54,999	134,025
mi	76,615	39,061	40,660	-16,801	10,624	21,197	13,503	16,279	15,221	91,314	25,389	107,935
mc	24,552	18,600	22,233	-7,919	-44,063	-17,264	11,463	39,435	44,462	201,351	-11,923	166,687
no	36,715	107,612	152,328	58,474	-2,642	-10,106	928	19,744	68,569	88,859	-56,120	56,710
ip	-23,465	-24,624	11,303	14,984	-3,854	25,214	-19,110	33,525	127,632	240,809	180,340	65,223
mp	187,922	78,603	98,783	-3,586	-99,782	11,957	6,248	58,110	70,378	91,064	140,738	3,591

Table 17: Projected required changes (future – baseline) in precipitation volumes for the upstream to maintain the baseline moisture index (see methods). Statistics are in million litre Negative values are highlighted

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-76,135	-6,164	-62,721	-98,902	-68,974	-55,480	4,599	7,573	56,460	-37,123	-32,246	-90,499
ac	-138,091	15,675	21,700	1,099	4,209	-2,121	-51,170	14,293	17,779	-109,534	109,814	-130,725
ce	-44,735	10,651	-58,437	-50,719	-6,510	-5,169	-12,100	-8,241	624	-15,644	-994	-35,052
in	-22,419	-7,810	-44,552	26,883	-16,839	-12,235	-360	-1,137	-26,384	-45,999	-14,539	38,377
he	-72,499	-2,203	3,472	-56,382	-9,975	-35,373	-6,312	22,869	33,086	-18,804	33,397	-61,532
cc	-57,380	-56,802	-19,584	-7,692	-9,057	-1,262	-7,820	8,855	40,932	34,425	6,518	5,640
gd	-166,218	61,466	83,498	102,480	89,890	11,699	11,201	7,454	47,435	-29,358	-117,514	-181,959
cn	-32,749	1,743	-11,981	57,971	-9,966	2,706	-11,448	20,192	35,260	17,865	-31,380	-37,772
hg	-91,960	-36,049	-15,546	-36,139	148,465	-16,691	3,394	32,930	155,617	31,114	-47,909	-151,047
gf	-87,678	-4,605	3,074	-40,338	-5,132	-13,378	-5,234	15,816	45,862	135,003	100,560	-169,782
gs	26,817	-19,047	12,099	-6,725	-33,366	-1,452	-351	4,380	-2,247	10,647	24,086	56,069
mg	-114,963	-87,399	-22,903	59,455	-55,734	-45,042	-2,201	51,843	93,322	114,169	67,821	117,386
bc	-95,179	-50,440	-53,853	177,599	113,478	-10,244	-10,706	-5,746	41,992	44,013	102,758	-51,854
mr	67,601	67,804	-1,950	-19,372	-16,790	3,425	7,401	4,149	4,287	29,988	49,739	129,354
mi	77,578	40,786	42,613	-12,072	15,160	23,139	12,177	14,390	12,461	93,885	22,543	110,828
mc	16,744	14,236	16,742	-15,229	-50,184	-22,043	5,252	33,391	37,656	188,009	-21,475	156,173
no	26,350	102,972	149,307	49,936	-8,301	-13,695	-4,969	15,201	64,698	80,048	-71,836	42,963
ip	-30,237	-29,135	6,336	8,682	-12,751	20,564	-25,087	27,493	121,698	229,523	167,766	51,162
mp	177,582	71,716	93,908	-14,045	-109,536	7,433	1,180	53,335	64,623	76,388	130,742	-10,488

Table 18: Projected changes (future – baseline) in moisture index for the upstream area, calculated from total precipitation and PET for the project area. Negative values are highlighted

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-44.71%	-3.05%	-27.34%	-43.57%	-33.85%	-28.78%	2.47%	3.94%	28.70%	-19.66%	-18.76%	-55.95%
ac	-81.04%	7.89%	9.72%	0.49%	2.08%	-1.19%	-25.92%	7.45%	8.85%	-57.89%	66.26%	-83.79%
ce	-26.09%	5.18%	-25.68%	-23.12%	-3.21%	-2.72%	-6.37%	-4.16%	0.30%	-8.10%	-0.57%	-21.81%
in	-13.43%	-3.89%	-19.16%	12.29%	-8.35%	-6.71%	-0.20%	-0.61%	-13.05%	-24.64%	-8.59%	25.02%
he	-42.36%	-1.08%	1.53%	-25.07%	-4.89%	-18.77%	-3.34%	12.03%	16.59%	-10.18%	19.23%	-38.85%
cc	-33.66%	-27.96%	-8.62%	-3.43%	-4.42%	-0.67%	-4.16%	4.50%	19.95%	18.34%	3.78%	3.59%
gd	-91.91%	29.37%	36.68%	46.75%	45.33%	6.45%	6.18%	3.88%	23.76%	-15.72%	-67.61%	-112.18%
cn	-19.29%	0.88%	-5.31%	26.99%	-5.03%	1.49%	-6.10%	10.57%	17.80%	9.82%	-18.34%	-23.94%
hg	-53.61%	-17.61%	-6.78%	-16.28%	74.95%	-9.05%	1.81%	17.40%	80.11%	16.93%	-27.71%	-94.17%
gf	-50.69%	-2.20%	1.32%	-17.40%	-2.48%	-6.89%	-2.74%	8.23%	22.36%	73.22%	58.95%	-105.07%
gs	16.02%	-9.44%	5.32%	-3.02%	-16.33%	-0.78%	-0.19%	2.25%	-1.10%	5.65%	14.17%	35.63%
mg	-69.28%	-43.52%	-10.16%	27.32%	-27.10%	-23.55%	-1.18%	27.30%	49.35%	62.96%	40.28%	75.42%
bc	-57.29%	-24.97%	-23.71%	80.94%	56.35%	-5.50%	-5.69%	-2.93%	20.56%	23.70%	60.74%	-33.31%
mr	41.00%	34.31%	-0.88%	-8.85%	-8.39%	1.86%	4.00%	2.14%	2.08%	16.06%	29.54%	83.67%
mi	47.53%	20.97%	19.45%	-5.66%	7.87%	13.08%	6.67%	7.52%	6.17%	51.60%	13.46%	72.77%
mc	10.01%	7.09%	7.32%	-6.84%	-24.74%	-11.65%	2.78%	16.95%	18.23%	99.42%	-12.64%	99.86%
no	15.63%	51.22%	66.20%	22.33%	-4.10%	-7.32%	-2.63%	7.80%	31.82%	42.79%	-41.73%	27.30%
ip	-18.12%	-14.50%	2.78%	3.91%	-6.20%	10.89%	-13.28%	13.95%	59.18%	121.97%	98.10%	32.49%
mp	105.36%	35.27%	41.20%	-6.24%	-53.07%	3.94%	0.63%	27.31%	31.46%	40.27%	76.87%	-6.66%

Section 4: Socioeconomic Status

4.1. Population and Ethnic Distribution

The four districts in the proposed project area are Matale, Anuradhapura, Puttalam and Kurunegala. As per the 2012 national census, the total population in these four districts is 3.9 million.

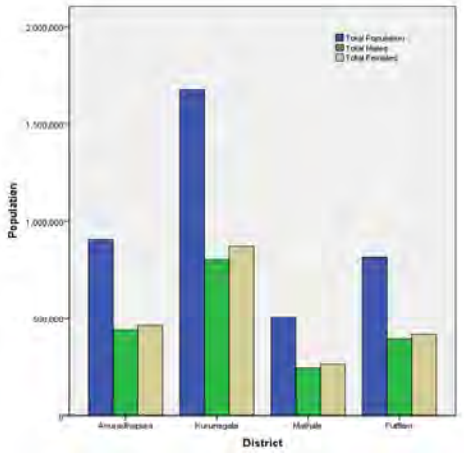


Figure 58: Population in project districts

The most populated district is Kurunegala, which has a population of 1.6 million with 804,830 males and 871,170 females. The lowest population is recorded in Matale District where the upper catchment area of the project is located.

A common feature among all four districts is that the female population is marginally higher than the male population.

The project area districts, Puttalam and Matale, involves a high percentage of Tamils and Sri Lankan Moors. Plantation communities in Matale is the home for most of the Tamils of Indian origin while the Moors are mostly engaged in trading in all districts. All communities have voting rights and they participate in the national and regional governance mechanisms.

Table 19: Ethnic distribution in project districts

District	Ethnicity (%)				
	Sinhala	Sri Lankan Tamil	Indian Tamil (Estate Community)	Sri Lankan Moors	Other
Matale District	83.9	4.2	5.3	6.4	0.1
Anuradhapura District	91.3	0.4	0.0	7.9	0.4
Kurunegala District Average	92.0	0.9	0.1	6.9	0.1
Puttalam District	79.8	5.1	0.2	14.6	0.3

4.2. Poverty Trends, Income and Expenditure

In general, in the project area, the average family monthly income is about LKR 30,000 which is about 170 USD per month.

Matale District: The mean household income per month is about LKR 30,000. The share of income to the total household income in Matale by the poorest 20% is only 5.4%. The richest 20% receives 47% of the income generated in Matale. Therefore, there is a considerable income inequity with a Gini-coefficient of 0.41 with over 70% of the families servicing some kind of a debt.

Anuradhapura District: The mean household income per month is about LKR 35,000. The share of income to the total household income in Anuradhapura by the poorest 20% is only 5.7%. The richest 20% receives 43% of the income generated in Anuradhapura with an income inequity presented with a Gini-coefficient of 0.37, which is almost comparable to Matale.

Kurunegala District: The mean household income per month is LKR 33,000. The share of income to the total household income in Kurunegala by the poorest 20% is only 4.2%. The richest 20% receives 52.6% of the income generated in Kurunegala with a Gini-coefficient of 0.48.

Puttalam District: The mean household income per month is LKR 40,935. The share of income to the total household income in Puttalam by the poorest 20% is 5%. The richest 20% receives 50.2% of the income generated in Puttalam with a Gini-coefficient of 0.44.

The 2009/10 Household Expenditure and Income Survey (HIES) reported a drastic reduction in poverty amongst the estate population. The survey reported that the percentage of poor households in the estate sector reduced from a high of 32% in 2006 to 11% in 2009/10. Collective agreement negotiations between the trade unions and plantation companies led to a near 100% increase in daily wages in 2009, and this is likely to have contributed to this substantial reduction in the poverty figures. Discussions are underway in 2019 to implement another increase in salaries in the estate sector and the plantations management have highlighted the difficulty in doing so, due to the poor economic performance of the tea and rubber sectors. The average income/expenditure of estate sector households continues to remain lower than the national averages and other sectors of the economy[16].

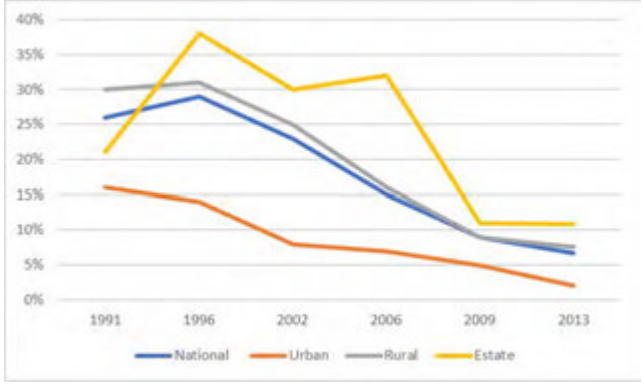


Figure 59: Percentage under poverty level

Overall there is a reduction in poverty levels in all sectors between 1991 to 2013 with poverty levels in the estate sector recording a relatively higher level with a declining trend. This lower income levels in the estate sector is negatively contributing towards the degradation of the upper catchment area, as these low-income groups are dependent on natural resources for food, energy and other needs. At the same time, they do not have resources to invest in erosion controls or conservation. The project proposes to invest in interventions to increase the income levels in the estate sector, especially in the Matale district.

[16] Department of Census and Statistics

Estate sector families live in houses provided by the estates, rent free given that one family member works in the estate. Whilst this reduces the expenditure of the household (in comparison to urban households) and increases the disposable income, living in poor quality line rooms stigmatize and alienate them from the rest of the society. In addition, relative to the rest of the households in Sri Lanka, estate households report lower access to toilets exclusive to the household, and access to drinking water within the premises. They also appear to perceive that the quality of water they drink is relatively unsafe.

Data on income and expenditure status, employment status, people's nutrition status, poverty context etc. obtained from the Department of Census and Statistics, indicate the vulnerability of families to climate shocks and the inability to spend on conservation measures to improve their adaptive capacity. For example, families are already in debt with more than 50% reporting the need to service debt, with Matale District being the second highest in the country. Participation in the labour force is between 52-62% with a male dominant trend. This is very much in line with the all-island trend where more women are engaged in household activities.

Table 20: Household income- expenditure, debt, internet and labour force participation

District	Household Income - 2016 SL Rs		Expenditure Distribution % - 2016		% in Debt - 2016	% of Internet Users-2016	Labour force participation - 2017		
	Mean	Median	Food	Non-Food			Total	Male	Female
Anuradhapura	**35,259**	**23,787**	**35.5**	**64.5**	**67.1**	**11.7**	**61.3**	**78.7**	**46.7**
Kurunegala	**32,575**	**21,600**	**31.7**	**68.3**	**64.2**	**14.2**	**58.4**	**77.6**	**42.5**
Kandy	**29,714**	**21,600**	**33.9**	**66.1**	**54.9**	**25.4**	**52.7**	**74.1**	**36.1**
Matale	**30,660**	**20,814**	**36.4**	**63.6**	**71.5**	**17.5**	**56.0**	**75.9**	**40.5**
Puttalam	**34,844**	**23,000**	**38.5**	**61.5**	**56.0**	**15.6**	**55.5**	**78.2**	**36.0**
Nuwara Eliya	23,945	16,071	42.8	57.2	66.8	7.3	62.7	76.0	51.3
Colombo	51,962	33,000	28.7	71.3	51.3	39.1	53.8	74.1	35.9
Gampaha	40,174	28,386	31.6	68.4	56.2	27.0	50.6	72.8	31.2
Kalutara	35,674	24,000	30.4	69.6	62	20.2	53.0	73.2	35.4
Galle	34,406	24,179	34.1	65.9	62.6	18.0	52.4	70.8	36.5
Matara	28,687	21,000	36.2	63.8	61.5	13.2	56.6	75.8	40.3
Hambantota	33,717	23,705	33.4	66.6	63.0	14.3	54.7	77.0	36.1
Jaffna	22,692	16,000	42.4	57.6	59.5	17.8	46.2	69.6	27.0
Mannar	25,650	21,033	47.5	52.5	57.4	8.6	46.4	69.5	23.8
Vavunia	28,039	20,833	37.9	62.1	80.8	16.6	55.4	74.8	38.0
Mullativu	18,461	12,864	50.0	50.0	58.4	9.1	50.9	74.8	28.6
Kilinochchi	19,800	18,369	51.6	48.4	42.0	9.6	45.3	70.5	22.8
Batticaloa	25,577	19,983	57.1	42.9	50.4	16.2	43.6	71.2	21.7
Ampara	28,353	23,000	49.1	50.9	57.5	11.7	45.7	72.4	23.2
Trincomalee	28,900	22,278	46.1	53.9	49.0	18.8	48.1	75.2	24.0
Polonnaruwa	35,044	22,000	34.7	65.3	78.2	9.7	50.0	73.8	29.5
Badulla	29,641	20,000	39.1	60.9	63.8	12.4	59.7	74.8	47.2
Moneragala	29,590	21,423	43.5	56.5	53.7	7.4	56.3	77.6	37.2
Ratnapura	25,366	18,200	40.8	59.2	62.3	11.6	58.1	76.8	40.9
Kegalle	27,186	20,083	34.7	65.3	59.6	9.4	55.3	73.1	40.6

4.3. Education, Employment Types and Gender Aspects

School education in Sri Lanka is compulsory until the age of 14, when students may disengage in favor of an apprenticeship or job. The first five years are considered as primary education and at the end, the student has the option to sit for a scholarship examination to transfer to a school with better facilities to continue his/her education. Grades 10 and 11 in the secondary school prepare students for the Ordinary General Certificate (GCE O-Level). Next the students continue to follow the Advanced GCE (A-Level) before entering college (University or Technical) level education. The education system is highly subsidized by the Government. However, there are significant variations within the schools and the access to education.

The number of students at different levels in the education process provides an indicative picture of the educational levels including dropouts. There are various reasons for 'dropouts' with household poverty being a key concern.

Table 21: Academic progression of students in project districts in 2016

District	Matale	Anuradhapura	Kurunegala	Puttalam
Student number in Grade 5	8,136	16,063	27,478	12,853
Students who obtained high marks at Grade 5	599	1,575	3,180	1,088
Students proceeding to GCE Ordinary Level	7,109	13,209	23,242	10,591
Students qualified for GCE Advanced Level	4,911	8,844	17,046	6,850
Students with 'pass' results in GCE – AL	3,151	5,273	10,767	3,894
% dropouts by GCE – OL	39.6	44.9	38.0	46.7
% dropout by GCE – AL	61.3	67.2	60.8	69.7

Based on the statistics for the year 2016, between 38% to 47% of students in the project districts did not continue conventional studies after GCE O/L and between 61% to 70% of students did not pursue regular education after GCE A/L when compared to the level of students who enrolled for education (using the Grade 5 student numbers).

Poverty and the demand for family work (unskilled labour) are some of the contributary factors for dropouts at the GCE O/L stage. About 20% dropout during the GCE A/L and there is a possibility that this group can be trained on technical and business skills in given areas to improve the household income and to reduce poverty. Further, compared to the rural and urban sectors, the estate community has a low educational attainment, in general. In a country where education is key to coming out of poverty, the lower educational attainment makes people from the estates less eligible for participating in technical and vocational job-related training and/ or jobs and is likely to create long-term vulnerability.

As per the Department of Census and Statistics data in 2017, the agriculture sector employment in project area districts are high when compared to other sectors. The same indicates that there is a high vulnerability towards people's livelihoods due to climate change.

Table 22: Percentage population under different employment

Occupation	Matale	Anuradhapura	Kurunegala	Puttalam
Managers/Senior officials/ Legislators	9	6.8	1.8	6.5
Professionals	4.7	3.9	6.1	5.3
Technical and Associate Professionals	5.2	2.3	5.1	4.9
Clerks and clerical support	1.9	4.1	3	3.4
Services & Sales Workers	7.2	11.7	14.4	11.2
Skilled Agricultural, Forestry and Fishery	19.7	44.2	24.5	15.8
Craft and Related Trade Workers	13.3	10.4	20	15.7
Plant and Machine Operators/Assemblers	8.9	4.2	8.4	8.9
Elementary Occupations	30.1	12.2	15.1	28
Armed forces & Unidentified	0.1	0.1	1.5	0.1

In order to enhance the income levels and thereby the climate resilience, the group of people identified as engaged in elementary occupations can be trained for additional skills. For example, over 30% of the working population in the Matale District is engaged in elementary occupations. Their capacity improvements, through training and exposure, can transform them to take up higher earning jobs in ecotourism and services, green listing work and others.

Most of the elementary occupations include a gender element as this category comprises of females who are interested and involved in household activities.

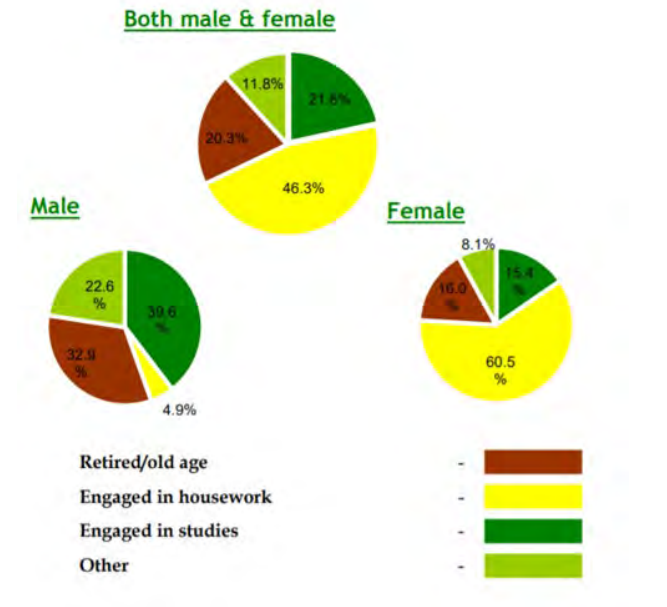


Figure 60: Reasons for less female in labour force

The national trend in the female participation also indicate less women participation.

The data indicate that women are heavily involved in household work where out of all women more than 60% are involved in household work, as per the Dept. of Census and Statistics. This is very much relevant as women empowerment through project activities could increase the household income.

It is important to design the project interventions for women in a way that they can participate in activities while engage in household work. Women can be educated to be climate smart and to adopt agriculture and other initiatives to improve the climate resilience of the entire family and the community.

4.4. Farmer Statistics

The farming population in the districts comprise mostly of subsistence farmers. Out of the 280,000 farmer members engaged in farm work, about 80% are male.

4.4.1. Age Distribution

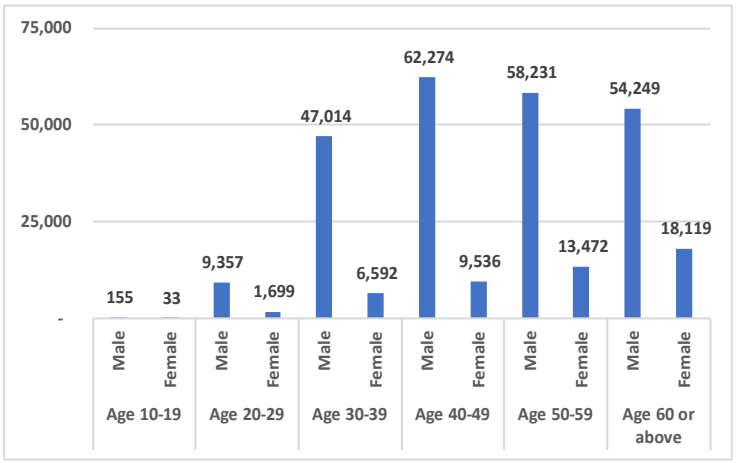


Figure 61: Age distribution of farmers by gender

Age distribution indicates that the distribution of male farmers in the 30's, 40's, 50's and over 60's age groups are about 50,000 farmers in each of the groups. 'Farming' as an occupation is less in the age group that falls between the ages of 30-39, indicating a shift in professions. However, this shift will not have much of an affect as technologies have compensated for the man-power needs. The female farming population shows an increase with each age category, especially after the child bearing age.

4.4.2. Education Levels

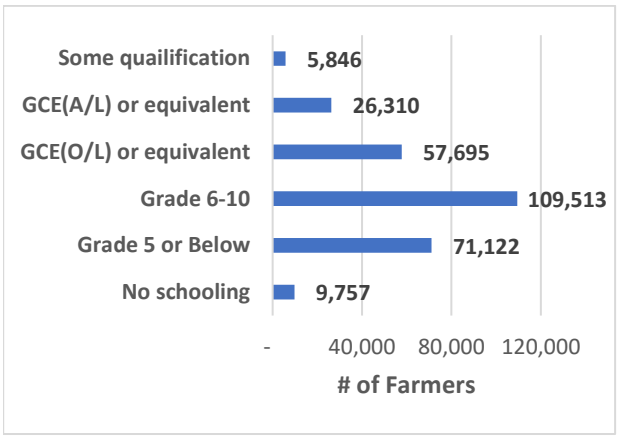


Figure 62: Education level of farmers

Out of the 280,000 farmers in the project area, only about 80,000 indicate an education level below Grade 5. These farmers are in a good position to absorb technologies and new ideas and will be able to read and understand simplified instructions.

About 26,000 have reached the GCE A/L and with training, they can be used as leaders in the farming community to carry the messages of the project.

4.4.3. Spatial Distribution of Farmers

The farmer distribution by gender among the DS divisions of the project area indicates the same gender ration in both upstream (89,000 males and 19,000 females) and downstream areas (172,000 males and 31,000 females).

Table 23: Number of farmers in DSD divisions by gender

District	DSD Name	Number of Farmers		
		Total	Male	Female
Kandy	Minipe DSD	12,013	10,083	1,930
	Udadumbara DSD	5,252	4,466	786
	Pathadumbara DSD	7,620	5,858	1,762
	Akurana DSD	4,812	3,804	1,008
Matale	Galewela DSD	13,817	11,262	2,555
	Dambulla DSD	13,565	11,537	2,028
	Naula DSD	6,244	5,374	870
	Pallepola DSD	5,720	4,771	949
	Yatawatte DSD	4,764	3,934	830
	Matale DSD	5,771	4,498	1,273
	Ambanganga Korale DSD	3,661	2,969	692
	Laggala-Pallegama DSD	3,085	2,782	303
	Wilgamuwa DSD	7,068	6,069	999
	Rattota DSD	8,862	7,083	1,779
	Ukuwela DSD	5,623	4,472	1,151
	Upstream DSD Total	**107,877**	**88,962**	**18,915**
Kurunegala	Giribawa DSD	8,042	6,576	1,466
	Galgamuwa DSD	13,259	10,251	3,008
	Ehetuwewa DSD	6,800	5,623	1,177
	Polpithigama DSD	20,441	16,579	3,862
Anuradhapura	Galenbidunuwawe DSD	11,809	10,108	1,701
	Galnewa DSD	8,240	6,940	1,300
	Ipalogama DSD	7,589	6,276	1,313
	Kahatagasdigiliya DSD	9,390	7,816	1,574
	Kekirawa DSD	11,458	9,516	1,942
	Mihintale DSD	6,313	5,210	1,103
	Nachchadoowa DSD	4,823	3,967	856
	Nochchiyagama DSD	9,566	7,885	1,681
	Nuwaragam Palatha East DSD	6,360	5,062	1,298
	Palagala DSD	8,599	7,249	1,350
	Palugaswewa DSD	3,746	3,076	670
	Rajanganaya DSD	7,753	6,318	1,435
	Thalawa DSD	13,427	11,086	2,341
	Thambuttegama DSD	7,831	6,523	1,308
	Thirappane DSD	6,708	5,557	1,151
	Downstream Total	**172,154**	**141,618**	**30,536**
	Project Area Total	**280,031**	**230,580**	**49,451**
	Percentage		**82.34**	**17.66**

4.4.4. Farmers in Small and Medium Businesses

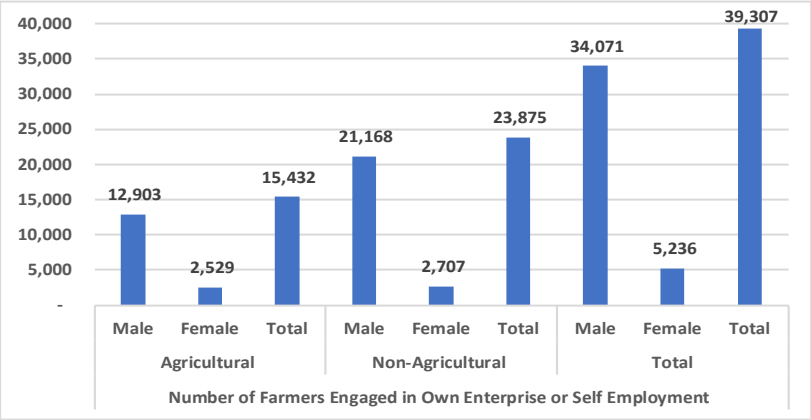


Figure 63: Farmers engaged in own enterprise or self-employment

Out of the 280,000-farmer population (39,000 males and 5,000 females), about 45,000 farmers are also engaged in agricultural and non-agricultural related enterprise work. This segment can be the first to be supported to expand their value-added businesses.

4.4.5. Farmers Engaged in Formal Work

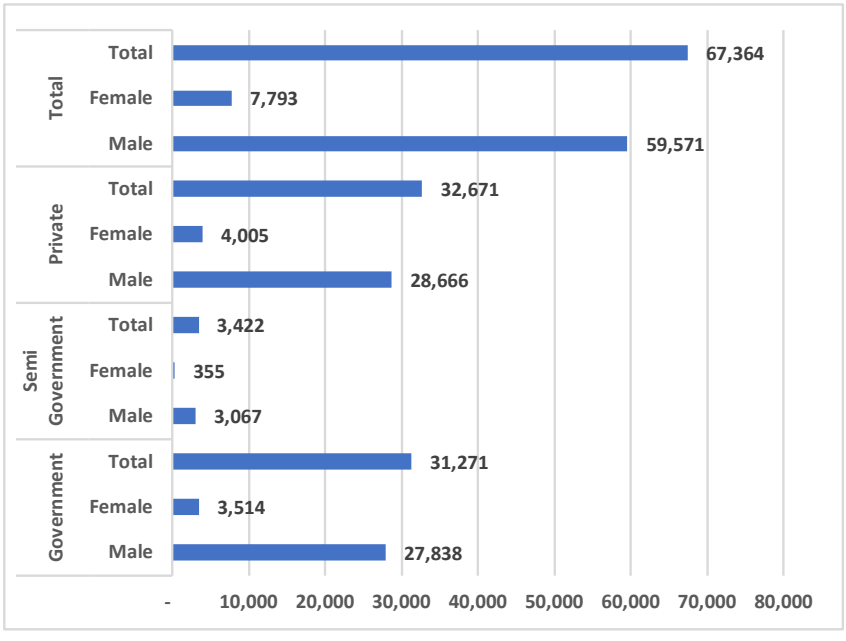


Figure 64: Farmers engaged in full-time employment

This segment of the farmer population engages in farming as a part-time activity. For example, a school teacher may engage in farming during the weekends and after school hours (i.e. after 2 pm). In the project area, a total of 67,000 farmers (about 24% of the 280,000) have other formal jobs.

Characteristics of the farmers engaged in private sector employment are not clear, yet. They may be engaged less in farming actions.

More than 75% of farmers are fully engaged in farming activities, without engaging in formal employment. The male fraction of farmers in formal employment is about 88% of the total employed. Majority of the farmers holding jobs are serving either in Govt. sector or in private sector.

4.4.6. Type of Crops Farmers are Associated with

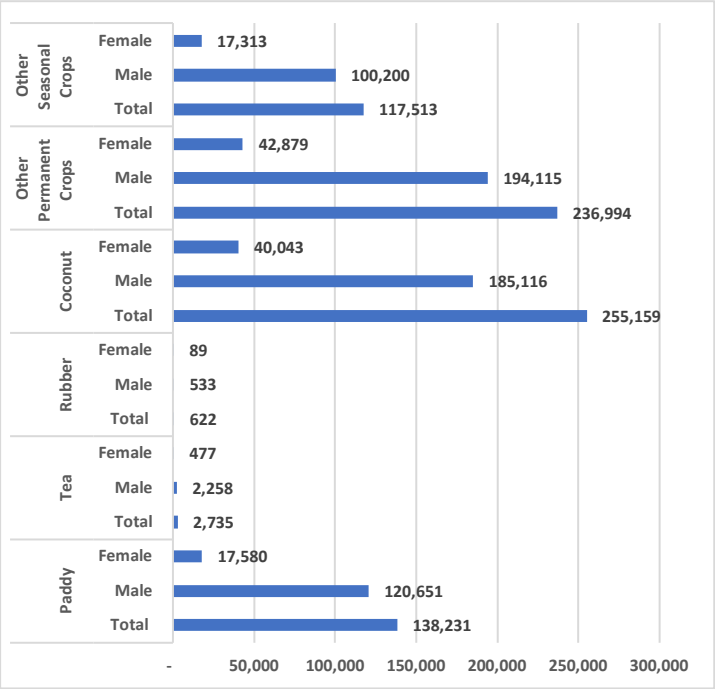


Figure 65: Crop types grown by farmers by gender

Farmer engagement statistics on agricultural crops indicate a high association with Other Permanent Crops and seasonal crops, coconut and paddy. This is interesting as statistics point out the diversity of crops cultivated by the farmers, which also includes the practice of intercropping. However, still they fall under the subsistence farmer category, needing support in value additions and improvements in terms of productivity.

4.4.7. Animal Husbandry

As in the case of farmers being engaged in cultivating different varieties of crops, they are also engaged in different types of animal husbandry. Most of the farmers who are involved are males and the highest engagement is in Cattle and Poultry. Some farmers may be involved in more than one variety of animal husbandry. The number of females being involved in Poultry is relatively low indicating a high potential to encourage women in poultry.

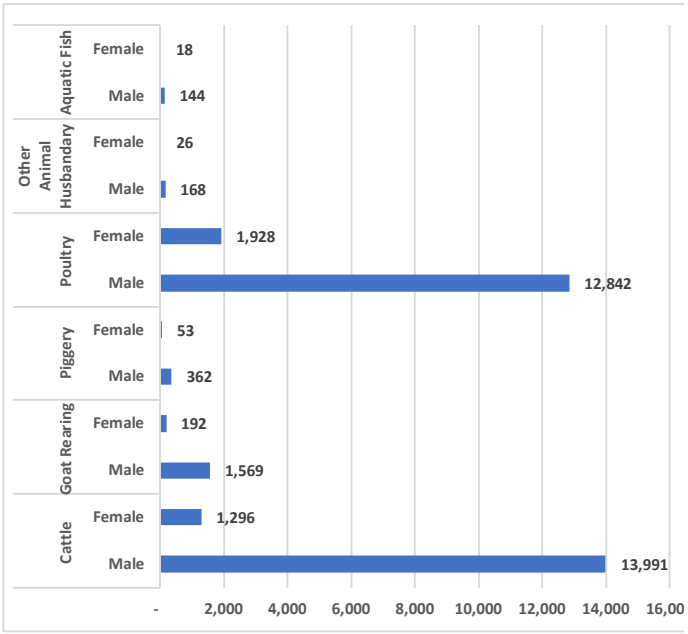


Figure 66: Farmers engaged in livestock and animal husbandry by gender

4.4.8. Land Ownership

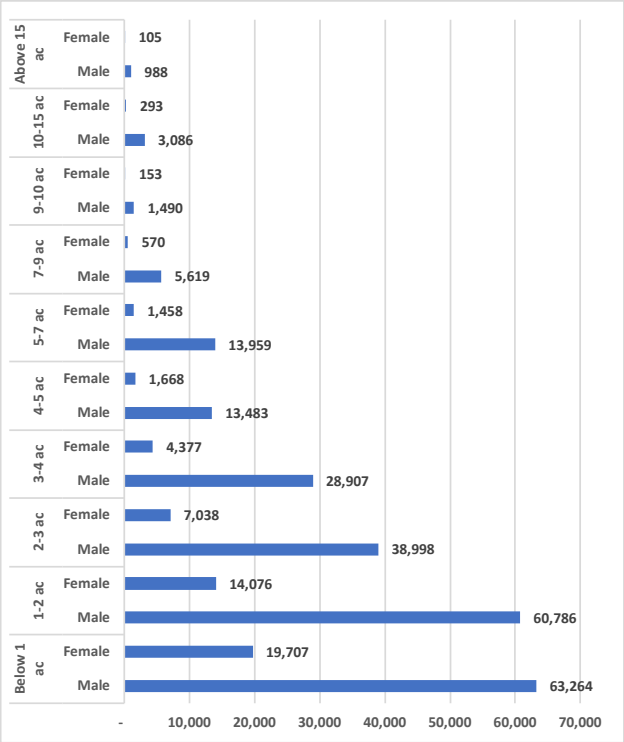


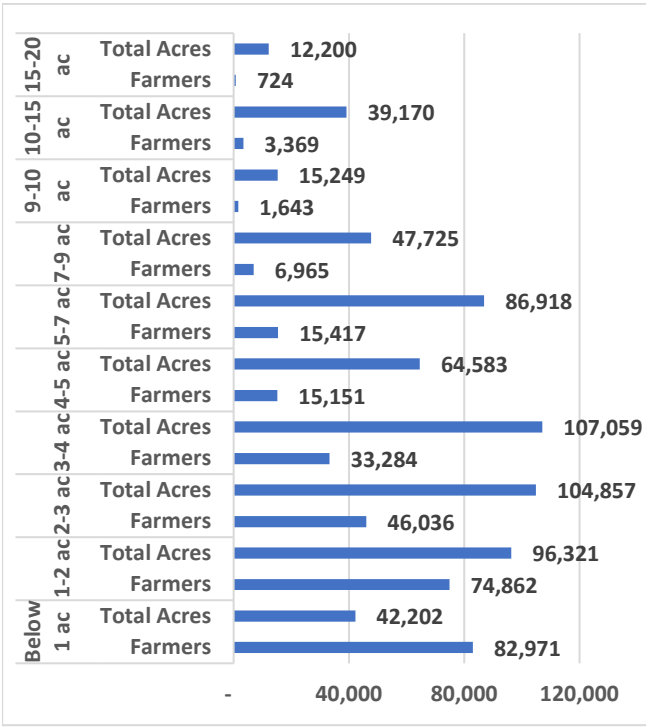
***Figure 67: Land ownership* types by farmers**

Majority of the farmers (except in plantations) own land across the project area. For example, out of the 280,000 farmers, over 270,000 own land. Some lands are owned by private parties while some are cultivated by sharing agreements between the landlord and the cultivating farmer.

The gender distribution of land ownership indicates that most of the lands are owned by men (231,000 males compared to 49,000 female farmers).

Land parcels below four acres dominate the land parcel sizes with less than two-acre parcels, representing a significant portion with over 150,000 farmers out of the 280,000 present in the group.

4.4.9. Land Parcel Sizes Compared to Total Area



The total land area is distributed among the approximate 280,000 farmer population with the smaller land parcels distributed among a large number of farmers.

Figure 68: Land distribution among farmers by gender

4.5. Cropping Pattern

Table 24: Crops grown in the project area and national contribution

Crop	Total Sri Lanka	Matale	Anuradhapura	Kurunegala	% of country total
Paddy	542,556	9,349	37,853	46,788	17%
Kurakkan	4,310	46	1,283	290	38%
Maize	27,100	164	20,201	1,150	79%
Green gram	6,090	47	405	871	22%
Cowpea	6,230	28	518	418	15%
Black gram	5,520	1	3,980	48	73%
Gingelly	3,320	5	216	129	11%
Peanut	7,800	60	6,100	925	91%
Manioc	12,490	184	480	1,195	15%
Sweet potatoes	3,010	244	75	236	18%
Green chilies	9,050	187	1,650	389	25%
Mustard	280	5	75	3	30%
Ginger	1,530	68	3	467	35%
Turmeric	680	60		53	17%
Luffa	2,528	105	295	223	25%
Brinjals	5,735	166	780	380	23%
Bitter-gourd	3,107	47	345	128	17%
Snake Gourd	2,340	60	90	103	11%
Tomatoes	3,645	120	188	116	12%
Cucumber	1,960	42	215	194	23%
Pumpkin	7,965	125	1,550	192	23%
Ash-plantain	1,154	32	390	300	63%
Capsicum	2,514	46	160	147	14%
Total	**660,914**	**11,191**	**76,852**	**54,745**	**22% approx**

The project area provides a significant contribution to the national production. The area is a major paddy producing area and it is also home to a number of other crop varieties. For example, the Anuradhapura area provides the majority of Maize, Black Gram, Peanuts and Ash Plantain (a curry vegetable).

In addition, Matale, Anuradhapura and Kurunegala together include over 25% of the national production area for Kurakkan (finger millet), Maize, Black Gram, Peanut, Green Chilies, Mustard, Luffa and Ash Plantain (both curry vegetables).

As such, the value of a steady supply of water to the farming areas of Kurunegala and Anuradhapura is vital to the food security of the country.

4.6. Welfare Provision by the Government to Subsistence Farmers

Table 25: District wise welfare payments paid during 2015 to poor families in the project area

District	Matale	Kurunegala	Anuradhapura	Total in SL Rs	USD millions
January	145,204,000	55,921,640	149,273,840	350,399,480	**2.34**
February	145,204,000	55,921,640	149,220,260	350,345,900	**2.34**
March	145,204,000	55,921,640	149,220,260	350,345,900	**2.34**
April	99,193,360	361,475,500	143,966,740	604,635,600	**4.03**
May	99,193,360	361,475,500	143,966,740	604,635,600	**4.03**
June	99,163,020	361,063,200	143,685,800	603,912,020	**4.03**
July	98,793,420	359,751,200	143,905,600	602,450,220	**4.02**
August	98,543,320	358,793,000	143,758,380	601,094,700	**4.01**
September	98,209,360	357,567,360	143,495,980	599,272,700	**4.00**
October	97,820,640	357,019,860	143,679,420	598,519,920	**3.99**
November	97,394,700	355,267,660	142,825,860	595,488,220	**3.97**
December	97,033,540	353,818,100	142,675,400	593,527,040	**3.96**
Total	1,320,956,720	3,393,996,300	1,739,674,280	6,454,627,300	**43.03**
USD	**8.81**	**22.63**	**11.60**	**43.03**	

Source: Divineguma (Government social welfare Programme) 2015 statistics

The Government of Sri Lanka provides social welfare for the low-income groups. The low-income households in the main districts of the project area, namely, Matale, Kurunegala and Anuradhapura districts, receive approximately 43 million USD as welfare. Mostly Govt. support is received by subsistence farmers. However, climate change will further impact their resilience despite the support from the Government. On the other hand, a sound investment in land use and income generation has the potential to bring these subsistence farmers out of their poverty-stricken lifestyles and make them resilient. Such an investment will also save the Government more than 40 million USD per annum from the welfare payments. Any up scaling of the same investment model applied in the project area may help to reduce the welfare needs in other similar districts. In the year 2017, the upstream area of the project reported 46,605 families obtaining welfare (Samurdhi) benefits. The total value of the disbursement is SL Rs 1,091,796,240 (i.e. over 7 million USD in 2017 only for the upstream area).

Table 26: Welfare payments paid for families in the upper catchment area 2015

DSD Name	Number of Beneficiaries	Amount Paid	Annual Amount
Galewela	6,830	12,325,700	147,908,400
Dambulla	5,033	9,947,500	119,370,000
Vilgamuwa	3,851	6,955,550	83,466,600
Naula	2,281	4,203,950	50,447,400
Pallepola	2,439	4,793,250	57,519,000
Yatawatta	2,665	5,284,600	63,415,200
Matale	3,314	6,279,700	75,356,400
Abanganga Korale	1,986	4,231,850	50,782,200
Laggala	2,442	4,988,850	59,866,200
Rattota	5,327	10,910,350	130,924,200
Ukuwela	3,969	8,317,200	99,806,400
Ududumbara	2,052	4,477,640	53,731,680
Minipe	4,416	8,266,880	99,202,560
Total	46,605	90,983,020	1,091,796,240
USD (in Million)		**0.61**	**7.28**

Section 5: Climate Change Related Plans and Approaches

5.1. Climate Change Policy and Coordination

The Climate Change Secretariat (CCS) functioning under the Ministry of Mahaweli Development and Environment (MMD&E) is the dedicated national agency/focal point entrusted to coordinate both adaptation and mitigation related affairs. The CCS acts as the National Designated Authority (NDA) for the Green Climate Fund, Adaptation Fund (AF), and manage policy and initiatives related to the Paris Agreement (ratified in 2016) and UNFCCC, including National Communications.

The CCS took steps to address the climate challenge through the National Adaptation Plan (NAP) for Climate Change Impacts in Sri Lanka (2016-2025).[17] The NAP took into consideration three major types of observed climatic changes in the country, such as the gradual increase in ambient air temperature; changes in the distribution pattern of rainfall; and increases in frequency and severity of extreme events. Based on the NAP, nine key sectors and priority areas were identified and Sri Lanka submitted the country's "Nationally Determined Contributions" (NDCs) that covered national commitments in relation to both adaptation and mitigation (Climate Change Secretariat, 2017).[18] The NDCs covered projections, physical effects, impacts, adaptation needs and adaptation options for five major types of changes in the atmospheric and oceanic systems that could create impacts on vulnerable sectors. CCS uses several mechanisms in its operation, including:

- Establishing and facilitation of Climate Adaptation Cells for key sectors
- Facilitating a National Working Group for cross-cutting national adaptation needs
- Supporting a Community Service Organization Forum (established during the UNREDD)

The sector working groups (Cells) cover the following thematic areas:

Climate Cell 1: Food security and water
Climate Cell 2: Biodiversity and coastal resources
Climate Cell 3: Health
Climate Cell 4: Human settlements and infrastructure
Climate Cell 5: Tourism, energy, industry and infrastructure
Climate Cell 6: Export agriculture

5.2. National Adaptation Plan

CCS led the effort to coordinate a multi-sector initiative to convey the global and local knowledge along with the relevant rational to a national plan; namely, the National Adaptation Plan (NAP). The consultations in the NAP process made it truly a multi-sector and multi-stakeholder product with multiple strategies to meet the adaptation challenges. The NAP process identified priority action areas that needs to be facilitated and implemented by the Climate Cells under the CCS.

17 Climate Change Secretariat, 2015, National Adaptation Plans - https://goo.gl/UrSzJc
18 Climate Change Secretariat, 2017. Nationally Determined Contributions (NDCs) - https://goo.gl/hkdsp2

Priority actions for each sector are summarized below with the actions related to the proposed GCF project highlighted in "Blue." The project is linked to 33 out of 56 priority actions.

Table 27: Priority sectors and actions in the NAP related to GCF investment
(Note: The proposed project will contribute to the NAP priority actions highlighted in Blue)

Sector	Priority Actions
Food security (5 NAP priorities all in line with the project)	**Develop tolerant varieties (paddy, OFC, horticulture) and breeds (livestock and poultry) to heat stress, drought and floods and resistant to diseases and pest attacks** **Develop and promote water efficient farming methods** **Adjust cropping calendars according to climate forecasts** **Develop systems for timely issuing and communicating of climate information to farmers** **Develop research institute capacity for conducting research on tolerant varieties/breeds and climate resilient farming methods**
Water resources (5 NAP priorities with 4 in line with the project)	**Develop and implement watershed management plans for critical watershed areas** **Increase the efficiency of use and reduce losses of irrigation water** **Assess the current practices of water management for climate resilience and identify ways to improve them** **Identify and map areas vulnerable to droughts and flood hazards and prepare disaster risk management plans** Design rational intra-basin and trans-basin strategies to harness periodic surpluses of water in storage facilities
Coastal and marine sector (5 NAP priorities – Coastal and Marine are is not covered by the project)	Implement a continuous program for monitoring shore line changes Develop shore shoreline management plans including M&E programs Study impacts of sea level rise on costal habitats over short-, medium- and long-term horizons Identify, declare, collect information and prepare maps on vulnerable areas to extreme events and inundation Conduct awareness programs on sea level rise and extreme events to coastal communities to empower them for facing the risks of climate change
Health (5 NAP priorities with 3 in line with the project)	**Establish a surveillance program for detection and monitoring of climate induced diseases** Conduct research studies on impact of climate change prevalence and spread of vector borne and pathogenic diseases Develop research institutes' capacity conducting research on health impacts of climate change **Strengthen the mechanisms for sharing information between disaster management and health management agencies** **Launch awareness programs on climate and health risks for healthcare workers and the public**

Human settlements and infrastructure (5 NAP priorities with 2 in line with the project)	**Promote climate resilient building designs** Revise building approval systems to increase the climate resilience Conduct research studies on climate resilient building designs, green building concepts and alternative materials Conduct training programs on climate resilient buildings for industry stakeholders **Prepare hazard preparedness plans for urban, rural and estate settlements**
Ecosystem and biodiversity (5 NAP priorities with all 5 in line with the project)	**Conduct research studies on climate change impacts on ecosystems and biodiversity** **Establish a comprehensive program to monitor climate change impacts on key natural ecosystems and biodiversity** **Prepare adaptive management programs for climate sensitive ecosystems** **Prepare recovery plans for highly threatened ecosystems and species** **Develop research institutes' capacity for conducting research on climate change impacts on ecosystems and biodiversity**
Tourism and recreation (5 NAP priorities with all 5 in line with the project)	**Increase the awareness of tour industry operators on climate change and its impacts** **Establish emergency communication channels for tourists and operators** **Identify tourism facilities in vulnerable areas and make arrangements to increase the climate resilience of them** **Assess the current promotional strategies with connection to emerging scenarios of climate change and adjust them accordingly** **Conduct research studies on climate change impacts on tourism and recreation**
Export agriculture sector (5 NAP priorities with 4 in line with the project)	**Introduce new cultivars/clones tolerant to heat, drought and flood and resistant to disease and pest attacks** **Promote improved nursery and plant management practices and sustainable cropping systems to increase the climate resilience of plantations and crops** **Conduct research studies on climate change impacts on export agriculture crops** **Identify and collect information on areas most vulnerable to disasters and prepare hazard vulnerability maps for all crops** Develop research institutes' capacity for conducting research on climate change impacts on export agriculture crops
Industry, energy and transportation (5 NAP priorities with 2 in line with the project)	Minimize the fluctuation hydropower generation potential through improvements in system management Diversify the energy mix with increased share of renewable energy **Diversify the supply sources of climate sensitive agro-based raw materials**

	• **Establish an early warning and hazard communication system for commuters and managers of energy, transport and industrial facilities** • Conduct research studies on climate change impacts on industry, energy and transportation
Cross-cutting needs of adaptation (11 NAP priorities with 3 in line with the project – the project will indirectly contribute to more)	• Undertake a review of relevant macro and sectoral policies, ordinances, acts, statutes and procedures to identify options for mainstreaming climate change adaptation activities in Sri Lanka • Develop policy recommendations necessary for addressing vulnerability to impacts of climate change in all development /management projects • Restructure and strengthen the Climate Change Secretariat as the National Focal Point (NFP) for implementation of NAP • Develop an inventory of international climate donors, funding schemes, training providers, training programs, research agencies/consortiums and events (conferences, seminars etc.) for the benefit of local stakeholders of adaptation • Create a *National Adaptation Fund* with the collaboration of the Ministry of Finance to support the implementation of NAP actions and supportive programs • Establish a national network of research agencies and universities that are carrying out research on climate adaptation for promoting coordinated research and information dissemination • Develop a coordinated multi-disciplinary small research grant program on thematic areas relating to climate change adaptation to be facilitated by the National Focal Point and managed by the national research support agencies (e.g. National Science Foundation, National Research Council, Council for Agriculture Research Policy) • **Establish a common repository of scientific and awareness materials on climate change adaptation** • Initiate a joint island wide program for identification of religious, cultural and archaeological assets vulnerable to climate change impacts and conservation of threatened assets • **Conduct training programs for government officers, CSO (Civil Society Organizations) members, and private sector employees on climate change adaptation** • **Establish a national research program on climate modeling for long- term climate projections**

5.3. Complementary Agencies and Programs

CCS work in climate change is also complemented by several agencies, such as the Dept. of Meteorology (DOM), Natural Resource Management Centre (NRMC) of the Dept. of Agriculture, National Water Supply and Drainage Board (NWSDB), Central Environment Authority (CEA) and the Disaster Management Centre (DMC).

The **Meteorology Department** is responsible for collection and dissemination of weather and climatic data and information and is also in charge of advising other agencies on climate events,

issuing early warnings on precipitation patterns, cyclones and other climate related disasters, and providing the nation with planning tools such as down-scaled climate predictions to improve the agriculture and service sector management decision making.

The Department of Agriculture and its division, the **Natural Resource Management Centre (NRMC)** implements the **Soil Conservation Act No. 25 of 1951** where interventions on the prevention of soil erosion is designed and promoted. NRMC is also in charge of providing drought related early warnings and introducing management practices to mitigate the impacts of droughts. NRMC and the Dept. of Agriculture maintains a series of training and research facilities located in different agroclimatic zones; conducts plant breeding, genetics and extension research; organize teaching programs and also maintains a world class "Agro-Technology Park" that include demonstrations of different types of agronomics, crop practices, technologies and initiatives to enhance soil quality, land productivity and ways to reduce risks in relation to agro-based livelihoods.

The **National Water Resources and Drainage Board (NWSDB)** is responsible for operationalizing the **Water Resources Board Act No 29 of 1964**. This Act provides provisions for the appointment of a Board to advise the Minister on the utilization of water resources; maintenance of irrigation schemes' drainage; flood control; hydraulic power; promotion of afforestation; control of soil erosion; prevention of pollution in rivers and other water courses; and formulation of policies and plans for the utilization of water resources.

The **Central Environment Authority (CEA)** was established under the **National Environmental Act No 47 of 1980** with a mandate to protect and manage the environment. In 1988, the Authority was transformed into a national pollution control board that acts as the national level regulating institution to prevent and control pollution of water resources. Key work areas of CEA are the development of discharge criteria for industrial waste and the development and implementation of ambient water quality standards.

The "**Green Lanka Strategy and Action Plan 2030**" by the Govt. of Sri Lanka, finalized in early 2017, with the participation of Government Agencies, Universities, Non-Governmental Agencies, Environment Advocacy Groups and Community Based Organizations, include 12 "Missions". For example, Mission 2 is on "Mainstreaming Biodiversity Conservation for Sustainable Development" and consists of several actions related to the proposed project activities of this proposal including Payment for Ecosystem Services (PES) and a multitude of conservation measures. Another example is Mission 7, "Water for all and always" that highlights catchment protection, water use efficiency improvements, demand side management of water etc., which is very much in line with the proposed project objectives and activities.

The **National Physical Plan** by the **National Physical Planning Department** (NPPD) highlights the importance of preserving the Central Highlands to the extent that it advocates reducing the population in this area to minimize the pressure on natural resources in the area. It advocates changes to the vegetation and cropping practices to reduce siltation and erosion, in the face of increasing climate impacts.

Through the UNREDD process, Sri Lanka developed the **"National REDD+ Investment Framework and Action Plan (NRIFAP, 2017).**" NRIFAP advocates for forest and watershed

restoration, sustainable natural resource management and governance, enhancement of land productivity and improvement of agroforestry models.

The **Sri Lanka Comprehensive Disaster Management Programme (SLCDMP) – 2018**[19], advocates enhancing initiatives towards disaster risk reduction and the need to move away from disaster response. SLCDMP relied on the "National Hazard Profiles (DMC/UNDP, 2012)[20]" to design risk reduction initiatives, including the drought profile along with nine other hazards. The proposed project area is one of the most drought-stricken areas in the country.

The project also aligns with the **Forestry Sector Master Plan 1995-2020, National REDD+ Strategy and the National Action Programme for Combating the Land Degradation of Sri Lanka (NAP-CLD).**

The **National Agriculture Policy of Sri Lanka"** advocates risk reductions in domestic food production, floriculture and export crop sectors as a measure to increase the self-reliance of the country. The purpose of the Agriculture Policy, *inter alia*, is to "…*meet the basic needs of the farming community…through the adoption of technically feasible, socially acceptable, economically viable and environmentally friendly agricultural production technologies…"*[21].

5.4. Alignment of the GCF Investment

As indicated in the introduction, the proposed investment including the GCF Financing seeks to introduce climate smart agriculture methodologies within the Knuckles upper catchment, which is used as the control region to reduce the vulnerabilities of subsistence farmers and plantation communities, while improving the irrigation and efficiencies in the downstream command area. As such, the project aligns extremely well with the above outlined national climate priorities by increasing the adaptive capacities of the targeted beneficiaries of the project.

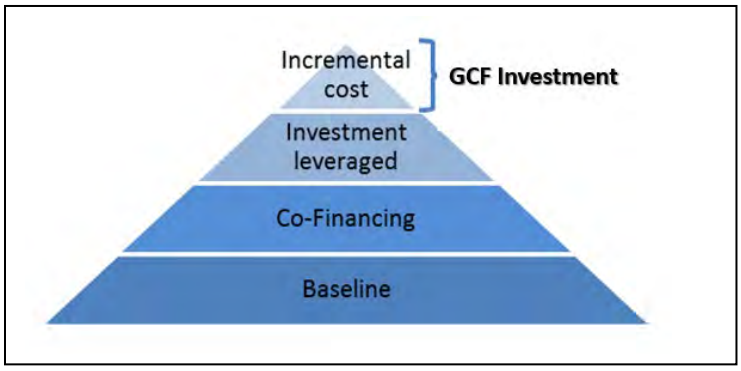
The proposed project is aligned with the National Adaptation Plan (NAP) for Climate Change Impacts in Sri Lanka (2016-2025) in its primary objective to build resilience in most vulnerable communities, sectors and areas that faces adverse effects of climate change and focuses on human health, food security (agriculture, livestock and fisheries), water and irrigation while prioritizing adaptation initiatives that derive mitigation co-benefits.

[19] Comprehensive Disaster Management Programme (Disaster Management Centre and UNDP, 2014) - https://goo.gl/8Ubeih
[20] Hazard Profiles of Sri Lanka (UNDP, 2012) https://goo.gl/8okLu6
[21] Sri Lanka National Agriculture Policy (2007) http://www.agrimin.gov.lk/web/images/docs/1252389643AgPolicy4.pdf

Section 6: Baseline, Incremental Reasoning and Paradigm Shift

6.1. Baseline Setting

The baseline setting of the proposed project is to address climate risks impacting the resilience of the subsistence farmers in the Knuckles range catchment area and the irrigated downstream command area.



The GCF investment is identified as the incremental cost necessary to climate proof a range of development efforts in the area described as co-financing and leveraged investments towards achieving the overall climate resilience taken along with the GCF investment. The larger context of the incremental reasoning is, therefore, closely linked to the anticipated paradigm shift that involves multiple sectors, partners and communities in a controlled programming environment.

6.2. Paradigm Shift Potential

The overarching paradigm shift expected through the GCF and other investments through the proposed project include at least three key elements.

a) Changing the capacity of subsistence farmers to meet the climate challenges by way of having the i) planning capacity; ii) technologies; and ii) financing;
b) Strengthen national food security using the full agriculture production capacity in the project area; and
c) Enhance engagement of private sector to add value to the products and services in the project area through i) innovative product designs and marketing approaches; ii) financing options to support income generation and risk reduction; and iii) having the skills of farmers, families and officials to work with private sector

6.3. Project Environment

6.3.1. Climate Threatened Nationally Important System

The land use in the upper mountainous regions in Sri Lanka are well regarded as they are key areas for water absorption, retention and distribution within the region as well as away from the region. In terms of ecosystem processes related to adaptation, water that is absorbed and released are used for power generation, agriculture and domestic consumption. The mountainous area and the command area are impacted by the climate in terms of shifting seasons, changes in the frequency, intensity and periodicity of rainfall, temperature rise, high winds etc.

The Knuckles region and its irrigated downstream area—which is the focus of this project—is dominated in the upper catchment by tea plantations and forest cover (natural and plantation) among other field crops and homegardens, while the lower catchment or the irrigated area is dominated by rice cultivation. Climate challenges lead to uncertainties of the primarily agriculture-based livelihoods in this area that involve subsistence farmers owning smaller land parcels in both upstream and downstream of Knuckles area along with plantation communities.

6.3.2. Smallholders Vulnerability

Smallholders are the main suppliers of certain key value chains in the agriculture sector, which contribute to both food security and are an asset to the country's economy in the sense that they can provide substitutes for imports while being considered for exportation, thereby generating a revenue. Given their key role in agriculture value chains, smallholder famers' vulnerability to changes and inability to cope with variations through their lack of planning and access to climate resilient farming techniques is a risk that must be addressed. The baseline scenario is about agriculture development and water resources management activities in the project area. However, climate risks are threatening these investments and their sustainability. If nothing is done to respond to climate risks, the Government may have to consider investing more resources, in a few years, to ensure that the infrastructure is adjusted to an environmental context, which will have evolved as indicated by the data provided in the feasibility study. If agriculture and water resource management infrastructure are developed as per the baseline scenario and associated projects, there is a need to guarantee on one hand that these infrastructures are resilient to climate change by integrating climate projections in their design. On the other hand, it is critical that smallholders, as the suppliers of agriculture value chains in the area, can adapt their current techniques to the projected changes in the climate.

The project will have a landscape approach while taking into consideration the resilience of livelihoods and natural ecosystems. For example, the project will work with smallholders as the main suppliers of critical value chains so that they can better plan. They will be empowered to adopt modern communications and insurance tools. The project will work towards a 'Jurisdictional Area-Based Approach' where an area is to be identified for its unique products and services and 'certified' for being environmentally friendly/climate resilient. As such specific high quality agro- and tourism products and services from the project area will be identified, developed and promoted. This would help in the sustainability of the paradigm shift by targeting high-end niche markets allowing higher returns of investments to the communities through private sector interventions. Eventually, the subsistence farmers will have resources and an incentive to pay attention to landscape restoration and conservation towards mainstreaming climate resilience. This approach would provide a replicable and unscalable model for climate adaptation by way of generating and using state-of-the art knowledge products, innovative financing packages, community led monitoring (citizen science) and climate proofing.

As indicated in the socioeconomic data analysis, these subsistence farmers own small land parcels, typically, less than two hectares. They are not economically and socially capable of meeting climate challenges due to poor access to knowledge, finance, technology, and market linkages. There are Government investments targeting them and to uplift the living standards by providing irrigation water, payment of welfare to low-income groups, subsidy on fertilizer and agri-inputs, promotion of agriculture systems etc. Even at present, however, the intensity of the

investments is not adequate to completely address climate risk or improve the conditions to attract critical private sector interest towards value added agriculture, tourism and new industries. Additional systems are also needed to bring the urgency and agency coordination support to a level that famers can connect with knowledge, climate early warnings, technology and generate diversified livelihoods to minimize climate induced shocks (agriculture, tourism and other options mixed).

6.3.3. Water Catchment Vulnerability

As presented in the feasibility study, climate scenarios show that in Sri Lanka, and particularly in the project area, climate change has caused increased erosion and the availability of less water resources. The landscape has been degraded and cannot provide all the ecosystem services it is expected to provide, which has resulted in reduced water availability and land productivity. Management of water resources must, therefore, be considered in terms of landscape level. This can be improved by ensuring that it adapts and responds to climate threats and variations, which will have a positive impact on agriculture production, and thereby, improve livelihoods in the area. The project will improve the currently degraded upper watershed area of Knuckles with a massive storage and release potential of water into the streams, reservoirs and ground water; potential to meet the drought related challenges on water use efficiency in both upstream and downstream agriculture; reducing the land degradation and improving the hydrologic systems in the area with public, private and people participation by enhancing knowledge, innovative financing, technology and marketing approaches, thereby making the ongoing and proposed conventional investments climate resilient while uplifting the adaptive capacity of the subsistence farmers and others in the project area.

This high intensity and coordinated efforts are expected to bring in a sense of urgency and involve extensive changes to the land uses and land cover to arrest the depletion of the overall water holding capacity, leading to the minimization of the surface runoff of water that results in higher soil erosion and sedimentation of reservoirs.

6.3.4. Private Sector Engagement

Private sector related innovative approaches are set to support socioeconomic development, improve community resilience and ensure sustainability. The GCF investment is expected to facilitate the barrier removal on private sector involvement by providing incentives, technology and community capacity. Presently, the lack of interest for private sector investments is partly due to the unreliable nature of agriculture product supplies due to crop failures and quality issues.

Better land use practices, high productivity and reliable supply through the GCF investment will attract private sector and additional opportunities with unique climate and nature/heritage opportunities in the area and are expected to result in a diverse set of private sector investments. High value farming; value added tourism; promotion of financial tools for risk reduction and use of e-marketing techniques to boost the sales of products and services out of the project area are some of the private sector opportunities. In addition to being a UNESCO heritage site, the area is enriched with scenic beauty, regular and seasonal waterfalls and cultural features of interest for tourists, nature lovers and researchers, beyond the value added agriculture options.

6.4. Incremental Reasoning

Hence the logical approach used in the incremental reasoning include:
Country Ownership by way of development investments → Well explained baseline conditions with identified co-financing, leverage financing and potential private sector involvement → Incremental reasoning → Paradigm shift → Green and sustainable growth with climate resilience → Sustainability and exit strategy

It is inevitable that the ongoing and proposed development investments by the Government will also be affected by climate change. The current inability of farmers to plan and secure sustainable agriculture production, threatens the viability of value chains and food security at the regional and national level. In addition, the vulnerability of the agriculture sector, despite substantial investments, is compounded by the increased pressure placed on water resources by climate change and climate variations. The Government, supported by some financing partners (see co-financing) is committed to support agriculture development and better land use planning for productive landscapes, including the use of water resources.

However, these multiple sustainable development activities within the project area to uplift the quality of life of the citizens will not suffice to cope with the expected increasing effects of climate variation without proper data and tools for sustainable and resilient planning purposes. Availability and use of climate smart techniques and enhanced water resources management in the context of a changing climate will empower the communities while providing the investments a sound platform to mainstream climate resilience of people and related development infrastructure.

It is important to realize that some of these development initiatives have a national focus. For example, the Agriculture Sector Modernization Project, funded by the World Bank will develop the infrastructure in both national as well as the project area for innovative and non-conventional agriculture initiatives. Yet this project will add value to the GCF investment by improving the area's infrastructure towards farming, transportation, market development and post-harvest loss reduction, therefore, a fraction corresponding to project areas had been included after factoring. The most recent addition is the Smart Agriculture Irrigation Project of the World Bank.

The GCF funding will be incremental in the sense that it will bring the necessity of climate resilience to the targeted subsistence farmers and prevent them from going bad to worse due to ongoing and predicted climate impacts.

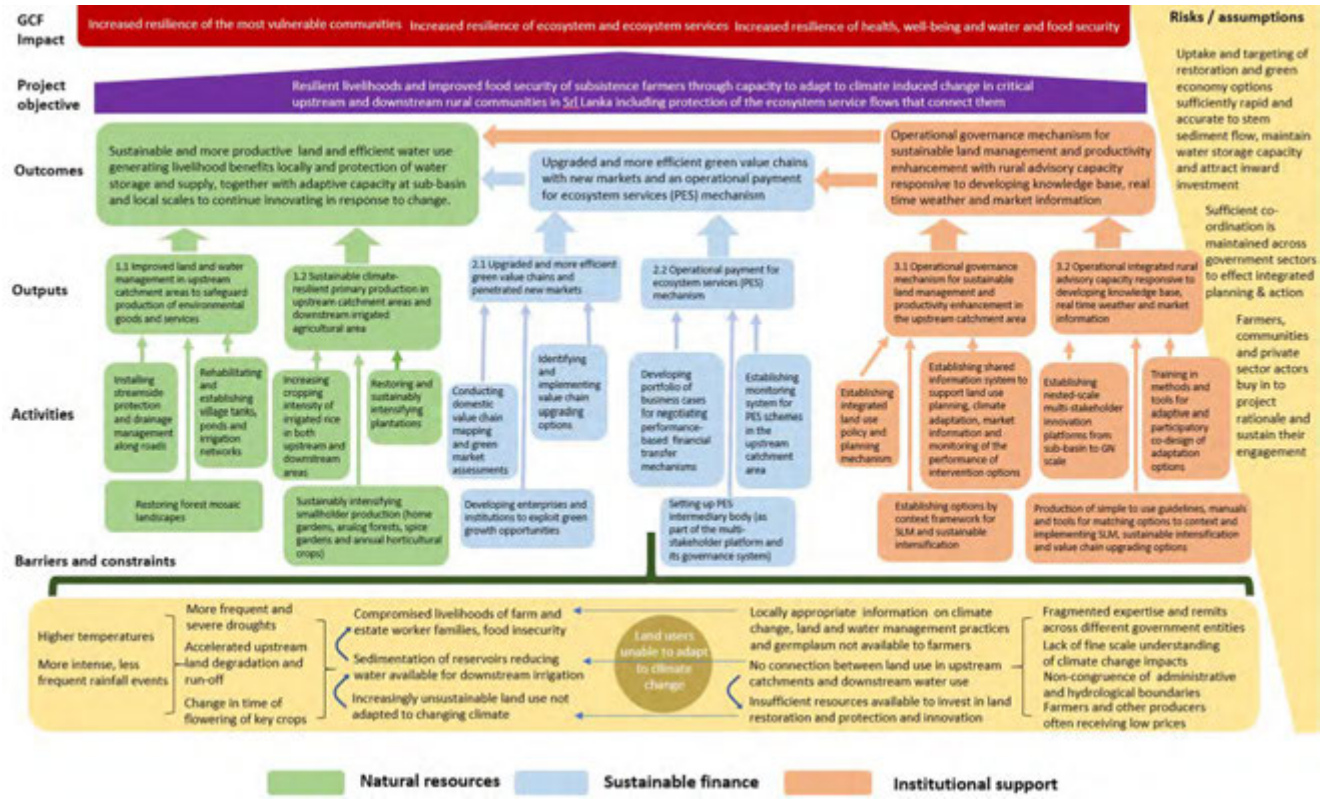


Figure 69: Barriers, constraints and proposed interventions towards project results

The GCF funding will cover the incremental cost linked to addressing the needed adaptation to climate change of the agriculture and water resources management sector in the Knuckles range mountain area. For this purpose, the GCF funding will complement some planned investments in these two sectors, which are described in the table below.

6.5. Sources of Financing Directly and Indirectly Related to GCF Investments

6.5.1. Direct Co-Financing Against the GCF Investment

This set of co-financing are the new funds to be invested in the project area by Government related agencies, totaling 10.5 million USD. This does not include several other leveraging resources and other welfare types of expenses related to the project area. Such sources are identified and described in the following sections.

Table 28: Descriptions of Co-financing for GCF investment

Breakdown of the total co-financing and descriptions[22]			**Risks and barriers relevant to the GCF investment related co-financing**
Mahaweli Authority of Sri Lanka (MASL) funds recovered from Mini-Hydro operators in the project area through Ceylon Electricity Board to be reinvested in the project	3 Million USD	The Ceylon Electricity Board (CEB) – the national utility is paying the MASL, the agency managing the ecosystem of the Mahaweli River Basin (part of the Project area) for the ecosystem services contributing to the sustainability of "Mini-Hydro" operations/projects by the private sector providing electricity to CEB. This value is recovered as part of the licensing levy for Private Sector. This amount of funds will be used as the PES investment by the MASL via MMD&E against the GCF investment	The reduction in rainfall and uncertainty (variability) observed threatens the water availability in the hydro areas. A reduction in water availability will reduce the revenues generated by the hydro producers and it may reduce the recovery by CEB as PES. The amount of funding available for ecosystems restoration and protection may be impacted. This may work the other way around if the conservation benefits and rainfall changes increase the availability of water to hydro operators.
Ministry of Mahaweli Development & Environment (MMD&E)	5.9 USD Million	This co-financing represents annual funds to MMD&E *via* the National Budget of the Ministry for catchment protection. These funds are provided to the Forest Department for conservation activities, such as tree planting in degraded hill slopes, removal of invasive species and promotion of community forestry activities. These investments are elaborated in the table below related to MMD&E investments such as FD (1.1 million); Gem and Jewelry 47,000; CEA 186,000; Mahaweli 424,000; Moragahakanda 1.6 million; Governance	Annual allocations planned may not materialize as expected due to changes in Government Priorities. These amounts may even increase due to increasing interests in protecting the Central Highlands. The uncertainty in Govt. budget allocations can go both ways. On the expenditure side, the tree plantings and projects funded by the money may be impacted by seasonal shifts in rain and lack of surface and ground water, thereby resulting in less leveraging.

[22] The co-financing letter provided covered only 9.2 million USD in writing and it is the amount used in the Funding Proposal. The additional co-financing cited in this chapter via LUPPD and Ministry of Primary Industries will materialize during the implementation so not counted in computations or Funding Proposal. Also as described in the FP and Feasibility the UNDP/GCF and Word Bank Climate Smart Agriculture projects will also have significant complementarities which this project will quantify during the implementation.

		20,000 etc. plus in-kind contributions of the Ministry towards project management	
Ministry of Primary Industries	0.4 USD Million	Ministry promotes economically viable crops for export agriculture, such as fruits and spices (mango, bell pepper, vanilla, cinnamon, cardamom, etc.). This budget is also leveraged by another 4.9 million WB investment named “Agriculture modernization” (See the 4.9 million investments in the Ministry of Mahaweli Development five-year investment table below)	This investment has the potential to go up as the Government policy is to invest more on export crops and high value cultivations (super foods, vanilla, species etc.). The delivery may become affected by the variability of rainfall, increased temperature, changes to the seasons etc.
Department of Agriculture	0.6 USD Million	This co-financing corresponds to the planned activities by the Dept. of Agriculture towards promoting best practices and increasing agriculture productivity. The funds are staff costs, training support and research in plant breeding, extension and maintaining regional offices including the Agro-Technology Park of the Dept. Managed by NRMC.	Minimal risk, as the co-financing is the Dept. Staff’s contribution to the project implementation and use of their facilities for training and extension. Climate risks hinder the optimal benefits of training, capacity building and extension support provided by the department. The knowledge developed at the central level is not totally transferred to the vulnerable farmers in the area.
Land Use Policy Planning Department	0.3 USD Million	This co-financing corresponds to the Department’s allocations on designing, training and carrying out new land use plans for uplands at different scales, during the project period covering the project area.	Minimal risk as the co-financing is the contribution to the project by staff and provision of equipment and facilities. Current level of LUPPD recommendations on land use may not hold due to climate shits and may have to be modified. On the other hand, the project results will be mainstreamed into national planning via the LUPPD participation.
Forest Department	0.3 USD Million	Staff contribution through technical advisory and knowledge transfer services in reforestation, identification of lands for conservation and changes to land use such as removal of Pinus. Funding is also available to use Forest Department facilities in Nuwara Eliya and Knuckles.	Minimal risk as the contribution is from staff time. Activities undertaken by the Forest Department are impacted by changing rainfall and temperature regimes. Increased forest fires are expected. Community Forestry approaches are not yet practiced by the Forest Dept. in the project area, so it will be a win-win investment for GCF and Forest Dept.

6.5.2. Funds Channelled to Project Area through MMD&E

The amount of funding is a mix of finances that will be invested through the MMD&E. Some of the funds are identified as direct co-financing against the GCF investment, except for the two World Bank (WB) related investments that are being identified as other initiatives, which are complementary to the GCF investment related activities. For example, the Ecosystem Conservation and Management Project funded by the WB will develop tourist infrastructure in the Knuckles area, which will be a benefit for the value-added agriculture produce developed through the GCF investment. In addition, the WB Agriculture Modernization Project—a national project, will promote new crop varieties and invest in irrigation infrastructure in the lower catchment command area in the GCF investment.

Table 29: Investments by the MMDE agencies between 2019 and 2024

Ministry of Mahaweli Development and Environment (MMD&E) related investments	Investment USD						Total USD
	2019	2020	2021	2022	2023	2024	
Environment Protection and Conservation - Governance	2,813	3,500	3,563	3,750	3,604	3,639	20,868
Department of Forests Conservation investments	218,750	187,500	162,500	200,000	183,333	181,944	1,134,028
Gem and Jewelry Research and Training Institute Livelihood Development	8,063	8,375	7,938	7,375	7,896	7,736	47,382
Central Environmental Authority	30,625	31,875	29,375	32,500	31,250	31,042	186,667
Forest & Environment Conservation by Mahaweli Authority of Sri Lanka	62,500	78,125	73,750	66,250	72,708	70,903	424,236
Moragahakanda and Kaluganga Reservoir Project – Govt. investment	1,587,500	-	-	-	-	-	1,587,500
Eco System Conservation and Management Project - WB	231,250	241,250	154,375	213,750	203,125	190,417	1,234,167
Agriculture Modernizing Project - WB	825,000	793,750	843,750	825,000	820,833	829,861	4,938,194
Total USD	**2,966,500**	**1,344,375**	**1,275,250**	**1,348,625**	**1,322,750**	**1,315,542**	**9,573,042**

6.5.3. Other Investments and Initiatives with Identified Links to the Project

These resources identified are directly and indirectly related to the proposed GCF investment, primarily, as they are being challenged by climate change. However, they are not identified as co-finance in the Funding Proposal. Some of the investments are from World Bank, ADB and GEF, which may not be relevant as GCF co-financing to our understanding.

Table 30: Infrastructure and development investments in the project area

Project/Organization	Funding involved	Type of support to enhance the feasibility of the proposed GCF project	Climate risks and other barriers relevant
Moragahakanda Project	64 USD Million (proportional amount for the project area out of the total investment of 370 USD Million) - Ministry of Irrigation, Water Resources and Disaster Management with ADB as the funding source	Only the Abanganga portion of the Moragahakanda project is relevant for the proposed GCF project (as apportioned). The purpose is to support downstream farmers with irrigation and drinking water to ensure high productivity in existing lands and cultivate new lands while meeting the drought related challenges. The ADB assistance will help the infrastructure development in the Moragahakanda project including irrigation infrastructure, dams, tunnels and diversions.	Water resources from the Knuckles upper catchment, in the form of surface, stream and ground water, is affected by the climate induced irregularities in the rainfall patterns and higher rainfall intensity driven erosion and resultant siltation of water holding structures in the Abanganga reservoir area. Siltation in surface water bodies will reduce the water holding capacity in the entire project area (both upstream and downstream).
Drinking Water Supply Projects	6.5 million USD - National Water Supply and Drainage Board (NWSDB)	This project implemented by the NWSDB is to provide safe drinking water by purifying the source water. The projects links CBOs in the area towards maintaining the source water supply side and improving water use efficiency including rainwater harvesting for drinking. GCF investment will increase the water availability.	Source water supply is affected by climate change in terms of quality and quantity. Quantity is affected by the droughts and the quality is impacted by increased sedimentation and chemical loadings due to intense rainfall related erosivity and water volumes.
Agriculture Sector Modernization Project	4 million USD - Department of Agriculture through World Bank (already highlighted above too)	Supply chain improvements, market establishments for farmer products including the food processing, value additions to agriculture products and water and energy efficient farming and processing. Project has a national focus. USD 4 million is for the Matale District. This funding will complement GCF investment and *vise-versa.*	Undisturbed supply depends on the availability of water and climate change affects the seasonality and quantity of water. The temperature increase due to climate change will add to the cost of refrigeration and quality control aspects related to pathogens.

Accelerated other Field Crop Production Programme	1.7 million USD - Department of Agriculture	This project is aimed at strengthening farmers in the upstream area of the GCF project by way of crop selection; climate resilient farming practices; and minimizing market risks.	Climate change affects the crop selection. The traditional knowledge on the crop suitability needs to be reorganized to suit the shifting seasons and temperature regimes, including the cultivars.
Smallholder Tea & Rubber Revitalization Project	7.8 million USD - Ministry of Plantations with IFAD as the funding agency	Aimed for smallholder tea plantations, usually managed by the private companies. The project aims to improve the lifestyles of the plantation communities through management improvements and limited investments as structural adjustments. Plantations have reduced their investments in conservation in the recent past due to financial difficulties. This will be a complementary initiative to GCF investment in the plantation areas.	Poor conservation investments in the plantations contribute towards land degradation. Climate change is further aggravating the extent of degradation due to high erosion in poorly managed lands sparking an irreversible trend in land degradation and poverty.
Climate Resilient Integrated Water Management Project	34 million USD - Ministry of Mahaweli Development and Environment with GCF as the donor and UNDP as the accredited Agency	Aims to improve some of the command area water holding capacity in Malwathu and Yan Oya basins by rehabilitating tanks systems. As the GCF investment is not focusing in the lower command area, this will act as a complementary investment again by GCF itself.	Climate change impacts the water availability of the Knuckles range upstream area, which ultimately reduces the water availability to the tank being rehabilitated, primarily due to the less predictable rainfall.
Ecosystem Conservation & Management Project (ESCAMP)	1.2 USD Million for the Knuckles area out of over 50 million USD - Forest Department with World Bank (also highlighted as an MMD&E related investment in the above table)	ESCAMP project aims to develop the ecotourism in the project area using the Knuckles regions world heritage site status. FD and ESCAMP project are in the process of engaging he farmers in ecotourism activities as service providers. eliminate or control the negative impacts to Knuckles due to climate change.	Climate change will positively work, when seasonal waterfalls get initiated with intense rains in the upper catchment area. However, the high intensity rains will impact the foot paths and trails to be developed by the ESCAMP project to promote ecotourism.
Climate Resilience Improvement Project	19 million USD - Ministry of Irrigation, Water Resources and Disaster Management with World Bank	This project is involved in river bank restoration activities in non-GCF project areas. Institutional capacities developed by the CRIP at Forest Dept. and other institutions can be shared with this GCF project, as a knowledge transfer.	Climate risks impacts the type of capacity development needs. The climate forecasting, early warnings etc. will help to improve the planning abilities.

Climate Smart Irrigation Project	125 million USD – Ministry of Agriculture funded by World Bank	The project will be implemented in 11 administrative districts (Kilinochchi, Mullaitivu, Anuradhapura, Polonnaruwa, Puttalam, Kurunegala, Trincomalee, Batticaloa, Ampara, Hambantota, and Moneragala) where operations in Puttalam and Kurunegala will overlap with this investment in a synergistic way. The project will improve knowledge and technology transfer and access to infrastructure assets to enhance climate resilience in farming resulting in increased revenue from crop diversification and participation in emerging value chains.	Water use efficiency improvements in irrigated area will help to better utilize the water generated in the catchment by this investment project.

6.5.4. Govt. Investments in the Project Area Leveraged with GCF Investment (not taken into co-financing)

Moragahakanda Kaluganga Project

The Moragahakanda-Kalu Ganga Irrigation Development Project can be considered a modern-day irrigational wonder of Sri Lanka that is slated to provide farmers in Rajarata with solutions to their agricultural and drinking water issues. With the completion of the Moragahakanda reservoir, the Five Mega Reservoirs under the Mahaweli Program were concluded, four decades since the Mahaweli water was first diverted to Rajarata from Polgolla on 8 January 1976. Water from the Moragahakanda reservoir will primarily be used to support agricultural needs in an area of more than 300,000 acres, benefiting 1.5 million families while also supplying clean drinking water to 300,000 families. The Moragahakanda Dam is a high gravity dam built to a height of 65 meters. The dam has created the Moragahakanda Reservoir, which has an active storage capacity of 521,000,000 m^3 and is four times bigger than the massive Parakrama Samudraya in Polonnaruwa.

Ecosystem Conservation and Management Project (ESCAMP)

ESCAMP aims to enhance the management and sustainable use of ecosystems in selected priority locations in Sri Lanka through a series of complementary and synergistic components. ESCAMP emphasizes on biodiversity protection with integrated planning that would align and balance development programs within the protected areas (PAs) based on environmental and social priorities by enabling the participation of local communities and other relevant stakeholders with the assurance of benefits for them. This project is designed along four main components comprising of several sub-components to generate national and local environmental and community-level benefits and is planned to be implemented over the course of five years. Under the second component of the ESCAMP project, which is the Sustainable Use of Natural Resources and Human-Elephant Co-Existence, the Forest Department is implementing the following sub-projects;

- Sustainable use of natural resources for livelihood enhancement of peripheral communities of Knuckles conservation forest
- Ecosystem conservation and management project –Knuckles Forest
- Ecosystem conservation and management project Matale Range
- Development of Nature Base Tourism in Knuckles
- Development of Eco-Tourism in Knuckles

Agriculture Sector Modernization Project

The World Bank Funded Agriculture Sector Modernization Project is aligned with the Country Partnership Strategy (CPS) 2013-2016 (Report 66286-LK, May 22, 2012). The project seeks to contribute towards two CPS focus areas, namely: "Supporting structural shifts in the economy" and "Improved living standards and social inclusion" through (a) improving agricultural productivity and competitiveness to strengthen the links between rural and urban areas and facilitate Sri Lanka's structural transformation; (b) providing and strengthening rural livelihood sources, employment opportunities in agriculture and along agriculture value chains, as well as market access for the poor, bottom 40% and vulnerable people, thereby improving income sources and

livelihood security in lagging rural areas; and (c) contributing towards improved flood and drought management through project's linkages to the water and irrigation sectors and a climate-smart agriculture approach. The project is also to promote diversification, value addition and increased competitiveness in the agriculture sector. The development objectives of the Agriculture Sector Modernization Project in Sri Lanka are to support increasing agriculture productivity, improving market access, and enhancing value addition of smallholder farmers and agribusinesses in the project areas.

Climate Resilience Improvement Project (CRIP)

CRIP was commenced in 2014 and implemented under the Ministry of Irrigation and Water Resources Management with the financial backing of the World Bank. Department of Irrigation (ID), the Road Development Authority (RDA), Mahaweli Authority of Sri Lanka (MASL), National Building Research Organization (NBRO) and Provincial Road Development Department (PRDD) are the key implementing agencies for the CRIP. The Project Management Unit (PMU) of the CRIP is in the premises of the Ministry.

The project is mainly focused on establishing a process that would build a more climatic resilient economy since the current understanding of multispectral impacts of climate, flood and drought modelling and scenario analysis are not adequate at present. In addition, the project supports to implement urgent climate mitigation investments required to ensure the short-term integrity of flood control and irrigation infrastructure, transport network and critical education facilities at risk.

Climate Resilient Integrated Water Management Project

Climate Resilient Integrated Water Management Project (CRIWMP) is a seven-year project (2017-2024) aimed at strengthening the resilience of small-holder farmers in Sri Lanka’s Dry Zone to climate variability and extreme events. The project targets poor and vulnerable households in three river basins—the Malwathu, Mi, and Yan (rivers), which flow through the northern part of the Dry Zone. These river basins are among the most vulnerable to the vagaries of climate and have a high presence of village irrigation systems and cascade systems on which poor and vulnerable farming populations depend on for their livelihoods and are in areas that significantly lack safe drinking water, which pose a high risk of kidney disease. The project pioneers a holistic approach to enhancing Dry Zone water security and agricultural productivity, and for the first time in a project in Sri Lanka, will include climate smart initiatives designed to combat the effects of extreme weather events on the continuity of irrigation and drinking water supplies.

The following figure illustrates the relationship between the previously approved GCF project area and its geographic linkage to the proposed new project area for this submission. Map of the proposed project area (left side map) and the map on the right side shows the previously GCF approved and funded UNDP/GCF CRIWMP project area (Me Oya, Malwathu Oya and Yan Oya basins) in right (in yellow). The proposed submission will enhance climate resilience in the vulnerable upper watershed of the Knuckles region and enhance the availability of water from this catchment area to the downstream agricultural lands shown in yellow on map on the right.

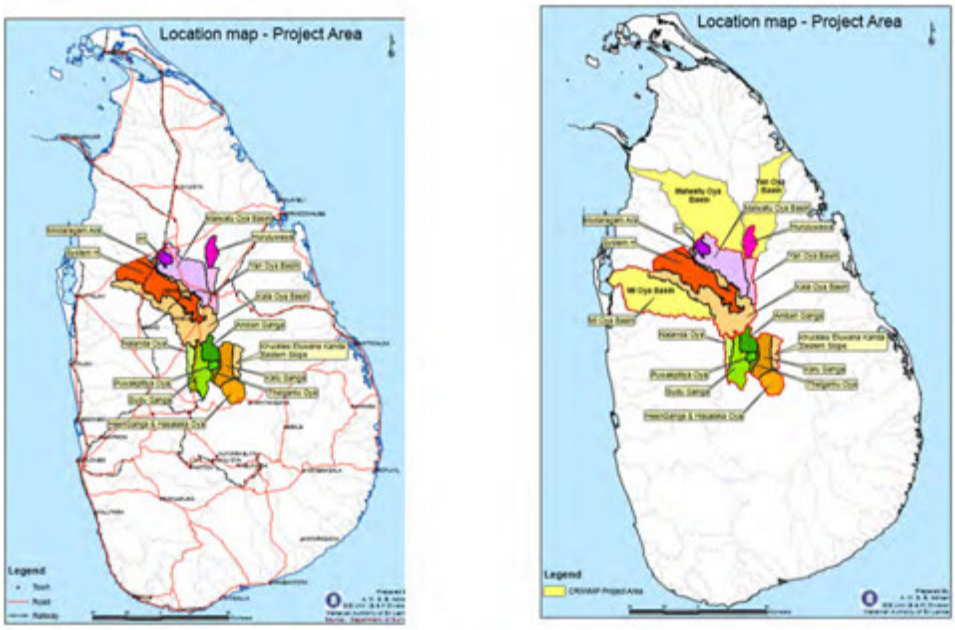


Figure 70: Spatial relationship between ongoing GCF project and the proposed project

World Bank Funded Climate Smart Irrigation Project

This project[23] brings in USD 125 million to Sri Lanka to improve a number of critical areas in terms of climate resilience in the irrigation sector. Signed in early 2019 the project will work with over 470,000 smallholder farmers in hotspot areas (375,000 ha) in 11 administrative districts (Kilinochchi, Mullaitivu, Anuradhapura, Polonnaruwa, Puttalam, Kurunegala, Trincomalee, Batticaloa, Ampara, Hambantota, and Moneragala) in the dry zone of Sri Lanka. Smallholder farmers consist of small farmers (1.0–2.0 ha of farmland) and marginal farmers (less than 1.0 ha) who are expected to gain knowledge and technology transfer and access to infrastructure assets to enhance climate resilience in farming resulting in increased revenue from crop diversification and participation in emerging value chains. Technical and managerial staff of the participating agencies will benefit through training and capacity-building activities. The project will also promote the participation of youth and women in all key project interventions to ensure that they would benefit from the project activities.

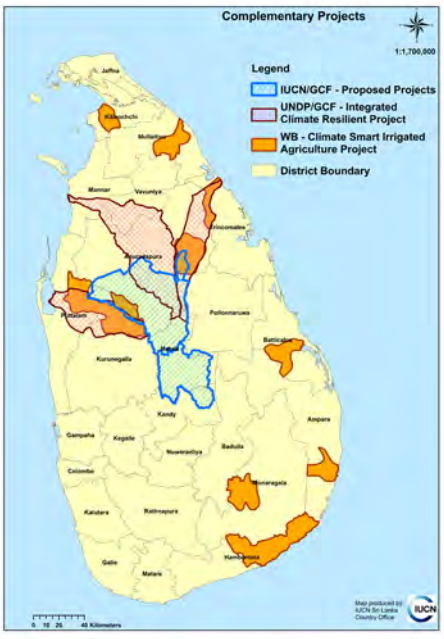


Figure 71: Project areas of GCF funded (UNDP and proposed IUCN) and World Bank projects

[23] World Bank Funded Climate Smart Irrigation Management project - https://www.dropbox.com/s/fr90c9ej04o0j09/Project%20Appraisal%20Document%20%28PAD%29%20World%20Bank%20Climate%20Smart%20Irrigation%20Project.pdf?dl=0

This project overlaps/complements with the proposed investment project in Puttalam and Kurunegala districts while the knowledge management and trainings are complementary as well. The main complementarity that exists with this investment project is that this project will generate source water for both World Bank and UNDP/GCF funded projects to be used in irrigation and agriculture in a climate smart manner (improved use efficiency with better technologies and practices). This project will generate more water *via* surface and ground water supplies through canopy modifications and other water conservation and management methods. Also, the erosion controls implemented in this project will also help to maintain the storage capacity in the downstream areas (tanks and reservoirs also supported by UNDP/GCF and World Bank investments) by erosion control approaches. On the other hand, both UNDP/GCF and World Bank projects will add value to this project investment by improving the irrigation water use efficiency, thereby improving the productivity and user efficiency of the generated water in the upper catchments by this investment. The educational material that will be developed, and the agency trainings could be coordinated during the implementation phase and the lessons learned can be shared between projects.

6.5.5. Private Sector Led Financing (to be explored during the project)

Private sector financing towards climate resilience related activities or community adaptation capacity improvements are limited primarily due to uncertainties in the agriculture. For example, there is no organized mechanism to buy larger quantities of agriculture produce in a consistent manner. Due to the of lack of investment and interest, communities continue to suffer as they are unable to sell their produce in a timely and consistent manner leading to post-harvest loses. These cycles add to the poverty cycle of the already poor and climate vulnerable families.

Enhancing the predictability of supply chains for both produce and off take plus the assured quality and quantity in products due to the enhanced private sector interest, can help vulnerable groups in the project area and improve their adaptive capacity. Increased earnings, new knowledge and access to technologies will lead to branding of products that can be specifically grown in different agro-climatic areas within the project area. These can fetch relatively higher margins and processing of produce (fruits, vegetables, spices and others) within the region and may help to reduce harvest loses as well as add more money into the hands of people, especially women who are keen to work closer to their homes to meet other family needs. In addition, insurance and e-marketing links can add value and improve the resilience and sustainability of value chains and people. Several illustrative examples of potential private sector engagements are highlighted in the Table 18 but not limited to. More options will be explored during the project period, especially by working with the Dept. of Export Agriculture from the Government and tour operators and corporates on the private sector.

Table 31: Potential private sector investments to be explored during the project period

Areas to be explored with Private sector during the project to add value to GCF investment	Specific value chains	Benefits	Attribution to adaptation capacity
Contract farming of super foods and local fruit varieties, improved packaging and market linkages along with quality assurance, labels and marketing support	Private sector manufacturers (food and nutritional supplements, medicines etc.), retailers and direct exporters; new products that have the area linked (Jurisdictional) – eg: Knuckles fruits.	Additional cash in the hands of communities including women; understanding of the value of conserving nature to obtain ecosystem benefits – eg: increased bee honey production along with better pollination in all crops.	Ability to buy insurance, medical cover and improved nutrition. Better knowledge on ecosystems and services.
Medicinal plant extracts and niche products to SPA and specific ailments – treatment programs etc. Area specific services (Branded)	Ayurveda and SPA products are increasing in popularity in the country and attract organizations, tourists, researchers and new businesses.	Additional cash in the hands of subsistence farmers, women and area SMEs (existing and new).	Increased coping capacity and diversity—away from agriculture income
Area specific year around tourism products covering nature, culture and heritage. Marketing high-end tourism of different kinds.	Knuckles area is a UNESCO World Heritage site. It is a known local tourist destination for the scenic beauty and pleasant misty climate. More trails, better guides and quality services can attract high-end tourists.	Enhanced income. Appreciation of the natural resource base leading to better protection	Ecosystem based adaptation applications. Realization of conservation benefits by communities.
Area specific seasonal research, tourism and other targeted tourism products based on the climate change – climate change induced tourism	Due to climate change, seasonal springs can be expected giving rise to periodic streams and waterfalls that may be of interest to a segment of tourists and researchers.	Appreciation of the climate change, both good and bad implications. Better understanding of the hydrologic cycle etc.	Additional sources of income through non-traditional services and unconventional income sources towards increased resilience.
Insurance industry – development and implementation of climate and small business-related (SMES/MSMES) insurance schemes	Expand the conventional insurance, banking and microfinance systems to address climate related impacts. Use of mobile phone apps; early warning etc. to support insurance products	Prevention of shocks to families, businesses and communities.	Better resilience to climate and other disasters.

Renewable energy options such as biomass (glyceredia), solar PV, decentralized wind energy including net metering to reduce costs. Knuckles area is known for wind.	Combination of adaptation and mitigation benefits while improving soil quality (nitrogen from leaves) and reducing the carbon foot print. Ability to test household level energy generation and storage options	Better savings as a result of energy generation. Extra income from biomass growing in homegardens especially as an income for women.	Broader adaptation benefits combined with mitigation benefits.
Connecting local marketing platforms like (Ikman.lk) leading to e-marketing of local products to get additional market share of area branded niche products.	Sri Lankans are increasingly using e-marketing and mobile applications (EZ Cash; E-Bay etc.). It may provide an avenue to market specialized projects that also involve household female population in production and specialized packaging	Extra money in the hands of women and children.	Increase adaptive capacity due to increased money circulation – unconventional.

6.6. Mitigation Benefits within the Adaptation Project

Although the investment project was developed and submitted as a climate adaptation project, the type of activities/interventions can directly and indirectly provide Green House Gas emission reductions by way of improved carbon sequestrations.

The project has significant areas that are degraded and require infilling by Analog Forestry, Replantation or Community Forestry Actions.

At the same time the project is developed with the intention to do-no-harm so it will not contribute to further land degradation in the project area.

An effort was made to estimate the mitigation benefits, firstly, as a response to a comment raised by the GCF Secretariat but also to highlight the complementary aspects of adaptation and mitigation, as indicated in the GCF comment.

We selected the EX-ACT tool[24], supported by the Food and Agriculture Organization (FAO) of the United Nations to estimate potential mitigation benefits. However, the mitigation benefits were not taken into the economic analysis, yet, in this project. Later during the project implementation, the mitigation benefits will be tracked and used to attract more funds towards project sustainability. The same tool can be extended to analyze the carbon benefits in value chains[25] and will be tried during the project implementation.

Time and skill requirements for GHG tools
(+ time and skill intense; ++++ fast and easy)

Calculator	Speed of assessment	Ease of use
AFD calculator	+++	++++
ALU	+	+
CALM	+++	+++
Carbon benefit project CPB	++	++
Carbon Calculator for NZ Agriculture and Horticulture	++++	++++
Carbon Farming Group Calculator	++++	++++
CFF Carbon Calculator	+++	++
Climagri®	+	+
Cool Farm Tool	+++	+++
CPLAN v2	+++	+++
Dia'terre®	+++	+
EX-ACT	++++	+++
FarmGAS	++	++
Farming Enterprise Calculator	++++	++++
FullCAM	+	+
Holos	++	+++
IFSC	++++	++
USAID FCC	++++	+++

6.6.1. EX-ACT Tool

The Ex-Ante Carbon-balance Tool (EX-ACT) is an appraisal system that estimates the impact of agriculture and forestry development projects, programmes and policies on the carbon-balance (net balance from all greenhouse gases (GHGs) expressed in CO_2 equivalent that were emitted or sequestered) due to a proposed or on-gong project implementation as compared to a business-as-usual scenario.

EX-ACT estimates GHGs as emissions or sinks of CO_2 per unit of land, expressed in equivalent tonnes of CO_2 per hectare and year. As such project designers can estimate and prioritize project activities with high benefits in economic and climate change mitigation terms. Therefore, the tool is applicable in a range of sectors, such as sustainable land management, watershed development, production intensification, food security, livestock, forest management or land use change.

6.6.2. Inputs to the EX-ACT Model

1. Estimate was done only for the project duration of six years.
2. 1,889 hectares of grasslands close to the forest patches will be planted with forest tree species using Analog Forestry Techniques and this value was used as an input in EX-ACT. In addition, 1,740 hectares of abandoned plantations including tea, rubber etc. will be replanted through the engagement of estate communities with suitable crop species and also to create wildlife corridors.
3. There are nearly 42,000 hectares of degraded lands in the project catchment area to be brought under best management practices (upstream project area). Business as usual (Forest Department Govt. funded program) is expected to reduce the degraded land by 3,000 ha. These lands include planting of perennial crops, soil erosion mitigation practices

[24] Estimation of mitigation benefits using carbon balance tools http://www.fao.org/tc/exact/ex-act-home/en/
[25] Use of EX-ACT tool in value chain related carbon benefits http://www.fao.org/tc/exact/ex-act-tool-for-value-chains/en/

etc. In the EX-ACT tool, it was assumed that these lands will be transformed from Medium level of degradation to Low degradation.

4. By working with smallholder farmers, the extent of seasonal crops will be increased especially crops such as maize, finger millet, tomato, beetroot, green chilies, green gram, cabbage etc. The extent of the existing homegardens/ homesteads is 98,798 hectares. With project interventions, such as analog forestry, river catchment protection etc. it is expected to increase up to 110,000 hectares. These additional lands would be released based on farmer woodlots agreements and or releasing the government lands for a lease period for agriculture purposes. This incremental change was used in computing carbon sequestration.

5. There are 2,128 hectares of grasslands in the project area with the status of moderately degraded and will be severely degraded without interventions to improve the status within the next five to six years. Therefore, those catchment area grasslands will be improved by planting forest trees and by managing the downstream grasslands better to be used with livestock industry.

6. Agriculture inputs like fertilizers, pesticides etc. are highly used in the project area. It is assumed that with the interventions of best agricultural practices, agriculture chemical usage will be at least reduced by 40-50%.

7. Data related to pesticide usage in the project area is hard to find. Data are available on imported pesticides but the distribution of the pesticides and its application, district-wise, are not monitored or regulated. This aspect was not modeled using EX-ACT.

8. Construction of concrete structures have been estimated as 318,400 square meters. This is related to the drainage constructions to manage degradation due to unplanned storm water runoff.

9. Conversion of flooded rice to SRI method and associated carbon benefits were not taken, in which is an additional amount of 3.4 tons of Carbon per annum per ha. This would be an additional amount on top of the estimated sequestration amount of 7.8 tons of CO_2 equivalent per annum per ha.

6.6.3. Model Output

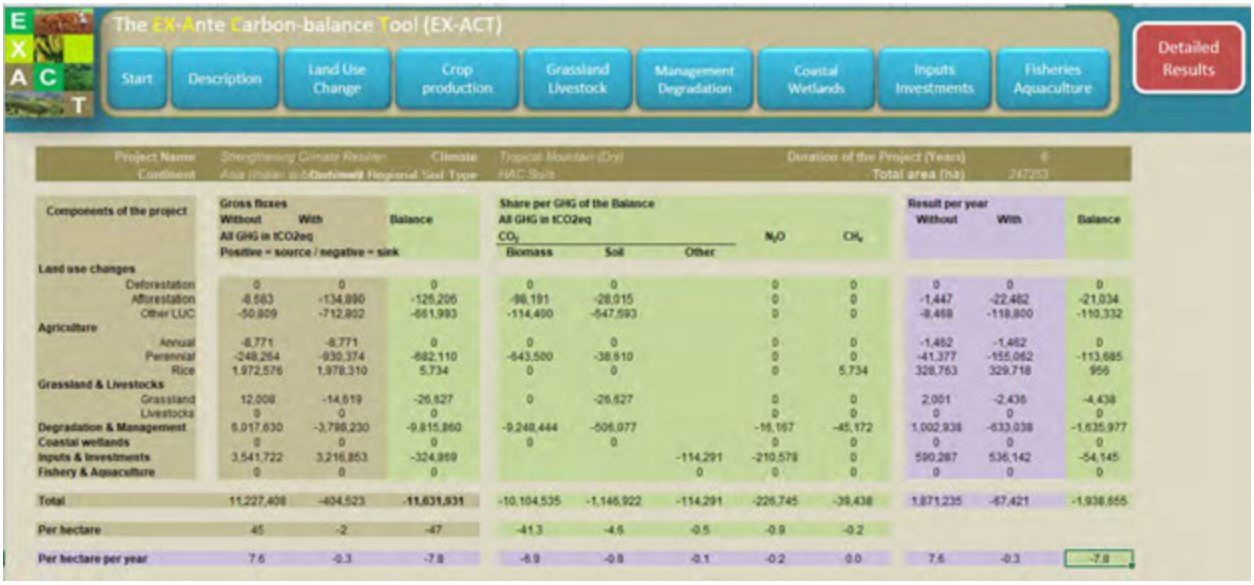


Figure 72: FAO Ex-ACT tool summary output

Summary of the GHG reduction potential

The six-year investment project focusing mainly on climate adaptation is expected to provide GHG emission reductions – mitigation benefits as well (Table 32), under each main land use type based on the estimated GHG reductions.

Table 32: Summary of GHG Reductions due to Project

Land use type	Area (ha) w/o project	GHG total for six years (tCO2eq)/ w/o project	Total GHG tCO2eq /ha w/o project	Area (ha) with project	GHG total for six years (tCO2eq) with project	Total GHG tCO2eq/ ha with project	Change in Area (ha)	Change in GHG total for six years (tCO2eq)	Total GHG change tCO2eq/ha
Deforestation, afforestation, other	3,200	-59,492	-18.5	45,950	-847,692	-18.44	42,750	-788,200	0.06
Agriculture (Annual, perennial, rice)	158,175	1,663,070	10.51	197,175	1,039,165	5.3	39,000	-623,905	-5.21
Grasslands & Livestock	2,128	12,008	5.64	2128	-14,609	-6.9	0	-26,617	-12.54
Degradation and Management including chemical reductions	46,100	6,017,630	130.53	44,500	-3,798,230	-85.35	-1,600	-9,815,860	-215.88
Inputs and Investments	73,000	3,541,722	48.51	374,400	3,216,853	8.6	301,400	-324,869	-39.91

The Ex-Act projection indicate that the highest GHG gains are due to the management improvements that include stream bank restorations, roadside improvements and reduction of chemical use by 50%. In addition, the expansion of green areas and the quality of green areas under homegardens add more GHG benefits under agriculture.

6.6.4. Mitigation Potential

Over the six-year project period, the project is capable of sequestration an additional 1.94 million tons of CO_2 equivalents at a rate of 7.8 tons of CO_2 equivalents per ha per annum. This amount is comparable to figures reported in literature including the values expressed in the EX-ACT manual.

In financial terms the project's total investment is about 49 million USD and the cost of producing a tone of carbon equivalent will be around 25 USD per ton, which is around the general norms.

6.7. Value Addition by the GCF Investment

The above investments by the Government, Donors and Potential Private sector engagements can be harnessed through the GCF investment in a coordinated manner through the proposed management arrangement involving six-management zones. The extensive involvement of the Govt. agencies, research, NGOs and CBOs will help towards improving the resilience in the project area by way of a paradigm shift where the approach and the models can be taken to other areas by the same set of Govt. agencies and NGOs, in addition to the donors (WB, ADB etc.) and private sector.

Section 7: Project Components and Approaches

7.1. Background to Project Objective

The project design is founded on the expected project outcome of increasing resilient livelihoods and improving food security of subsistence farmers through their capacity to adapt to climate induced change in critical upstream and downstream rural communities in Sri Lanka, including protection of the ecosystem service flows that connect them (Figure 54).

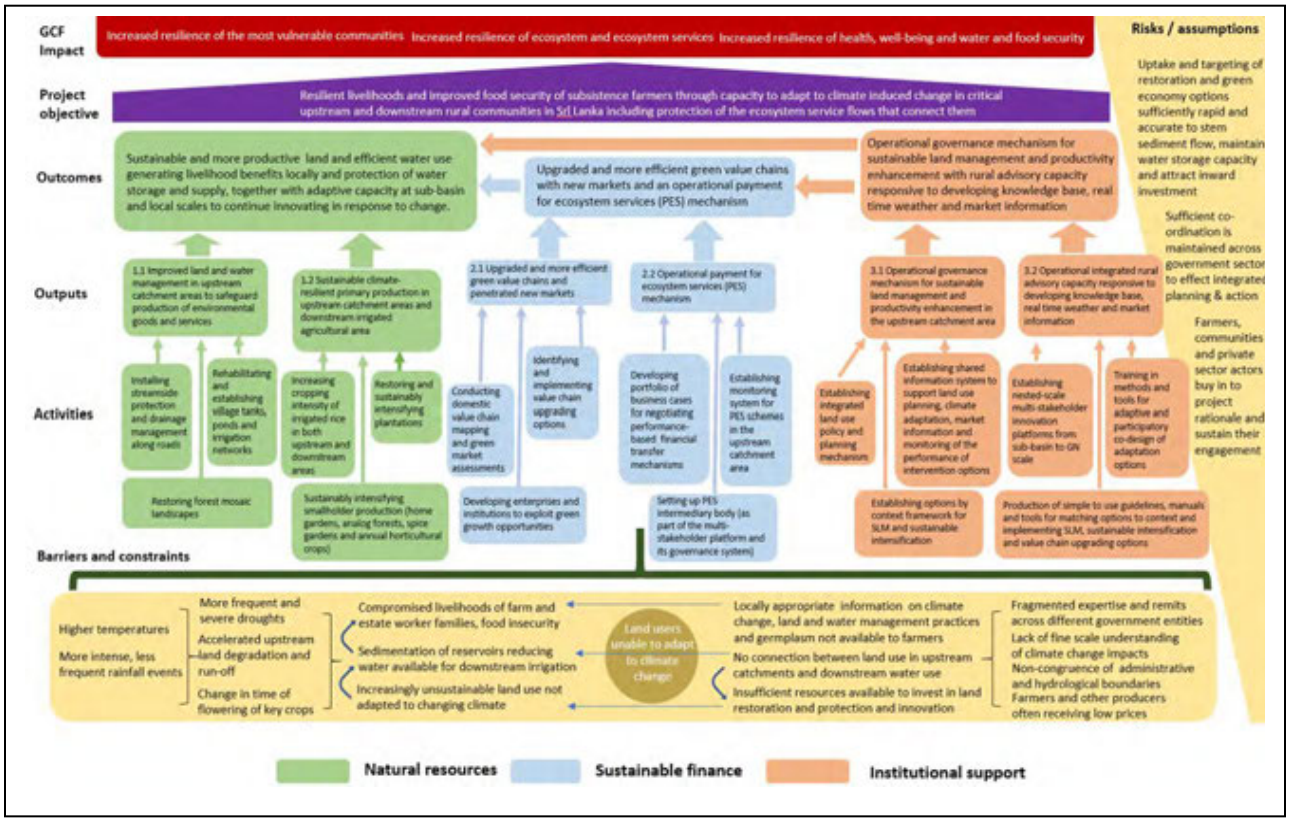


Figure 73: Project results framework

The project elements contribute to three GCF adaptation impacts by increasing the resilience of the most vulnerable communities; their health, well-being and water and food security; and ecosystem services through reducing the risks by working with stakeholder entities. As such the project aims to protect, enhance and harness the ecosystem service flows in a way that the impact on livelihoods will be realized, in a positive manner.

To achieve this, actions are required, both to promote sustainable land use and profitability of farming and plantation management in upstream areas, as well as to promote the efficient use of irrigation water and climate adapted agriculture in the downstream area (the intermediate project results). These require different approaches but are interconnected as the downstream area receives its irrigation water from the upper catchments. Furthermore, the development of PES schemes by GOSL that recognize the value of catchment restoration and protection in delivering

water to downstream users, provide the necessary investment to maintain catchment protection in the upstream.

Catchment protection and adoption of climate adapted agricultural practices while necessary are not sufficient on their own to tackle climate adaptation as they are unlikely to deliver sustainable outcomes, unless coupled with value chain upgrading that generates sufficient revenue from land use to sustain. The growth of national and global markets for green products and services, provides key opportunities to make climate adapted land use profitable enough to be sustainable. This leads to the focus of the project, which is assisting the GOSL in overcoming barriers and constraints that land users face when adapting to climate change, which comprise of three main thrust areas:

- assisting people to adopt improved natural resource management, principally in the upstream catchment area while addressing efficient use of irrigation water and food security downstream (the green cluster of nodes in the centre of Figure 48);
- setting in place sustainable financing to enable people to invest in catchment protection and sustainable land use; and
- providing institutional support to develop appropriate governance mechanisms, information systems and rural advisory services capable of delivering appropriate land use options across the project area.

7.2. Project Components and Outputs

The three major project components identified in three different colours in the diagram (Figure 48) at output level comprise of six interacting project outputs. Each output is directed at overcoming one or more major constraints or barriers identified in the design (bottom green bar in the figure).

7.3. Description of Project Outputs

Output 1.1: Improved land and water management in upstream catchment areas to safeguard production of environmental goods and services

This output focuses on providing locally relevant information and resources to prompt best practices in catchment restoration and protection, thereby addressing the key constraints;

i) The unavailability of locally appropriate information on climate change, land and water management practices and appropriate germplasm to farmers and other land users in the upstream catchment area; and,
ii) Sedimentation reducing water availability for downstream irrigation. These are addressed through:
    a. streamside protection and drainage management along roads;
    b. rehabilitation and establishment of village tanks, ponds and irrigation networks; and
    c. restoration of forest mosaic landscapes.

Key behavioral changes induced through this method is for farmers, foresters and plantation companies to adopt catchment protection practices, made possible by recommendations customized to local circumstances, co-adapted with local stakeholders to their circumstances; and in the long-term sustaining a continuing culture of innovation and adaptation through local

stakeholders co-learning about the principles of adaptation rather than just following externally provided prescriptions.

Output 1.2: Sustainable climate-resilient primary production in upstream catchment areas and downstream irrigated agricultural area

This output rests on two key premises—that water yield of catchments can be sustained through catchment protection, so that Output 1.1 will deliver a greater and more reliable quantity of water for downstream irrigation and secondly that this water can be more efficiently used in downstream agriculture through improved irrigation methods and climate adapted cropping choices and management. It also addresses the constraint that agricultural practice in the upstream catchment area is often, not well adapted to climate change (more intense rainfall events and increasing wind events and speeds) and as a result faces low and declining productivity. In contrast to the more direct intervened upstream, the emphasis with downstream farmers is to provide climate information and relevant climate adaptation options that focuses on improving the water use efficiency. These constraints are addressed through:

a) increasing the cropping intensity of irrigated rice in both upstream and downstream areas;
b) promoting sustainable intensification of smallholder production; and,
c) restoration and sustainable intensification of plantations (some sunk investment in restoration from project funds coupled with value chain upgrading from Output 2.1 to sustain).

A key focus will be on restoring plantations as productive landscapes that can sustain the nutrition of estate workers and their families through development of food forests, as well as reversing land degradation through soil and water conservation while operating at sufficient profit to make them sustainable enterprises that will attract continued inward investment (assisted by Output 2.1). Exemplar landscapes will be set up on this model to demonstrate their practicality. Climate-proofed tree species varieties will be promoted from suitability modelling with downscaled climate change predictions. It requires a behavioral change in the rural advisory services and amongst farmers to come together in a partnership to, on the one hand provide customized options to farmers, and on the other, to evaluate the performance of these options across contexts and use Smartphone Apps to record and share these data and perceptions.

Output 2.1: Upgraded and more efficient green value chains and penetration of new markets

This output includes both upstream and downstream target beneficiaries and emphasizes on providing opportunities to sustain adaptive management through capturing sufficient resources to make local agriculture and associated businesses sufficiently lucrative to survive and prosper. This principally addresses the constraints of

i) farmers and other producers often receiving low prices for their produce; and
ii) insufficient resources being available to invest in land restoration, protection and innovation to address climate induced change.

It involves close co-operation with the private sector around three key areas of activity

a) domestic value chain mapping and green market assessments;
b) enterprise and institutional development to exploit green growth opportunities; and,
c) identification and implementation of value chain upgrading options.

A key behavioral change will be required amongst farmers and other value chain actors in the private sector, around developing and harnessing business skills and forming new forms of business relationships.

Output 2.2: Payment for Ecosystem Services (PES) mechanism

This output focuses on how upstream target beneficiaries can sustain land use practices that protect ecosystem services in the catchment by providing funding to maintain them. This principally addresses the constraint that there is a lack of connection between upstream land use and downstream water use as well as contributing to overcome insufficient resources being available to invest in catchment protection. These constraints are addressed by

a. developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms;
b. setting up PES intermediary bodies as a part of the multi-stakeholder platforms at sub-basin scales; and,
c. developing a monitoring system for PES schemes and capacity to adaptively manage them in the upstream catchment area.

Figure 74: Environmental Services

This involves behavioral changes, that the Government has already committed to, with respect to transferring resources from water users back to land users and taking action to protect the catchment. It also requires broader development of awareness amongst those who benefit from ecosystem services generated in the upstream catchment and an understanding of the need and costs of maintaining the ecosystem flow and hence the legitimacy of paying towards catchment restoration and protection.

Output 3.1: Governance mechanism for sustainable land management and productivity enhancement in the upstream catchment area

This output focuses on tackling two constraints:

i) fragmentation of expertise and sharing of resources across different GOSL ministries and departments; and

ii) the non-congruence of administrative and hydrological boundaries.

These constraints are addressed through:

a) novel application of stakeholder engagement methods to develop an integrated land use policy and planning mechanism at sub-basin scale;
b) innovative development of the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options; and,
c) development and refinement of an options by context framework for sustainable land management and sustainable intensification.

The game changer here is to set up multi-stakeholder innovation platforms at sub-basin scale that facilitate horizontal integration (across sectors and disciplines). This involves setting up five new governance structures (implementation teams) that integrate across non-congruent administrative (Divisional Secretariat - DS) and hydrological (sub-catchment) boundaries:

- The five sub-catchments on the east of the target catchment area (Amban Ganga, Puwakpitiya Oya, Thelgamu Oya, Kalu Ganga and Knuckles Ellewana Kanda Eastern Slope). These are well connected to one another and embrace the large DSs of Lagalla Pallegama and Wilgamuwa as well as the larger eastern part of the Naula DS (the rest falls into 3 below).
- The upland part of the Sudu Ganga sub-catchment including the Rattota and Ambanganga Korale DSs.
- The lower part of the Sudu Ganga sub-catchment including the Ukuwela, Matale and parts of Akurana and Naula DSs
- The Nalanda Oya sub-catchment embracing Pallepola and Yatawatta DSs.
- The Heen Ganga and Hasalaka Oya sub-catchments in the south, comprising Udadumbara DS and part of Minipe DS.

Implementation units 2 and 3 liaise to deliver coherence across the Sudu Ganga sub-catchment and operations for the part of Naula DS falling within Sudu Ganga will be implemented through the cooperation with Implementation unit 1 that has the larger part of the DS within its sub-basin remit. This involves significant behavior changes amongst the key stakeholders comprising the implementation teams in terms of sharing information, working conjointly on a problem-solving basis rather than from their own disciplinary or sectoral viewpoint and placing emphasis on the co-design and adaptation of interventions with local level stakeholders and co-learning about performance of options together.

Output 3.2 Integrated rural advisory capacity responsive to developing knowledge base, real time weather and market information

This output focuses on tackling the key constraint of a lack of understanding about climate impacts, and the contextual conditionality of options to address them, at a fine enough spatial and temporal resolution to advise upstream land users on appropriate options for their specific contexts. This constraint is addressed through:

a) establishment of nested-scale multi-stakeholder innovation platforms from sub-basin down to local Grama Niladhari (GN) division scale;
b) training in methods and tools for adaptive and participatory co-design of adaptation options; and,

c) development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.

This involves significant behavioral changes amongst key stakeholders in terms of vertical integration (across scales of operation) and embracing a participatory approach that recognizes the importance of local perspectives on the appropriateness and performance of different land use options as well as developing the capacity to operate a responsive rural advisory system capable of tailoring advice to different contexts and in response to real time information about changing conditions.

7.4. Component 1: Climate-Resilient Sustainable Land Management

7.4.1. Output 1.1: Improved Land and Water Management in Upstream Catchment Areas to Safeguard Production of Environmental Goods and Services

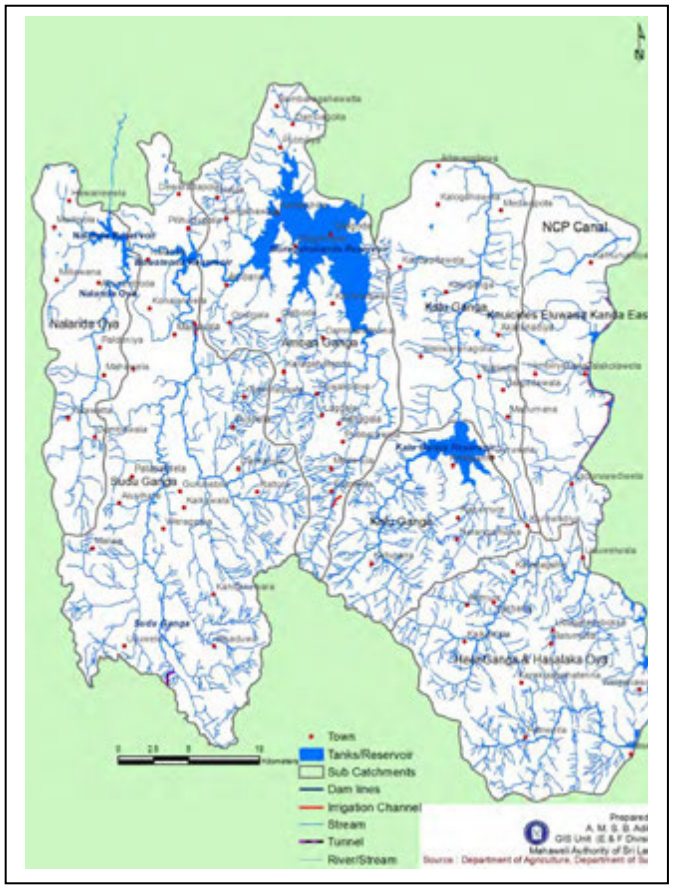


Figure 75: Existing waterbodies in the upstream area

This component will improve land and water management with two key outcomes:

- Safeguarding ecosystem goods and services generated in the upstream Knuckles catchment area
- Increasing productivity and climate resilience of primary production in both, upstream catchment area and downstream command area, to which the upstream supplies irrigation water

For the rehabilitation and establishment of village ponds, irrigation and road networks, community action is required *via* the GN innovation platforms, established in Activity 3.3.1 with technical and financial input (from the PES mechanism) support, coordinated by the sub-basin implementation teams.

Priority areas for intervention will be determined based on the sub-basin planning process in Activity 3.1.1. using information derived from the information portal that will be established in Activity 3.1.2. and funded where appropriate *via* the PES mechanism that will be established in Activity 2.2.1. Initial funding will be provided as sunk costs, directly from project funds, to initiate catchment protection and improve water supply

for upstream households and farms while the PES will be gradually phased in to maintain “best practices” over the life of the project. As a result, towards the end of the project, a sustainable mechanism will be in place to maintain appropriate water flow and quality and control across the sub-basin implementation areas.

i) Activity 1.1.1: Streamside Protection and Drainage Management Along Roads

Streamside protection in upstream area

These are conservation measures focused on the linear stream and road networks. This will include vegetation management in streamsides to control runoff and enhance infiltration (this will have benefits for reducing reservoir spills, i.e. dam safety, and sedimentation and therefore downstream irrigation supply); and soil health management (soil C, water retention, biotic function) along with a focus on streamside management. Community inputs will be used to conserve the streamsides as well as to maintain the restored streamsides.

Table 33: Stream/River Length - Upstream

Stream Type	No of Segment	Length (km)
Canal	32	17
Stream/River	3,465	2,347
Tunnel	3	1.3

There are about 2,300 km of streams and canals within the upper catchment of the project area to be selected for project interventions. The streamside interventions will be implemented by the Government agencies with the support and involvement of community-based organizations.

Figure 76: A model of vegetated riprap for bank protection

There are established techniques for streamside protection including the techniques developed by the Central Environment Authority (CEA) and Natural Resource Management Centre (NRMC). The farmers who are living in the catchment areas will be supported through the developed PES in the long-term in order to continue the work that will be initiated with the support of this project.

While establishing streamsides, additional measures can be taken to minimize the energy and volume of the water running off to the streams, not only to prevent the sediment loads but also to minimize the addition of fertilizer and agro-chemical residues to the streams—an area already identified as a serious water pollution pathway in Sri Lanka. Climate induced high runoff of water in times of intensive rain can be addressed by stabilizing the riparian buffers put in place as part of streamside protection.

Figure 77: Buffer strips to prevent land-based pollution in streams

Drainage management along roads

Roads are a source of huge volumes of runoff that can be safely collected and stored either above or below ground for multiple uses. These uses include recharge of groundwater; to support the establishment and growth of trees along and besides roads; for diversion into pans and small dams for livestock and crop production.

Table 34: Road Length in Upstream Area

Road Type	No of Segment	Length (km)
Footpath	335	108
Jeep/Cart Track	2,658	1,376
Main Roads – A Type	39	61
Main Roads – AB Type	4	6
Main Roads	158	236
Railways	7	16
Secondary/Minor Roads	111	88

However, to operationalize such a system, the challenges arising due to governance, social access to resources along roads and the use of appropriate techniques to sustain the roads need to be introduced and addressed.

Drainage management along roads is aimed at preventing the run-off and increasing groundwater recharge, using community led dyke establishment and maintenance. This initiative will minimize the silt accumulation in reservoirs and ponds. The water harvested in this way will be diverted to increase the household and field water supply.

Main Roads are constructed and maintained by the Road Development Authority. However, there are many roads in different categories managed under different organizations including provincial authorities, Forest Department, Irrigation Department etc. The project will develop a methodology with the participation of multi-stakeholders to identify critical areas that require urgent attention in developing runoff and surface water management on the roads, comparing the fragility of the soil and issues of vegetation. The amount of water that can be infiltrated into the soils is also determined by the landslide potential in the area as more water and soil saturation can induce landslides. Due to the highly technical nature of this work, this feasibility is not attempting to identify the roads to be used for water

management. The project will therefore work with multiple agencies in charge of different dimensions, such as Road Development (National and Provincial) Authorities; Natural Resource Management Centre (NRMC) on erosion control; and the National Building Research Organization (NBRO) on landslide potential and drainage. The following table developed for high slope situations (over 21.5% slope) highlights some of the aspects to be considered during the designing of the drainages.

Table 35: Length of potential roads to be covered by conservation activities

Criteria	Estimate Road Length (KM)
A Class Roads – Slope >21.5, Soil type: Reddish Brown Latosolic soils; steeply dissected, Geology code: 58,89,54, Rainfall > 3000 mm, soil: Red Yellow Podzolic, Mountain Regosol & Lithosol soils	5 km
B Class Roads – Slope >21.5, Soil type: Reddish Brown Latosolic soils; steeply dissected, Geology code: 58,89,54, Rainfall > 3000 mm, soil: Red Yellow Podzolic, Mountain Regosol & Lithosol soils	24.09 km
Jeep tracks Slope >21.5, Soil type: Reddish Brown Latosolic soils; steeply dissected, Geology code: 58,89,54, Rainfall > 3000 mm, soil: Red Yellow Podzolic, Mountain Regosol & Lithosol soils	130 km
Minor Roads Slope >21.5, Soil type: Reddish Brown Latosolic soils; steeply dissected, Geology code: 58,89,54, Rainfall > 3000 mm, soil: Red Yellow Podzolic, Mountain Regosol & Lithosol soils	0.2 km

ii) Activity 1.1.2: Rehabilitation and Establishment of Village Tanks, Ponds and Irrigation Networks

Rehabilitation of tanks and ponds is a common objective in both upstream and downstream areas. Upstream area has over 60 village tanks and ponds with less than 1-ha area. However, overall the upstream area has about 100 village tanks and ponds that can be rehabilitated with community involvement.

IUCN is specialized in techniques of tank and ponds rehabilitation and the use of the "Partial Desiltation" technique that improve the storage capacity while the silt and clay are being stabilized within the tank has proved to be successful.

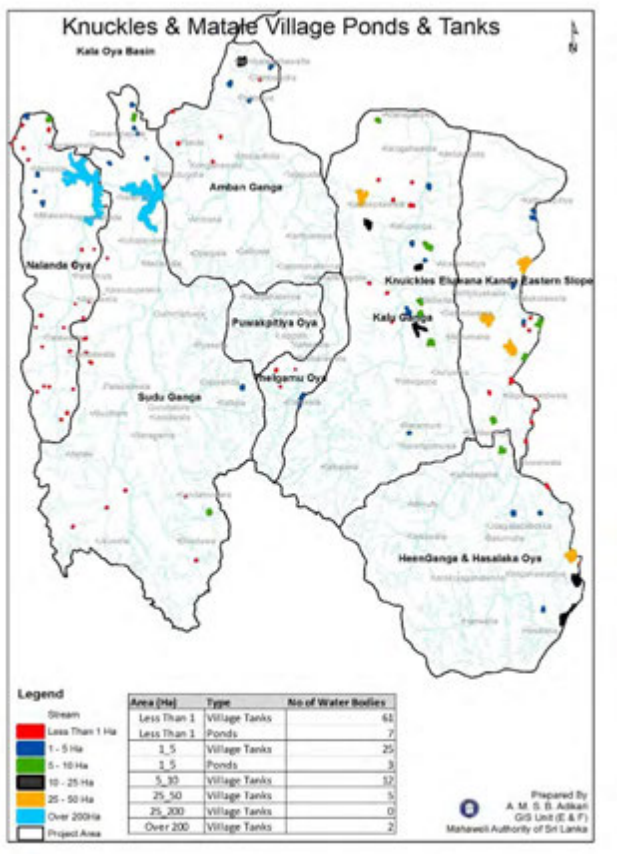


Figure 78: Tanks and irrigation networks in the upstream area

Rehabilitation and development of village level ponds and irrigation channels (including both direct rainwater harvesting and tapping stream networks) will include water flow and quality, stream erosion and ground water re-charge monitoring at GN level and will be led by the Department of Agrarian Development in the Ministry of Agriculture. These village tank systems are man-made ecological constructions, which has served the rural subsistence farmer communities to produce their own food and look after their social welfare with little outside interference since ancient times.

Table 36: Knuckles and Matale Village Ponds and Tanks

Area (Ha)	Type	No of Water Bodies
Less than 1	Village Tanks	61
Less than 1	Ponds	7
1-5	Village Tanks	25
1-5	Ponds	3
5-10	Village Tanks	12
25-50	Village Tanks	5
25-200	Village Tanks	0
Over 200	Village Tanks	2

A participatory development approach is vital to address the real needs of the rural people; make beneficiaries and line agencies strong partners in the project implementation; to create a sense of responsibility, ownership and accountability; and to ensure involvement in the post project sustainable operation and maintenance (O&M). As such, the selection of tanks for rehabilitation will be based on the community needs. Beneficiaries of the selected schemes should be willing to participate actively and contribute their maximum in whatever possible manner and should also be ready to take as much responsibility as possible during all stages of the project implementation. Therefore, in this activity the project will use a strong community mobilization component from the initial stages through appointment of specialist catalyst agents. Capacity building of all stakeholders from early stages of a project on their roles and responsibilities combining the knowledge to address emerging issues, use of global and traditional knowledge will strengthen the use of the GCF investment while creating opportunities for stakeholder cooperation and collaboration.

Experience show that formation of different rehabilitation committees *viz* procurement, construction; and supervision and then assigning tasks has provided the opportunity for most beneficiaries to be involved in the rehabilitation activities conveying some sort of responsibility and ownership. Divisional or District Secretary with the participation of line agency officers and farmer representatives has contributed to positive results in achieving targets and mobilizing duty bearers into the process, in the past. Construction contracts could use local Farmer Organizations when practically feasible, after providing basic construction and contract management training, which facilitates the mobilization of more resources from beneficiaries, improving the quality standards of construction. Actions to establish a separate O&M fund for post project sustainable maintenance of schemes with necessary institutional arrangement and procedures for fund utilization is a very important aspect to be considered in the rehabilitation process. Appointment of a dedicated caretaker and payment of an honorarium for his services would boost this sustainable O&M. The following intervention matrix for small tank rehabilitation will benefit subsistence farmers by increasing the cropping intensity.

Table 37: Interventions in tank rehabilitation

Possible reasons	Causal factors	Technical indicators	Physical observations	Quantification	Intervention recommended
1. Inadequate tank capacity	Tank is silted	Capacity/water spread is low	Weed infestation, shallow water depth, large water spread, upstream salinity patches, lack of trees around	Sedimentation survey	Partial desilting to improve tank bed geometry
	Low structural capacity	Capacity/ command is low	Frequent spilling, water shortage for irrigation	Inflow estimation	Investigate for capacity increase
2. Low tank water storage	Limited catchment area	Catchment/command is low	Low runoff, rare spilling	Inflow estimation and land use interpretation	Watershed management
	Blocking/diversion of streams Newly constructed tanks/ anicuts Land use changes	Land use data	Field evidence	Inflow estimation and land use interpretation	Watershed management
3. High tank water losses	Tank is silted	Capacity/water spread is low	Weed infestation, shallow water depth, large water spread, upstream salinity patches, lack of trees around	Sedimentation survey	Partial desilting to geometry
	Structural failures	Catchment/ command is high	Downstream water stagnation, water leakage, rapid storage reduction	Preliminary investigation	Structural repairs
	Absence of wind	Land use maps	Absence of *kattakaduwa* and *gasgommana*	Land use interpretation	Ecosystem development
4. Poor management of tank storage	Upland cultivation	High irrigation water demand, low water productivity	Staggered cultivation, continuous irrigation, late cultivation	Preliminary investigation	Cultivation scheduling
	Poor maintenance of downstream canals/ structures	Observations	Water wasting in canals, unwanted water stagnations	Preliminary investigations	Downstream development
5. Socioeconomic issues	Collapse of institutional mechanisms	Disorganized cultivations	Marketing problems	Socioeconomic survey	Social mobilization
	Low profitability of paddy cultivation	Frequent fallowing	High cost of cultivation, unnecessary operation and management practices, low yield, post-harvest losses	Socioeconomic survey	Crop diversification
	Land fragmentation	High land fragmentation index	Ad-hoc fallowing, crop protection failures, irrigation difficulties	Socioeconomic survey	Land consolidation
	Off farm employments	Ad-hoc abandonment	Low interest in group works, frequent abandonment	Socioeconomic survey	Crop diversification

Key points in tank rehabilitation

Partial desilting to improve tank bed geometry could be undertaken as de-siltation is expensive. As such, it is important to develop a technological concept, which generates a low-cost and effective de-siltation process. The partial de-siltation concept is introduced in this context, on the basis of findings obtained from hydrological research studies conducted by the Department of Agriculture. The main objective of the concept is to reduce tank water losses by manipulating the tank bed geometry through de-siltation. Studies of sedimentation indicate that the amount of sediment deposited in minor tanks is between 20-35%, and half of this sediment is found within one-third of the tank bed area close to the bund. The same capacity can be maintained by removing sediment in this area and heaping it in the upstream tank bed. Such partial desilting increases the spread of the water and keeps more than 50% of the tank bed free of water.

Physical tank rehabilitation / structural constructions

- This includes preliminary investigations, headwork improvements and repairs. Both communities and line agencies could work together with the support of engineering contractors.
- The components related to tank performances could be directly improved during this stage such as sluices, spills, bunds and other structures required to derive the maximum benefits from the tanks.
- Because of this intervention, it is expected to increase the irrigable extent, cropping intensity, and the availability of tank water.

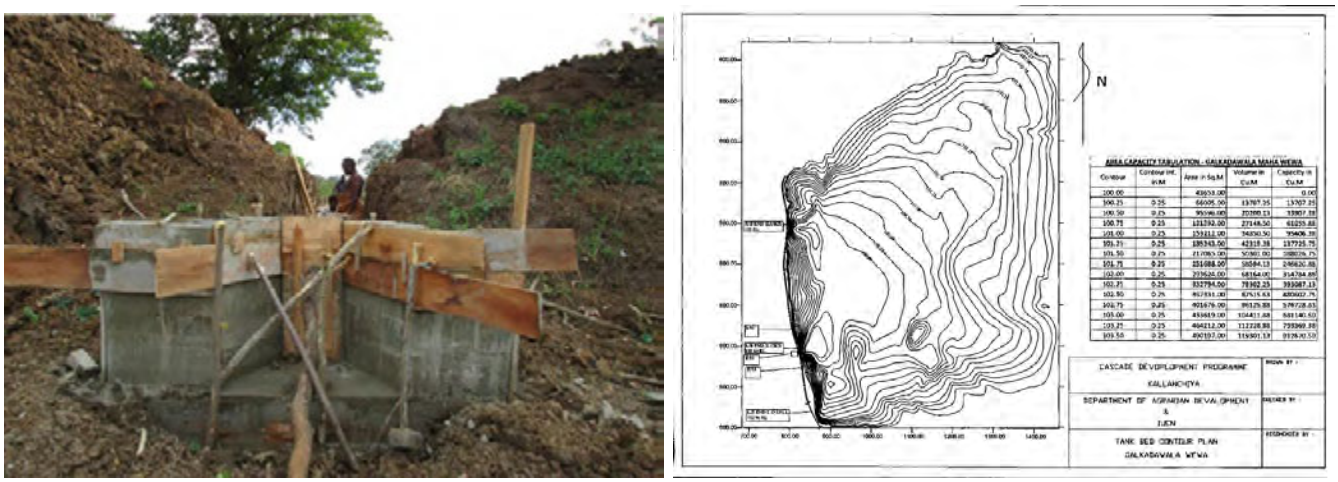


Figure 79: Structural measures in tank rehabilitation

Functional descriptions of a typical tanks system would include the following based on the traditional knowledge on tank-cascade systems in the country:

- *Gasgommana*: is the upstream land strip above the tank bed, accommodating water only when spilling. Large trees and climbers are found in this area. *gasgommana* acts as a wind barrier reducing evaporation from the tank and lowering water temperature. It provides a closure to the bund from either side where roots of large trees make water

cages creating breeding and living places for some fish species. This tree strip demarcates the territory between human and wild animals.

- *Perahana*: is a meadow developed under the *gasgommana* and filters the sediment flow coming from upstream chena lands.
- *Iswetiya or potawetiya*: an upstream soil ridge constructed at either side of the tank bund to prevent the entering of eroded soil from upper land slopes.
- *Godawala*: a manmade water hole to trap sediments. and provides water to wild animals. This might have been a strategy to evade the 'man-animal' conflict.
- *Kattakaduwa*: is a reserved land below the tank bund. It consists of three micro-climatic environments: a water hole; wetland; and dry upland. Therefore, a diverse vegetation is developed. This land phase prevents the entering of salts and Ferric ions into the paddy field. The water hole minimizes bund seepage by raising the groundwater table. Villagers plant *vetakeya* along the toe of the bund to strengthen the bund stability. It is similar to a village garden, where people utilize various parts of the vegetation for purposes such as fuel wood, medicine, timber, fencing materials, household and farm implements, food, fruits, vegetables etc. Specifically, they harvest row materials from this vegetation for cottage related industries.

Downstream development

- The main purpose of the rehabilitation of the tank is to provide the downstream communities with water for agricultural purposes. A network structures to carry water to downstream areas are to be identified, demarcated and constructed. Communities will be utilized for these activities as well as the committees formed by communities will be involved in the maintenance.
- The purpose of downstream development is to expand the command area, which benefits from the water provided by the tank.

Crop diversification

- The smallholder farmers will be made aware/educated to identify climate-smart crops. The key elements when deciding regarding the suitability of a crop are the soil suitability, level of climate change, market opportunities and farmer knowledge on crops.
- Rice is known as the staple food of Sri Lanka and naturally, farmers tend to grow paddy. However, the Government of Sri Lanka has already initiated programmes to encourage farmers to diversify the crops to high-value and input efficient crops. More than the climate change, this step is taken due to export opportunities and the high market income generated when compared with paddy. Currently the times of excess paddy harvesting, the Government declare maximum prices to safeguard the paddy farmers or invest resources to buy stocks. Due to the lack and excessive water situations in different time periods of the year, the farmers need to be educated to use a mix strategy for agriculture.
- The main purposes of the crop diversification are to increase the income of the subsistence farmers and reduce the burden for the economy due to paddy harvest damages because of droughts or floods.

Land consolidation

- Land consolidation is very important in terms of achieving a high crop intensity. The proposed project targets to almost double the cropping intensity of the project area. However, one of the major hindrances to achieve this target is that in the upstream, the extent or the land share of each farmer is fragmented, which is in contrast to the

downstream area where farmers have adequate lands to cultivate. As a result, subsistence farmers in the upstream suffers from the dilemma of inadequate lands and most of them carry out farming on an individual basis. Therefore, an initiative of the project will be the preparation of a common plan to coordinate the agriculture with adjacent farm lots. This will reduce the cost for agricultural inputs and increase water efficiency and productivity.

- Another important intervention will be the introduction of precision farming. If the number of farmlands is limited and a main objective of production is to produce beyond the farmer's own consumption, then the produced goods/services must be enriched with high quality and productivity. Therefore, all agricultural inputs will be scientifically distributed, and these decisions need to be driven not by the farmer experience, but by data driven geo referenced advisory mechanisms.

Cultivation scheduling

- Cultivation scheduling is a key activity in agricultural adaptation. This activity needs to be strengthened by the initiatives proposed by the GCF project, especially on climate and weather forecasting capacity enhancement of local weather departments and farmers themselves.
- More software components, such as farmer trainings on water use efficiency, crop management, soil management, environment conservation, post-harvest practices etc. will be conducted.

Social mobilization

- Social mobilization is important to sustain project initiatives and in transferring the ownership of project activities to farmers. The free labor activities that can be organized to strengthen the farmer associations, encourage farmers to contribute their resources and efforts to the common interest of the majority. Experience sharing with farmers who live in different climate vulnerable areas will be organized under farmer mobilization.

Rainwater harvesting

- The rehabilitated tanks of the villages need to be sustained during the dry period. Therefore, the communities will be provided with varying options, such as rain water harvesting, to conserve and collect water during the available time and to use during dry periods. Activities such as home gardening, drinking and other domestic requirements could be fulfilled by rainwater harvesting.
- Testing/piloting rainwater harvesting options in the upstream will be an interesting take as some of the downstream rainwater harvesting techniques will not be replicable at all times. Therefore, innovative methods such as infiltration and storing the water in the upper water table of the land etc., need to be tested/piloted.

Infrastructural development

- The village economy needs to be further supported by enabling the subsistence farmers to earn a reasonable income because of properly managed marketing. Sometimes communities' access to nearby markets could be ensured by rehabilitating/constructing

new roads/routes and marketplaces, especially targeting buyers from outside, such as tourists.

Homegarden development

- Perennial crops, such as Jack, Jackfruit, Mango, Avocado etc. and more profitable productions such as Jaggary and Kithul Honey could be harvested/grown in homegardens *via* planting of the said trees. The limited space in a home garden is one of the key challenges, therefore a good selection of crops is required, based on climate condition and market potential. Furthermore, bee honey cultivation is another profitable income generating activity that farmer families could start utilizing their own homegardens.
- The purpose of home gardening is to diversify the income source of families while efficiently making use of the land to prevent degradation.

Livestock and freshwater fishing

- Depending on the cultural acceptance in different areas, livestock and freshwater fishing could be introduced. However, this has to be done in consultation with the communities. It is observed in some areas of the country with the exception of the project area that freshwater fishing was immediately initiated after the rehabilitation of a tank. In some areas, the farmer associations rented the tank to an external fishing community where they utilized the rent for tank O&M.

Institutional development

- As per the rural context experience, villagers most of the time form village associations for purposes, such as funeral aid, youth development etc. Furthermore, in forest adjacent areas, community forest associations could be found while in areas prone to disasters, village disaster management committees have been formed. There is no legal issue as to whether such associations are legally recognized, and as a result these already formed associations could be utilized as a platform where villagers could work together with the proposed GCF project and its partners to implement many activities mentioned in this section. In case, such an association does not exist, a new farmer association could be formed by the community and the legal status could be obtained from the Divisional Secretariat. Thereafter, the project can work with those organizations and organize village level adaptation activities. This is a good strategy than working with individual farmers.

Enterprise development

- The external support for climate risk communities and farmers will be provided by the project through identified Government and private partners in areas such as;
    - Markets for products
    - Food processing
    - Export market
    - Quality and certification: branding of products as a unique brand for global markets
    - Bridging funding opportunities offered by the global community, such as tree planning, forestry activities etc.

Based on extensive experience of promoting rainwater harvesting in several countries, rehabilitation and development of village level ponds and irrigation channels (including both direct rainwater harvesting and tapping stream networks) will be guided by a GIS based method for mapping rainwater harvesting options across biophysical and socioeconomics context. The GIS-based tool will be used to generate thematic maps for prioritizing interventions in the target

upstream areas through multi-criteria analysis. The tool will employ basic data including administrative and infrastructural information (political subdivisions, roads, electricity); land and soils information (land use, land cover, geology, lithology, geomorphology, soil types, topographic data); climate information (temperature, precipitation, PET, ACZs); and water resources information (hydrology, hydrography, hydrogeology). It will quantify rainwater harvesting potentials across the targeted upstream area, guiding land users in locating appropriate sites for capturing and storing rainwater. Since the method considers relevant biophysical and socioeconomic parameters, the land with the best capability for agricultural production (either crop or livestock) will be matched to the available water resources within the landscape/watershed. The tool will produce thematic maps showing areas suitable for practicing various rainwater harvesting options, such as village tanks and farm ponds. Areas undergoing severe land degradation will be identified, the hotspots will be mapped, and drivers of such negative land use will also be identified, and investigations will be carried out for corrective measures. The entire process will be undertaken in full consultation with land users, local authorities and other stakeholders. The tool will enable communities and local authorities to develop a sub-catchment management plan as a mid-term tool for prioritizing actions on the ground. ICRAF will work with relevant staff in the Department of Agrarian Development, in the Ministry of Agriculture, to apply the method to the upstream target area. A monitoring system will be established by the Department of Agrarian Development and this system will include water flow (quantity) and quality, stream erosion and ground water re-charge monitoring at GN level.

The following figure/s indicate the spatial distribution of different land use types in the Knuckles and Matale area (upstream area) shown by four maps a) Dense Forest, Open Forest and Forest Plantations (top left); b) Knuckles and Matale Area – Home garden, Spice Coconut & Rubber (top right); Knuckles and Matale Area – Scrub Land and Grass Land (bottom left); and Knuckles and Matale Tea and Forest Planation (bottom right).

Activity 1.1.3: Restoration of Forest Mosaic Landscapes

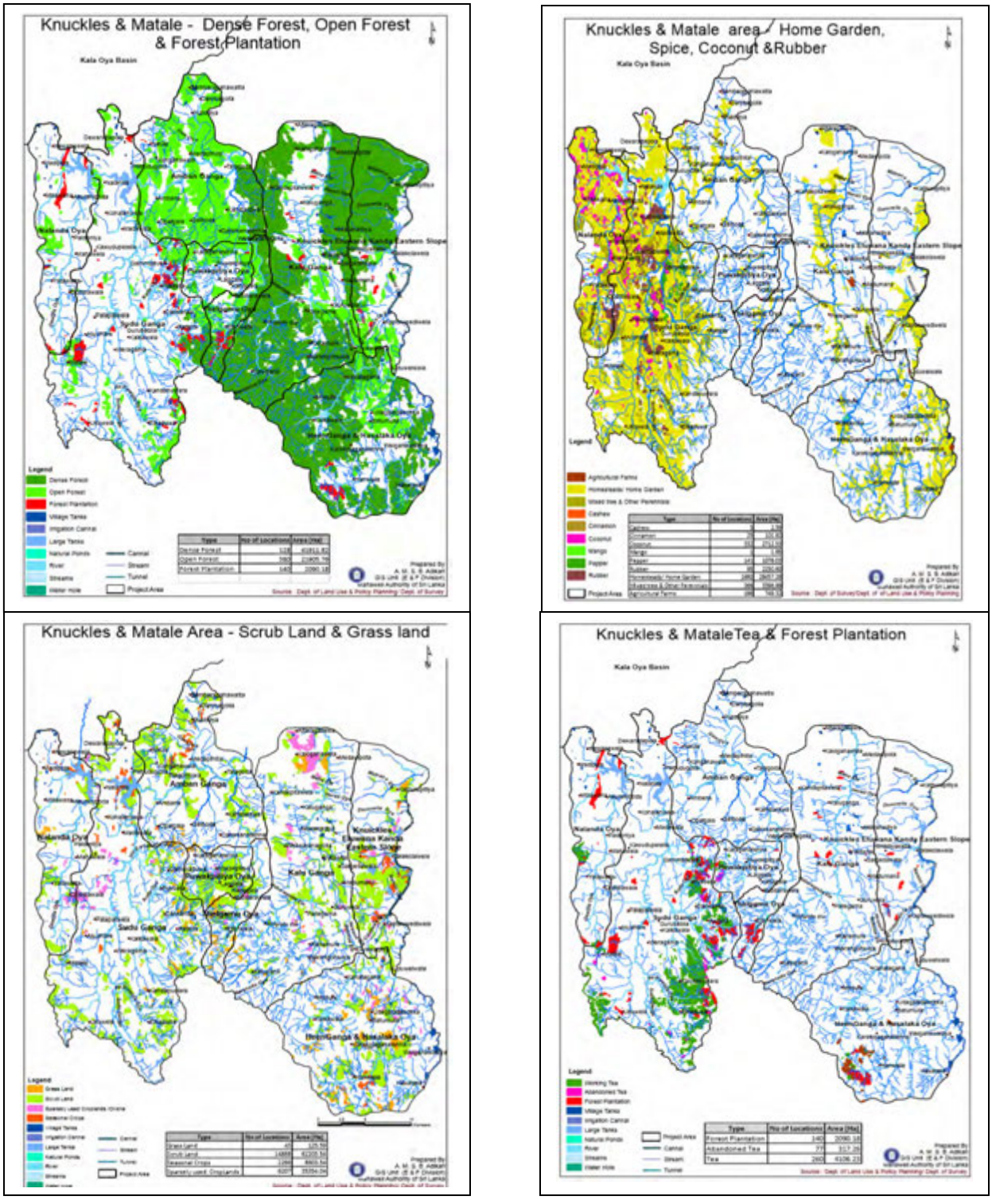


Figure 80: Different land uses in Knuckles and Matale upstream area

This component focuses on restoring degraded forests within protected areas and forest fragments, re-growing forests in priority areas for the supply of ecosystem services—especially for watershed protection, and the planting of trees outside forests for improved sustainability and livelihoods. The project will employ a Forest Landscape Restoration (FLR) approach. The three pillars of FLR are,

a) inclusive and devolved natural resource management, which ensures local communities' benefit for restoration activities and hence supports long-term sustainability of interventions;
b) land use planning through multi-sectoral and multi-level governance, with a focus on ecosystem service delivery; and
c) integrating a diversity of restoration technologies across the landscape to optimize livelihood and environmental outcomes.

FLR is more than just planting trees. Fundamentally, it involves addressing the degradation drivers and transitioning a whole landscape to a restoration trajectory to meet present and future needs and to offer multiple benefits and land uses over time. In this project, key actions will include assisted natural regeneration and planting of diverse tree assemblages to restore degraded forests, and various agroforestry interventions, including climate smart agriculture, homegardens and boundary plantings. A focal area will be to enhance the ecosystem service provisioning of existing timber plantations (covering over 2,000 ha in the upstream catchment area), through understory rehabilitation and under-planting with species more suited to the local environment and people's needs than the pines and eucalypts that were planted previously and that have been associated with degradation of ecosystem services in key parts of the Knuckles upstream catchment area.

Equally important will be the restoration of degraded grassland areas, which have thus far defied restoration attempts. Furthermore, the Knuckles area is experiencing rapid climate change and hence ensuring forest resilience and identifying appropriate species and genetic compositions of any plantings will be crucial. ICRAF will employ its experience in tailoring restoration approaches and embedding learning to address these challenges. This activity will involve the Forestry and Central Environmental Authority, Knuckles Environmental Protection Agency, Ministry of Mahaweli Development and Environment; Department of Agrarian Development, Ministry of Primary Industries, Wildlife Department, Ministry of Sustainable Development, Land Reform Commission and the Ministry of Lands. The inclusive and developed decision-making will be conducted through the GN innovation platforms that will be established in Activity 3.3.1.

7.4.2. Output 1.2: Sustainable Climate-Resilient Primary Production in Upstream Catchment Areas and Downstream Irrigated Agricultural Areas

Climate-adapted options for sustainable intensification will be matched to context using the framework that will be developed in Activity 3.1.3 using tools that will be developed and refined in Activity 3.2.3.

i) Activity 1.2.1: Increasing Cropping Intensity of Irrigated Rice in Both Upstream and Downstream Areas

This activity focusses on the development of smart farming techniques to grow appropriate climate adapted varieties and how to make efficient use of irrigation water and fertilizers (maximizing use of organic inputs and recycling) as well as ways to employ integrated pest control based on real time weather and pest incidence data (connected to the information system that will be developed in Activity 3.1.2.). The 130,943 ha of irrigated rice in the project area, over 90% of which is in the downstream command area (see Map below), represents 16% of the total across irrigated rice in Sri Lanka.

Rice varieties are categorized into three types according to the time taken for maturity: short duration (up to 3 months), medium duration (3-4 months), and long duration (4-4.5 months) with the short and medium duration comprising over 93% of the rice production of Sri Lanka. There are two cropping seasons, *Maha (*October to February) and *Yala* (March to September). Traditional irrigation methods such as furrow irrigation (FI) and continuous flooding irrigation (CI) result in a higher loss of water. Water saving irrigation methods introduced and advocated during the project will improve overall Water Use Efficiency (WUE).

The System of Rice Intensification (SRI) that the project will promote is a climate-smart, yield-increasing system that is being utilized by more than 10 million smallholder farmers in over 55 countries. This innovation combines several agronomic practices to boost yields while reducing the use of purchased inputs and water. In contrast to the water intensive continuous flooding method that causes anaerobic conditions in the soil, under SRI, farmers can practice alternate wetting and drying along with increasing air retention capacity of the soil. The utilized technology makes it possible to transplant 8-12 days earlier at wider distances compared to the conventional 3-4 weeks old rice seedlings. This allows plants access to more nutrients and sunlight, producing stronger stalks and more tillers. SRI methods have reduced the irrigation requirement by 46-50% compared to conventional practice in Korea and SRI practices produced a 49% higher grain yield with 14% less water than under conventional practice in India.

In addition to promoting SRI, the project will provide customized advice for enhancing rice productivity through the use of appropriate varieties for each context, storage and processing to maintain quality as well as to support enhanced production of associated crops for increased dietary diversity. Using seasonal forecasts has shown to increase agricultural income in a system with varying crop costs and returns in Sri Lanka by allowing more diversified crop choices. This activity will involve the following four key elements.

a) Make better use of irrigation water (higher WUE) through better irrigation management and variety choice

The introduction of the SRI method will reduce the amount of water needed to grow rice while reducing methane emissions as well. The soil is kept moist rather than continuously saturated, minimizing anaerobic conditions, improving root growth and supporting the growth and diversity of aerobic soil organisms. Baseline information on the amount of water being used in the current flood irrigation method will be calculated across the different rice varieties (short and medium duration) and compared to the amount using the SRI and with alternate wetting and drying (AWD). Using data on

water provided and rice yields/productivity, water use efficiencies will be derived across the three systems. This will be computed for different varieties. Baseline figures for the methane emissions across the different watering systems and varieties will also be determined.

b) Achieve cropping intensity greater than or equal to 2, with enhanced productivity.

Nearly 72% of rice in Sri Lanka is grown during the wet season in dry areas where water resources are already stressed. Suitable high yielding varieties appropriate to the sites will be used for each season, based on water availability and climate predictions. A baseline survey on the current varieties widely used by farmers and their potential yields will be carried out. To boost production in the drier season, SRI systems, will be used. Under this system, the abundance, diversity and activity of soil organism's bacteria, fungi, earthworms and other soil biota that improve soil fertility will be enhanced and will contribute to plant growth and health and consequently to the productivity. Rice seedlings will also be transplanted when young, less than 15 days old, with just two leaves; quickly, in shallow depths and carefully, to avoid trauma to roots and to minimize transplant shock. Rice plants will be planted singly and spaced optimally to permit more growth of roots and leaf area and to keep all leaves photosynthetically active. Applications of fertilizers of organic origin (such as plowing the straw back into the field, green manure, cow dung, poultry manure, and liquid fertilizer) will be encouraged. SRI provides as much organic matter as possible to the soil. While chemical fertilizers also provide positive results with SRI practices, the best yields are derived with organic fertilizers or manures as they help to improve the soil texture and carbon, that in turn increases the water retention of the soil. Weed control through simple mechanical hand weeders will be promoted to help aerate the soil and so may outperform herbicides or conventional hand weeding. Other adaptation strategies that will be promoted where appropriate include: adjusting the planting window and using short duration varieties in response to weather forecast information. Capacity needs of the farmers will be improved and appropriate awareness raising programs and trainings will be organized. The validated APSIM-Oryza module will be used to evaluate changes in the potential areas for rice cultivation across the project area in response to predicted climate change scenarios.

c) Store, process and assure quality to achieve reasonable prices.

Climate change has shifted the rain/wet period over the typically dry harvesting period, and thus harvesting rice has become a challenge for farmers as there are fewer sunny days. Furthermore, the arrival of early winds has forced farmers to harvest wet rice; however, they still continue to face challenges in drying the harvested rice as the number of dry sunny days are limited and unpredictable with quick rains and showers spoiling the open-air sun drying methods, traditionally used. The project will promote the use of dryers that are run on renewable energy (wind, run of water, hydro, solar), operated by individual farmers; and shelters made from locally available material that will ensure the right conditions for air drying (long-slow as opposed to fast, which impacts on quality). Purpose-constructed drying floors will also be recommended where there is a need to dry large quantities of grain. These would also act as temporary storage facilities. Heated air driers will be recommended for use as fixed bed batch driers, where farmer collectives are able to afford them. Use of modern milling methods to ensure clean, whole grains and proper sorting of rice for quality will be recommended to ensure quality and hence good market access and prices.

d) Dietary diversity (through the enhancement of what is available across landscapes) and wind issues.

Increase in wind events and speeds associated with climate change, in the interim season between rice crops, during which farmers try to cultivate a cash crop (typically a 3-month period in which beans, tomatoes and sweet potatoes are commonly grown) has negatively impacted yield. Recommendations to establish windbreaks or switch to wind resilient short-term crops will be promoted. Participatory development of options for other suitable crops will be made and will likely include spices such as basil and rosemary, onions, groundnuts or other locally available and marketable crops such as cloves, pepper, and cardamom. Attention will also be given to perennial crops and annuals such as kitul, jack, mango fruit, coffee, cocoa, durian, salad curry leaves, that farmers depend on. Support on processing technology and value addition will therefore be a key element in this regard. Considering the limited crop choices of the farmers due to the wind problem, post-harvest losses need to be minimized and value addition options provided. Vegetables can also be processed to facilitate long to mid-term storage to avoid post-harvest losses and to enhance shelf life. This will reduce the impact of reduced prices caused by seasonal excesses in production of these commodities.

ii) Activity 1.2.2: Intensification of Sustainable smallholder production

This will focus on options for sustainable intensification of homegardens, analog forests, spice gardens and annual horticultural crops in the upstream catchment. Interventions include climate proofing of selected tree species, pruning to control distribution of light in multi-strata systems and improve timber quality and agronomic management.

Smallholder farmers are the predominate land users in the upstream catchment area, producing food, tree products and environmental services from small landholdings. Smallholder farmers develop and manage such systems by nurturing trees, along with crops and livestock, on their farms and homesteads. These tree-farming systems are efficient agricultural and natural resource production systems. A prominent component of 'trees outside the forest', smallholder tree-farming systems are primarily 'planted' systems that restore marginal farmlands where annual agricultural crop production alone is no longer biophysically or economically viable. These systems can also be used to reclaim degraded public lands that have been abandoned, through 'restoration agriculture'. Smallholder tree-farming systems can include forest-like systems where selected species are integrated in natural and secondary forests. In these systems, farmers cultivate trees to diversify production; generate commodities for home consumption; enhance income through market sales; and to reduce risk. Smallholder systems tend to contain multiple species, producing multiple products.

In the upstream catchment area, the most prominent and important smallholder systems include homegardens, spice gardens, annual horticultural crops, and analog forests. Homegardens are species-rich tree-based systems, usually occupying lands immediately surrounding or adjacent to the household and are used to produce a diverse array of food, trees and other products from perennial and annual species. Tree components of these systems yield fruits, vegetables, medicines, spices, timber, poles, fuelwood, and other commodities (coffee, cocoa, tea). Traditionally focused on producing goods for home consumption, the advent of rural infrastructure and market-economies provide opportunities for homegardens to be more commercially oriented. Spice gardens can be considered a type of homegarden focused on commercial production of species for local, national and international markets. Common crops produced in spice gardens include cinnamon, pepper, cardamom and cloves. Spice gardens also include timber, fruit, medicinal and commodity tree species and annual crops as secondary components. The above picture highlights the difference between the analog forest model (left) in Mirahawatta (Rainforest Rescue International) and degraded business as usual in the right-hand side (Photo – Ananda Mallawatantri).

Figure 81: Analog forest vs conventional land use models

As the name implies, annual horticultural systems focus on annual crop production. Crops commonly cultivated in these systems include kidney beans, beets, chilies, big onions, green gram, cabbages, bitter gourd, pumpkin, tomato, okra, eggplant, luffa, and long beans. These crops are produced for both household consumption and market sales. Individual farms cultivate a diversity of crops under low input and rainfed conditions. While focused on annual horticultural crops, these systems also contain tree components that provide both service and production roles. The diversity of tree species is similar to homegardens and spice gardens.
Analog forests are an ecosystem restoration approach, originated in Sri Lanka, that seeks to model the process of natural forest development and forest service functions in (re)establishing a sustainable ecosystem, characterized by a high biodiversity to biomass ratio. Analog forests are designed through a synthesis of traditional and scientific knowledge, to optimize the production and service potential of the system rather than to maximize the productivity of a single species component. While focused on ecosystem restoration, analog forests are also designed to provide economic benefits. Annual species are also components of analog forests.

Homegardens, spice gardens, annual horticultural systems, and analog forests can be viewed as a continuum of smallholder systems. From horticultural systems focused on annual crops, to homegardens and spice gardens representing perennial (tree) farming systems, to analog forests being a forest management and restoration approach—all include both annual and perennial

species and are concerned with sustainable management. A difference is that homegardens, spice gardens and annual horticultural systems focus on enhancing smallholder livelihoods in an environmentally sustainable manner; whereas analog forests focus on ecosystem restoration with livelihoods as the secondary objective.

Smallholder systems are generally successful on their own terms. In most cases, management represents a conscious investment for which farmers forfeit other options. Farmers, generally, simultaneously pursue tree and annual crop cultivation only where these can be properly integrated and maintained. For example, the management practices undertaken to assure good annual crop yields through appropriate cultivation practices, weed control and fertilization also benefit their tree crops. Despite this, most smallholder systems are still suboptimal with regards to management practices and productivity. Farmers are interested to intensify management to improve their productivity and livelihoods but are often unsure where to focus their efforts. Three key problems exist: farmers have limited knowledge of and access to quality germplasm, particularly for tree crops; limited experience and capacity in intensive tree crop management; and limited information on and access to value-chains.

To assist farmers to improve the sustainable intensification of their homegardens, spice gardens, annual horticultural crops and analog forests, this activity will offer a matrix of best-fit 'options by operational contexts'. In other words, the selected 'options' will offer farmers a menu of management practices relevant to their operational 'context'. As conditions regarding land availability and productivity, labor, capital, and other production resources will differ, each farmer can choose and adapt the management options that best-fit their specific conditions. Key options offered will include:

- Enhancing species diversity to reduce climate, biophysical and market vulnerability;
- Strengthening farmers' access to the best-available quality germplasm of priority climate-resilient species, varieties and cultivars that match local biophysical and soil conditions;
- Developing individual and group tree nurseries to empower farmers to independently produce high quality seedlings of priority species;
- Promoting thinning to achieve recommended spacing, removing unproductive trees and ow value species, and increasing the vigor and productivity of the remnant stand;
- Promoting pruning to remove unproductive branches, improve tree vigor and productivity, and increase light levels for understory intercrops;
- Promoting intercropping with annual crops to improve overall system productivity;
- Promoting the production and use of organic mulch and fertilizers to rehabilitate soils, improve water recharge, and produce products for the green economy;
- Exploring the feasibility of drip irrigation for high-value tree crops to improve water use efficiency and increase tree vigor and productivity

This menu of options will remain flexible and dynamic throughout the project period, with additional best-fit options identified collaboratively with farmers and project partners as they are rolled out and their performance evaluated. The options will be offered to farmers through a series of knowledge and capacity building events, including workshops, trainings, cross-visits and field days. The events will be field-focused and hands-on.

Figure 82: Soils in the upstream area

For example, loamy soils are productive and easy to work due to their high porosity (more air space) and well aerated and drained characteristics. Loams can retain moisture to support plant growth as well as nutrients improving the water and fertilizer use efficiency.

Promoting composting within the fields and regular infusions of organic matter to maintain the high organic matter content would provide soil characteristics that are comparable to loam soils.

Figure 83: In-situ composting

The project sub-basin teams will lead the activities with farmer partners and most field activities will occur on farmer's land. Best-fit options selected by farmers will be applied directly in their fields. This will assure that the farmer (or land manager) approves of the options selected and provides validation of the selected options that perform under their actual operational context. These events will be supported by the training methods that will be produced under Activity 3.2.2 and the guidelines and manuals that will be developed under Activity 3.2.3.

Figure 84: Guidelines for conservation in slope areas

The implementation of 'exemplary landscapes' of key interventions will serve a number of purposes: i) sustainable intensification of smallholder production; ii) functional demonstrations of best-fit options; iii) opportunity for farmers to develop innovations; and iv) establishment of venues for future training and cross-visit events. Initial testing of best-fit options on farmers land and in exemplary landscapes is expected to lead to broad requests for assistance from farmer partners, as well as, spontaneous adoption and innovation by other farmers and communities.

This activity will be linked closely and mutually supportive of activities under Output 2.1.

iii) Activity 1.2.3: Restoration and intensification of sustainable plantations

This will include tea, coconut, rubber, timber and large-scale cultivation of spices and will also include development of landscape planning at estate level and the development of food forests to address food security of estate worker families. These workers can expand the type and quality of farming arrangements they have with estate companies to use the landscapes for production purposes beyond their employment. This approach will allow the project to educate the estate workers on best management practices in conservation and land base pollution control while adopting best sanitation and chemical management practices.

Eroded sediments generally contain human waste, fertilizers, pesticides, and improperly disposed industrial waste. These contaminants will mix up with surface water bodies with the retreating flood water and runoff water from adjoining highlands.

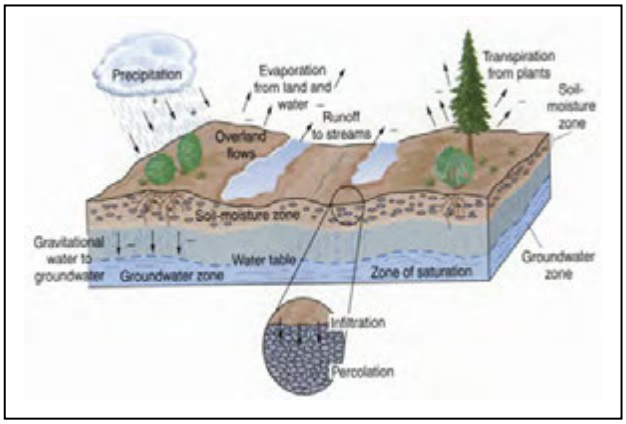


Figure 85: Water cycle

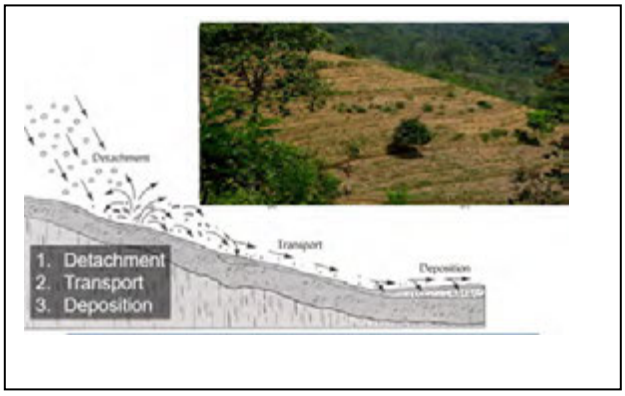


Figure 86: Rainfall impacts on land degradation

The amount of water available for crops in the catchment area depend on the amount of water retained as ground water and surface storage (including the unsaturated zone of soil). Water storage therefore can be improved by enhancing the infiltration of rain water to ground water by project interventions such as a) enhanced recharge through roadside drainage; and b) constructed/repaired surface water holding areas including wetlands.

These stored waters slowly provide water to the downstream paddy and other cultivations in the command area.

In the command area, the water cycle is important to reduce the evaporation, keep water in the surface soils by having a good cover and minimizing water losses due to runoff. Ground water recharging can also happen in the command area and the stored water could be used during the season for drinking and irrigation purposes, minimizing the situation generated from runoff water over the degraded and uncover land areas. The rivers and streams flowing to the downstream areas of the project start/divert from the upper areas of the upper catchment of the project area. In broad, minimization of the sedimentation and siltation through proper land use and land protection activities will directly benefit Government irrigation projects to sustain the investments and serve the original purposes of the development projects.

The Sri Lankan plantation sector cultivates globally traded perennial commodities. The sector is a long-time mainstay of the national economy, a primary employer of the country's labor force,

makes important contributions to the national GDP and is a significant source of foreign exchange. Major plantation crops in the project area include tea, coconut, rubber, timber, spices such as cardamom, cinnamon, pepper, cloves, and nutmeg; and to a lesser extent fruits, vegetables and other food crops, predominantly for domestic consumption. Except for rubber, the country's major agricultural exports experienced growth between the years of 2010 and 2015. Export earnings increased during the same period, with agricultural exports comprising around one quarter of the total.

The plantation sector is comprised of twenty privately managed regional plantation companies and three state owned companies, a board and a corporation. Despite the positive macro-economic outlook, most plantation companies face challenges due to volatile international markets, low productivity, high estate labor costs, restrictions on plantation management practices, and limited access to long-term credit. Many plantations are of a mature age with low productivity and profitability. This condition is further exacerbated by a history of unsustainable land management, which has caused soil erosion, siltation of waterways and has degraded the natural capital of the plantations. As a result, the plantation sector generally lacks financial resources and confidence to invest in rehabilitation or the transformation of their current assets. A closely linked problem is the vulnerability of the plantation workers and their dependent families, whose welfare cannot be improved independently of the economic health of the plantation sector. Downturns in the plantation sector have resulted in under-employment of plantation workers, further stressing this population that was already at the bottom of the formal economic sector. Plantation workers have limited access to land, housing, savings, and basic infrastructure. Their location in remote rural areas allow them limited alternative employment and livelihood options as well.

To assist the plantation sector and plantation workers to achieve restoration and sustainable intensification of the plantation sector, this activity will offer a matrix of best-fit options by operational contexts. As under Activity 1.2.2, the options will offer plantations and plantation workers a menu of management practices relevant to their operational context; and plantations and plantation workers will be able to choose and adapt the management option that best-fit their specific conditions. The options offered to plantations will seek to improve plantation productivity and profitability. This will include the options offered under Activity 1.2.2. Utilizing those options, the project will also work with companies to transform under-performing crops and plantations into food gardens of nutritious and high-value superfood species that target domestic and export demand in the green economy. Those efforts will include the adoption and development of agri-processing technologies for post-harvest value-adding treatment that targets the production of higher-value green economy markets. Potential crops for post-harvest and value-adding processing could include jackfruit, mango, durian, kittul palm, moringa, coffee, cocoa, cardamom, cinnamon, pepper, cloves, and nutmeg. Efforts will also include the intensification of intercropping with high-value short-rotation horticultural crops.

Options offered to plantation workers will focus on strengthening their food security and livelihoods by establishing food forest production systems on land allocated to the workers by the plantation where they are employed. All the options offered under Activity 1.2.2. will be available to plantation workers. Utilizing those options, the project will promote the establishment of diverse multi-species systems that combine perennial and annual crops for plantation workers and their families. Diverse multi-species systems are linked to nutritious diets, enhanced livelihoods for

farmers and climate-resilient farming systems. Further, such systems support dietary diversity and nutrient adequacy, which support the overall micronutrient intake and family health. The combination of perennial and annual crops will provide the best combination of foods with nutrient density, energy content, micronutrients (mineral and vitamins), macronutrients (protein, carbohydrates) and phytochemicals (e.g. antioxidants). Such diverse diets are important to plantation worker families as they are low income earners, have limited access to and ability to purchase nutritious foods, and have limited access to health care facilities.

As in Activity 1.2.2., the options will be presented to plantation companies and plantation workers in a series of field focused, hands-on knowledge and capacity building events, including workshops, trainings, cross-visits and field days. Best-fit options selected by plantation companies and plantation workers will be applied directly in their fields, including the development of strategically placed exemplar landscapes. Training methods that will be produced under Activity 3.2.2. and guidelines and manuals that will be developed under Activity 3.2.3. will support knowledge and capacity-building events. This activity will be closely linked and mutually supportive of activities under Output 2.1.

7.5. Component 2: Secure Financing Mechanisms for Sustainable Land Management

This component is focused on sustaining improved land management through the establishment of **sustainable financing**. This involves two major outputs: upgraded value chains developed with the private sector (Output 2.1) and the establishment of a PES mechanism to transfer value realized back to conservation (Output 2.2).

Figure 87: Traditional medicine in health tourism for value chain development

7.5.1. Output 2.1: Upgraded and Efficient Green Value Chains and Penetration of New Markets

Adoption of sustainable land uses will only endure if they are profitable enough to sustain farmers and plantation companies sufficiently for them to continue. Investments in conservation, agriculture and services with the support from green co-financing along with innovative markets and value-added production and processing activities is the aim of the project.

For example, the agro-ecological characteristics in the upper catchment area as well as the downstream command area supports the cultivation of a range of plant species that have medicinal value. The traditional medicine practices, still widely available are being adopted by the Spa Industry and being linked to medicinal tourism.

i) Activity 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers

This involves the detailed geo-referenced mapping of existing agricultural value chains (cash crops, spices, herbs and fruits) to capture their current lengths (vertical upstream to downstream) and breadths (horizontal links to input and service sectors as well as the National System of Innovation – NSI) as well as the identification of respective intra-governance structures. It will result in a detailed overview of actors, especially weaker actors (women, smallholder and subsistence farmers), their relationship to each other through business models, their physical location in biophysical and socioeconomic systems as well as their placement in the intra-chain governance regime and in the political and macroeconomic systems of governance. This activity will further involve the establishment of modes of regular market analyses and trade regimes, conducive to green production and processing methods as well as products plus an identification of Sri Lanka's agricultural value chains in national/regional/global markets, opportunities of rent appropriation and comparative advantage.

ii) Activity 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands

This involves the development of capacity to operate farms and collective groups as business enterprises. It further involves providing support to actors to set up soft institutions where needed (based on Activity 2.1.1) such as cooperatives, innovation platforms, producer, agri-business and trade associations or chambers of commerce in key foreign markets. Overall, the goal is to identify bottlenecks and inefficiencies along and across value chains, to co-innovate new green technologies and to stimulate the development of new businesses and business relationships to exploit green growth opportunities for smallholders and subsistence farmers adopting sustainable practices. Key to this will be value chain innovation platforms that serve as meeting points of stakeholders, including value chain actors such as smallholders, estates, input providers but also the NSI and Government.

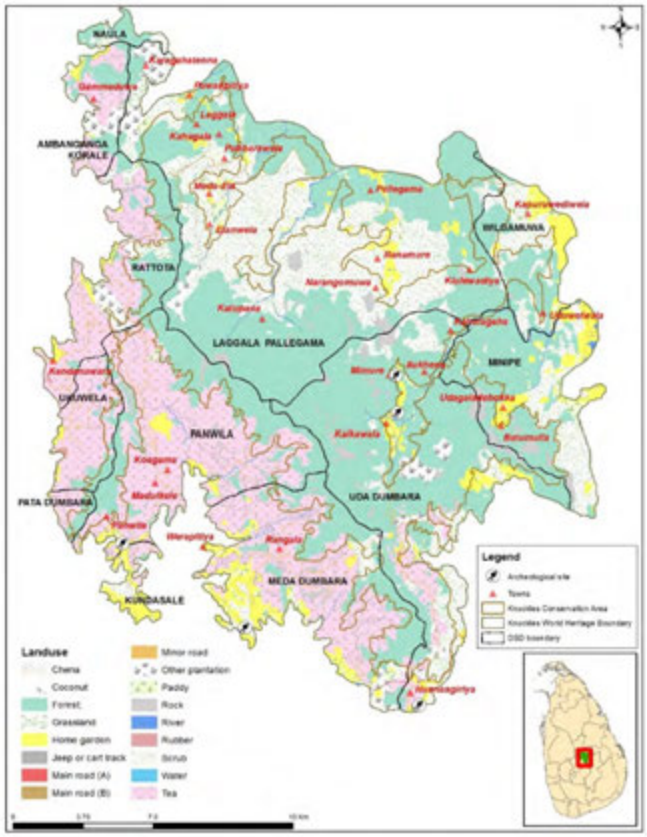


Figure 88: Archaeological sites in Knuckles Conservation Area

Figure 89: Floristic Areas in Knuckles

As an example of green growth programmes, IUCN Green Listing and associated income generation improvements can be adopted, among other value chain improvements using the area-based niche characteristics. Knuckles Conservation Forest (KCF) is a crucial geographical area in the proposed project site. The Knuckles region is a breathtaking landscape consisting of mountains, valleys and a variety of ecosystems and species. Its importance is reflected in the level of protection and international recognition that has been accorded at various times. The Knuckles Conservation Forest, together with the Peak Wilderness Protected Area and Horton Plains National Park (collectively referred to as the Central Highlands of Sri Lanka) was declared a UNESCO World Heritage Site in 2010. In 2000, the Knuckles area was declared a Conservation Forest by the Forest Department and in 2007, its buffer zone was declared as an Environmental Protection Area under the National Environmental Act. Aside from its scenic beauty, Knuckles is a vital watershed in the Mahaweli drainage system. It constitutes 30% of the watershed forest of the Mahaweli catchment, a major source of water for the country's agricultural sector. Further, the newly commissioned Moragahakanda and Kaluganga reservoirs also depend on the watershed of Knuckles conservation forest. These features make KCF an ideal site to introduce IUCN Green Listing process to provide the benefits to communities as a climate resilience measure.

Species diversity related to green listing

The Knuckles forest is an important reservoir for biodiversity and is home to several range restricted and point-endemic species. The wide range of climatic and landscape features in the Knuckles region has resulted in diverse natural vegetation types, ranging from lowland semi-evergreen forests to montane forests. An astounding 1,033 different varieties of plant

species are found in Knuckles, of which about 15% are endemic to Sri Lanka. A total of 391 species of vertebrate animal species have been recorded, which include large mammals such as the leopard (*Panthara pardus kotiya*), Sambar (*Rusa unicolor*), Elephant (*Elephas maximus*) and Purple-faced leaf monkey (*Semnopithecus vetulus*). Of the total vertebrate species, over a 121 species are endemic to Sri Lanka, and also include a large number of threatened species. Range restricted species found in the Knuckles include the Leaf-nosed Lizard (*Ceratophora tennentii*), Knuckles pigmy lizards (*Cophotis dumbara*) and the amphibian species Kirthisinghe's rock frog (*Nannophyrus marmorata*) and Moore's shrub frog (*Pseudophilautus mooreorum*) amongst others. Further, 118 butterfly species, which includes nine endemics have been recorded from Knuckles range. These include two of Sri Lanka's largest endemic butterflies—the Birdwing (*Troides darsius*) and Sri Lanka Tree Nymph *(Idea iasonia*). The Ceylon Tiger (*Parantica taprobana*) is an endemic butterfly species, which lives in higher elevations. Furthermore, 45 species of land snails, 42 dragonflies and seven freshwater crabs are among some of the recorded invertebrates.

The high degree of climatic and altitudinal variation within Knuckles has given rise to a rich diversity of plants. According to published information, a total of 1,033 flowering plant species including many endemic and nature species, have been recorded within the area. Interestingly, many exotic and invasive alien species have also been recorded. Due to its geographical separation from the Central massif, the Knuckles Range and the Mahaweli River Valley contain highland plant species, which have evolved into new species. One such example, is the Knuckles Ilex (*Ilex knucklesensis*), a range restricted species found in the highland areas of Knuckles. Further, species such as *Stemonoporus affinis*, Knuckles syzygium (*Syzygium fergusonii*), *Eugenia hypoleuca* and Grassland yam (*Brachystelma lankana*) are also restricted to Knuckles Conservation Forest.

Ecosystem diversity for green listing

Montane evergreen forests, Mid-elevation evergreen forests, Moist-mixed evergreen forests, Rock outcrop forests, Riverine evergreen forests, Upland savannas, Intermediate upper patana, Rivers, Streams and Waterfalls are natural ecosystems which occur in KCF. Secondary forests are found in areas where natural forests have been previously cleared for cultivation purposes. In addition to these natural ecosystems, semi-natural ecosystems present in the area include Forest plantations—Monoculture (Pinus and Eucalyptus), Pasture lands and Homegardens.

Montane evergreen forests are the natural climax vegetation in the areas above 1,200 MASL. Mid-elevation evergreen forests occur between 900-1,200 MASL in KCF in the vicinity of Riverston, Kabaragala and Cobert's Gap. Most of these Mid-elevation evergreen forests have been degraded due to cardamom plantations and the expansion of tea cultivation during the colonial period. Moist-mixed evergreen forests can be found in the lower elevation of KCF especially in the north-eastern and eastern side of the Knuckles Mountain Range

Cultural heritage, community rights, and livelihood practices

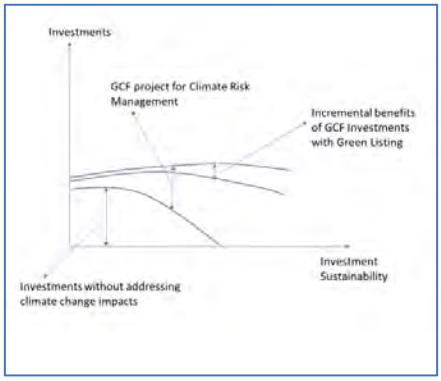
There are many traditional practices and cultural heritage sites and practices in and around Knuckles Conservation Forest. The management authority has taken a very pro-active approach, especially since World Heritage Designation, to engage local stakeholders and reflect their rights

and interests into the governance and management of the site. Local NGOs, such as Dumbara Surakinno, have received support and capacity development to assist in engaging with community leaders and representatives. The most recent management planning efforts included provisions for documentation and restitution of 'traditional wildlife cultural practices' by local communities, including negotiated access rights for certain customary activities within the conservation area. However, the communities near Knuckles continue to suffer from economic hardship during periods of inclement weather, especially through over-production of soils and through irregular rains and water availability for crops such as cardamom. As climate change exacerbates the periods of drought and water availability, there is a need to recalibrate the focus of the protected area protection and management activities into providing more robust means by which communities can benefit from the ecological services that are conserved. New management approaches need to provide more local responsibility in governance and decision-making, more access to emerging markets and economic opportunities, and seek to provide incentives for activities that will enhance the protection of biodiversity and ecological function and also to stimulate the flow of ecosystem services to the surrounding region.

Tourism development, while a fickle industry, could provide a low-impact alternative income source for local entrepreneurs and their communities. Linking local community service providers to an eco-label tourism destination, through a special 'Green List' marketing campaign, could provide an innovative blueprint for protected area-based tourism in Sri Lanka, and worldwide.

The IUCN Green List – setting the standard for nature-based resilience through fair and effective management of climate risks through conservation

The KCF has a great potential of becoming the first 'Green List' site in South Asia. The Green List programme is operational in around 50 countries worldwide, and KCF could be the pioneer for Sri Lanka. The IUCN Green List operates as a Sustainability Standard for protected and conserved areas. The Green List consists of two parts. Firstly, the Standard that describes successful nature conservation success for the challenges of the 21st Century, including climate change. Secondly, the recognition and certification process, or 'Green Listing' for those sites who commit to implementing the standard and can demonstrate that they comply with all the Standard criteria. IUCN assures the process in collaboration with Assurance Services International, but the programme is built on a model of voluntary inputs, stakeholder engagement, and accredited local expert validation. The Green List programme is also compatible with other standard systems, such as the Forest Stewardship Council and Global Sustainable Tourism Council labels but has significantly lower operating costs. This is due to the focus and investment in mobilizing local expertise and national professionals' time and energy, using IUCN's unique Expert Commission structure, rather than implementing an expensive third-party auditing system. In the Green List process, independent reviewers assure the process and encourage credibility principles, but the evaluation is carried out by accredited IUCN Commission experts.



The Green List programme will help incentivize KCF to become a more fairly and effectively managed world heritage site, especially creating a win-win situation for the Biodiversity and

climate-resilience values of KCF and the local communities living in and around the forest. The Green List process will help verify that essential biodiversity and ecosystem services, and their contribution to climate-resilience in the landscape, are being equitably and successfully conserved.

Reducing the impact of climate change in KCF with the IUCN Green Listing approach

The area-based communities can be trained, empowered and engaged in the green listing approach to improve their resilience though better income, improved understanding and alternative livelihoods with compared to the livelihoods contributing to land degradation.

Figure 90: Villages in Knuckles for Green Listing Approaches

Once the Green List label is awarded to the protected area, it will be used to actively promote the support and participation of local actors in relevant sectors and value chains. It will also underpin the sustainability credentials and premium value of local services and products. Local stakeholders such as non-governmental or civil society organizations directly supporting the protected area to achieve successful conservation outcomes will be empowered to use the Green List logo as a 'supporting partner' or a community enterprise producing a sustainably harvested or farmed product permitted in the buffer zone of a protected area. This will support their activities by benefiting from better confidence from the public (eg: tourists interested in visiting the area).

Specifically, the project will provide the Green List label to local tourism providers and community-based entrepreneurs, through a platform facility linked to sustainable and ecotourism promotion for the Green Listed sites in Sri Lanka. This will allow local providers the chance to market their services as compatible with, and contributing to a 'Green List' destination. The premium value added to the label will dovetail with site-based mechanisms that also equitably share more centrally-collected tourism benefits, such as entrance ticket sales, produce and souvenir outlets, and green fees, also linked to supporting the Green List label.

In the process the project will have several incremental benefits including:

- Concepts such as Eco-tourism, ecological farming, biodiversity agriculture etc. could be practiced and will make the conservation efforts more sustainable, and the Green List process can help monitor the impacts on the core values of KCF.
- Green Listing has great potential of leveraging private investments and also attracting more international tourists through IUCN destination promotion, especially the green listed

sites. While the authorities have advantages of standard maintenance, they can think about finding ways to improve infrastructure for tourism in KCF without harming the core environmental and biodiversity value of the destination.

- Make GCF investment safer through green listing of KCF. Also this will enhance the investment efficiency such as applying to green listing, technical awareness to the authorities, developing indicators and reviewing management plans, monitoring the practices and IUCN evaluation and awarding of Green Listing are not significant in financial terms but it has a great potential to multiplying the benefits and institutional capacity.
- Having Green Listing logo in site promotion campaigns is immensely helpful especially in gaining competitive advantages. This is important not only as a global tourist destination but also as a better destination among locally promoted destinations as well. In macro view of tourism development in Sri Lanka, the benefits for the host communities are considered as strategically aimed benefit. Therefore, at a time when the host communities are suffering from climate risk enterprises and agriculture, establishing livelihoods surrounding the KCF is a great achievement in socioeconomic context of the country.
- Promoting KCF as a green listed destination will popularize the brand name “Knuckles“ or “the misty mountains” that can be used for many enterprise development initiatives to be planned in the project especially related to Component 2. The Green Listing programme will bring a focus on branding and promotion of the site’s commitment to certified conservation.
- Conflict resolution through improved dialogue on good governance, negotiated access and rights-based approaches for local communities.

Key interventions of the project	**Contribution of Green List Standard and Process to KCF**
Restoration of forest mosaic landscapes (Activity 1.1.3)	The Green List Standard prioritizes good governance and sound design and planning, especially for the role of a protected area in providing biodiversity and ecosystem service values within the landscape context. Consideration of both of these components by KCF management will enable a more informed dialogue with local stakeholders on the needs and incentives for reforestation, and to seek their help to identify the location, technical provisions and species composition for restoring habitat, under a climate change scenario. With community engagement and active participation, the opportunity for longer-term maintenance and adaptive management of these restored areas becomes greater.
Domestic value chain mapping and green market assessments for products specially from smallholder and subsistence farmers (Activity 2.1.1)	The Green List standard requires that protected areas contribute to the social and economic situation of local communities, compatible with nature conservation values. Understanding the socioeconomic context is a key approach of green listing that will lead to effective management of KCF specially to manage social and economic benefits. This will strengthen the detailed geo-referenced mapping of potential agricultural value chains (cash crops, spices, herbs and fruits) and let the community receive access and benefits, for example, through negotiated rights for NTFP collection. The incentive of the Green List, and the credibility of an IUCN

	Standard, help open dialogue with administrators and authorities in issues of improved governance, access and rights-based approaches – with the reward of global recognition and certification for the political will of local leaders in promoting change.
Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands (Activity 2.1.2)	Enabling the adjacent and forest inside living communities to engage in community led forest management, which is fulfilling the guarantee legitimacy and voice of the people as a part of good governance. This can be through formation of community organizations who also involves the development of own capacity to operate farms and collective groups as business enterprises.
A PES intermediary body as a part of the multi-stakeholder platform, and its governance system established (Activity 2.2.2)	KCF is a critical area for receiving support from the PES schemes to be introduced by the project. The conservation and restoration work funded by PES are to be monitored and the progress is to be captured. The process of Green Listing will contribute to the monitoring of this biodiversity conservation, restoration, and climate adaptation interventions inside KCF. The verified outcomes of ecosystem service provisions, independently assured, provides the necessary assurances for PES transactions. The Green List is the best in class standard system for PES involving protected areas.
Develop an integrated land use policy and planning mechanism at sub-basin scale (Activity 3.1.1)	KCF belongs to the Mahaweli River Basin with sub basins Abanganga, Kambarawa ganga, Middle Kalu Ganga, Heenganga etc. The land use changes to adopt with the climate change will take place in these areas with more attention towards conservation of KCF, especially the forest buffer zones. The selection of crops, irrigation arrangements and agriculture inputs are critical areas to pay attention. The process and maintenance of green listing standards will encourage a pro-active integration of KCF conservation objectives within the context of the broader landscape. KCF will need to demonstrate that management is actively considering the benefits—ecological and economic—to land use and sustainable production in the adjacent areas of KCF.
Develop a shared information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options (Activity 3.1.2)	Both agriculture and tourism related developments led by community to be linked with the SHARED system. This information is to be passed to buyers and potential markets, at the local and international levels. The value of Green Listing certification will have a competitive advantage to wider communities in the Knuckles mountain range. Green List data is stored in a compatible system, using a salesforce.com data platform. APIs from this platform can be linked to other data systems, such as the SHARED system, allowing a two-way flow of data and information to support continued progress against the Green List standard through tourism and agricultural developments.

iii) Activity 2.1.3: Identification and Implementation of Value Chain Upgrading Options for Smallholder and Subsistence Farmers Engaged in Climate Smart Agriculture

This involves the joint analysis (linked to Activities 1.2.1-3) and pursuit of meeting buyers' critical success factors; and of value chain upgrading options with respect to products, processes, functions, inter-sectoral relationships, institutions (link to Activity 2.1.2) and new (green) technologies to achieve greater value chain efficiencies and market penetration of existing value chains; the participation in new value chains and/or the exiting from unprofitable or environmentally unsustainable value chains. For example, new products and services will be developed as well as a more targeted branding of existing products will be undertaken focusing on their sustainable and equitable production or further processing. It can also involve the establishment of a Green Sri Lanka national brand and obtaining appropriate third-party certification and quality assurance.

Standard Certifications available in Sri Lanka

Rainforest Alliance: The Sustainable Agriculture Network (SAN) has given the Rainforest Alliance an exclusive and perpetual license to the 2017 SAN Standard. It focuses on environmental, social and economic criteria. The Rainforest Alliance authorized certification bodies audit farms and ensure that not only do the farms adhere to the standards mentioned in the standard but will also ensure that traceability of Rainforest Alliance certified products to the groups and communities which source the raw materials is intact. This traceability from farm to the trading/manufacturing/warehousing stages is assured via the Chain of Custody Certification (CoC). The CoC is recognized by both the Rainforest Alliance as well as the certification system

UTZ Certification: UTZ certification shows consumers that products have been sourced, from farm to shop shelf, in a sustainable manner. To become certified, all UTZ suppliers have to follow their Code of Conduct, which offers expert guidance on better farming methods, working conditions and care for nature. The standard operates through two sets of guidelines a) Code of Conduct (which covers the growing and harvesting process), and b) Chain of Custody (which covers products from the moment they leave the farm to when they arrive on the shelves).

Sri Lanka Tea Board CQC Programme: The Ceylon Tea Quality Certification (CQC- QMS) programme by Sri Lanka Tea Board involves compliance with the principles of Japanese 5S and Kaizen.

Society General Surveillance (SGS): SGS is a world's leading certifying body which is recognized as a global standard for quality and integrity. It carries out inspection and verification services, such as checking the condition and of traded goods at transhipment, helping the organizations to control quantity and quality, and meeting all relevant regulatory requirements across different regions and markets. And it enables organizations to reduce risks, shorten time to market and test the quality, safety and performance of products against relevant health, safety and regulatory standards. SGS certification demonstrates that the products, processes, systems or services are compliant with national, international or customer defined standards and covers the entire supply chain from raw materials to final consumption.

Good Agricultural Practices (GAP): Good Agricultural Practices (GAP) are activities that would take place at the farm level to ensure that food safety during pre-production, production, harvest and post-harvest stages are ensured. The standard considers environmental, economic and social dimensions of the production systems. The four pillars of GAP are a) Food safety and quality; b) Economic viability; c) Environmental sustainability; and d) Social acceptability. The GAP modality ensures sustainable agriculture and EDB provides the necessary support to farmers to obtain GAP certifications.

Fairtrade: Fairtrade certification is a product certification designed to allow people to identify products that meet agreed environmental, labour and developmental standards. Overseen by a standard-setting body – FLO International and a certification body FLO-CERT, the system involves independent auditing of producers to ensure the agreed standards are met.

Sri Lanka Standards Institution (SLSI) Certification: Sri Lanka Standards Institution (SLSI) in association with the Sri Lanka Tea Board (SLTB) operates a Product Certification Scheme to certify the manufacturing process and the final product (i.e. Black Tea). SLSI – SLTB: Product Certification Scheme for Tea (PCST) is designed to meet the specific needs of the tea plantation sector and to provide an internationally recognized third party guarantee to customers. The scheme is centered around essential elements of the Quality Management System combined with additional requirements on process control and product testing as specified in the relevant standards along with applicable legal requirements.

Hazard Analysis & Critical Control Points (HACCP): Hazard analysis is a basic aspect of an effective food safety management system, since conducting a hazard analysis assists in organizing the knowledge required to create an effective combination of control measures. Knowing that, ISO 22000 integrates the principles of the HACCP system and application steps developed by the Codex Alimentarius Commission. By means of auditable requirements, it combines the HACCP plan with prerequisite programmes. HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product. HACCP is referred as the prevention of hazards rather than finished product inspection.

ISO 22000: 2005: ISO 22000 is an international standard specifying the requirements of a food safety management system covering all organizations in the food chain from "farm to fork" and where we are concerned – from "bush to cup". It is all about managing food safety risks across the food supply chain. **The standard combines generally recognized key elements to ensure food safety along the food chain including** a) interactive communication; b) System management; c) Control of food safety through pre-requisite programmes; d) HACCP plans; e) Continual improvement and updating of the food safety management system.

Forest Stewardship Council (FSC): The Forest Stewardship Council (FSC) has introduced as international labeling scheme for forest products, which provides a credible guarantee that the product comes from environmentally responsible, socially beneficial and economically viable sustainably managed forest.

Tea Research Institute (TRI): The Tea Research Institute (TRI), since its inception in 1925, has been the leading national body in Sri Lanka for generating and disseminating new technologies related to tea cultivation and processing. The TRI act was approved in parliament in 1925 and the TRI was established under this legislation.

The Sri Lanka Export Development Board (EDB): EDB established the National Organic Control Unit (NOCU) under the regulations published under section 29 of the Export Development Act No. 40 of 1979 in the extraordinary gazette no. 1870/71 dated July 11, 2014. The main function of NOCU is to protect the credibility and of Sri Lanka's organic enterprise. The Sri Lanka Export Development Board (EDB) lists seven international certification agencies which are currently in operation within the country, namely, a) Control Union (SKAL, Netherlands); b) Institute for Market Ecology – IMO, Switzerland; c) NASAA, Australia; d) Naturland, Germany; e) EcoCert, Germany; f) Demeter and BioSuisse, Switzerland; and Organic Farmers and Growers Ltd, United Kingdom.

Other forms of organic certifications: Include Participatory Guarantee System which is a form of certification provided by the Good Market – an entity managed by NGO Sevalanka; SriCert - a locally recognized organic certification agency; and Naturland – a German international body active in Sri Lanka. In addition, in tea sector the "Ethical Tea Partnership" is a scheme supporting producers and smallholder farmers who are part of the supply chains to understand the importance and work towards obtaining recognized standards.

EU - Regulation EEC No. 834/2007 of Organic Production: Organic imports into the EU need to have a Certificate of Inspection through the IT tool named **TRACES** which the EU commission uses. This certificate ensure that the products are free of genetically modified organisms (GMO) and synthetic substances. During the production chain, organic and non-organic products are clearly separated and contamination across these two categories are prevented. The whole chain of the organic production needs to be certified in order for the final product to receive this certification (Control Union, no date a). Control Union is able to issue this certification.

USDA – National Organic Programme (NOP): The NOP is a regulatory programme functioning within the United States Department of Agriculture (USDA) Agricultural Marketing Service and involved with providing the standards to which organically produced agricultural products should adhere. NOP explicitly does not address concerns about food safety or nutrition. USDA has accredited Control Union Certifications for the NOP.

Japanese Organic Regulation (JAS): The JAS (Japanese Agricultural Standard) System is based on the Law Concerning Standardization, etc. of Agricultural and Forestry Products (Law No.175, 1950) which governs all the agricultural and forestry products, except for liquors, drugs, quasi-drugs and cosmetics. The JAS System refers to the certification system to attach the JAS marks to the products inspected in accordance with the JAS established by the Minister of Agriculture, Forestry and Fisheries. The JAS are voluntary other than JAS Standards for Organic Foods.

The activity also involves the improvement of production, harvesting, post-harvest management, storage and transport technologies and the co-innovation of new technologies along the lines of green value chain principles. Furthermore, it involves the creation of new markets for novel products such as sweet dwarf mangos, superfoods and Ayurveda products, which will be offered specially to smallholder and subsistence farmers to help them to "climate proof" their livelihoods.

7.5.2. Output 2.2: Payment for Ecosystem Services (PES) Mechanism

Operational PES schemes that have endured, have invariably had a strong scientific basis and intensive facilitation, involving a series of inclusive and fair negotiations among related stakeholders, for the design, implementation, monitoring and evaluation of the scheme. Lessons from Asian countries are applicable for implementation of new PES modalities in Sri Lanka. PES as a voluntary transaction, negotiated among private entities has been superseded by the implementation of conceptually similar but broader schemes, characterized by the involvement of and mediation by national and sub-national Governments acting to connect those who benefit from and those who protect ecosystem functions. This broader definition of PES may include direct payments through public funds, by public authorities, to private land owners in order to maintain healthy watersheds or restore degraded land. In this project, a portfolio of business cases and workplans for local partners will be developed to increase awareness and urgency to protect the degraded Knuckles upstream watershed area, trigger collective responsibility and actions, and enable joint investments (financially and non-financially) among stakeholders. The governance set-up of PES involves putting in place the financial and advisory support required to sustain climate adapted best practices in the upstream catchment. There is a clear potential to implement PES for the Knuckles area catchment as the Government of Sri Lanka is committed to implementing a PES modality, initially based on revenue from micro-hydro power generation to provide incentives to maintain best practices in terms of catchment protection.

i) Activity 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms

A robust socioeconomic and ecological baseline and supporting information will become the core for evidence provisioning the ecosystem service (output-based payments) and address additional concerns to reduce the cost of policy implementation. This comprises the basic appraisal of ecosystem services (ES) that are economically valuable and ES providers practicing environmentally protective best practices in the upstream catchment, including their livelihood options and local conservation knowledge. Information on ecosystem services and solutions for ES provisions will be linked to spatially explicit assessments and interventions of land degradation (Activity 3.1.2), and locations for prioritizing PES schemes will be determined based on integrated land use planning at sub-basin scale (Activities 3.1.1). Potential smallholders as PES participants will be selected by considering their opportunity costs, farming systems and other socioeconomic profiles by applying behavioral economic methods, such as reverse auctions. Payment modalities will be discussed and consulted with both providers and beneficiaries. Options and values of revenue from ES beneficiaries, such as hydropower companies and large-scale water users, will be determined based on a watershed valuation process, negotiation and policy analysis of possible revenue collections when engaging public entities. An incentive-based scheme, such as PES, synergized with relevant development programs (linked to Output 2.1) will become an alternative sustainable finance for activities 1.1.1, 1.1.2 and 1.1.3 (as a key element of the exit strategy).

ii) Activity 2.2.2: Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established

The potential roles of PES intermediary bodies include information exchange, program design, upscaling and replication, networking, representation and mediation, administration and coordination of PES programs, including payment collection, financing, distribution, performance monitoring and evaluation. The intermediary body will be a committee within the nested-multi-stakeholder platform (Activity 3.3.1) and involve establishing adaptive rural advisory services (RAS) facility to support adoption of catchment protection practices (including implementing regulations from Activity 3.1.1 as well as prioritized promotion of best-fit practices, matched to local context. Intensive facilitation from the intermediary body will be essential to ensure that the committee members understand their roles, have sufficient capacity, and are able to monitor, evaluate, upscale and replicate PES (linking to Activity 2.2.3).

iii) Activity 2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area

Initiated by participatory scoping of watershed problems, criteria and indicators for PES that are contextual for each PES scheme will be developed together with the multi-stakeholder forum members. A monitoring system for PES schemes will comprise of both socioeconomic and ecological criteria and indicators by considering SDG and other national commitments to global goals, such as the Sri Lanka Nationally Determined Contributions (NDC) and National Adaptation Plan (NAP). Practically, the monitoring system will also determine the performance of ES providers in accessing the payment, financially and non- financially. Moreover, a series of capacity strengthening activities will be conducted for local stakeholders to strengthen their capacity to monitor, evaluate and develop further relevant criteria and indicators, when there is a need to modify existing, or establish new PES schemes in the future.

7.6. Component 3: Institutional Capacity Strengthened

This component focuses on the provision of **institutional support** to enable farmers and other landowners in the upstream catchment and downstream command area to adapt their land use to climate change, in order to make their livelihoods and landscapes more resilient.

7.6.1. Output 3.1: Governance Mechanism for Sustainable Land Management and Productivity Enhancement in the Upstream Catchment Area

Successful governance mechanisms require institutional ownership and support for inclusive and cross-sectoral planning and decision-making processes that are evidence based, taking into account up-to-date, relevant and readily accessible environmental, social and economic information. This involves institutional and multi-stakeholder coordination and engagement that bridges diverse stakeholders and sectors in a coherent way. Implementation teams that represent a sub-basin multi-stakeholder innovation platform relevant to the needs of the location with contextualized compositions according to the relevant Government, civil society and private sector actors at each location, and identified through stakeholder mapping, will be set up during this activity. These teams will develop integrated land use plans for the sub-basins using

Figure 91: Flow and sediment monitoring for PES

information systems that support land use planning. The units will also co-ordinate implementation of the PES mechanism locally and the implementation of climate-adapted land and water management options at local GN level. Local level innovation platforms will be constituted within the existing GN structures to ensure a participatory 'grassroots'-based co-design and local adaptation of options.

Indicators for PES computation will use state-of-the -art monitoring and modeling approaches that will include bi-weekly sediment and daily flow measurements at selected locations in the project area.

Sediment load estimates on weekly basis will be conducted using US Army Crops of Engineers Flux Load estimation model as done in the Kelani River Basin (IUCN, 2016)[26]. The variation of the sediment loads will indicate the effectiveness of the conservation practices. As such the project will setup flow and sediment monitoring systems at sub-basin level locations and engage schools, universities and sub-basin teams in data collection. The same teams will be engaged with interpreted data, so the impacts of good practices will be communicated to the stakeholder entities, scientifically.

i) Activity 3.1.1: Develop an Integrated Land Use Policy and Planning Mechanism at Sub-Basin Scale

To build robust institutional support for integrated land use policy and planning mechanisms at sub-basin level, the Stakeholder Approach to Risk Informed and Evidence Based Decision Making (SHARED) methodology will be used to co-design and implement an inclusive and evidence-based planning process across non-congruent hydrological and administrative boundaries; and this will also involve the development of an integrated land use policy based on the observed land degradation related indicators. The SHARED stakeholder engagement process will involve multi-stakeholder workshops that bring together relevant sectors and stakeholders, including District Secretariat, representatives of key local agencies, private sector, plantations and farmers organizations. This will include stakeholder networking, causal and outcome mapping, reviewing of existing decision-making cycles and structures and the formulation of desired outputs. The workshops will be used to co-design information systems and define capacity, governance and information needs for each sub-basin implementation unit. The

[26] IUCN (2016). Kelani River Basin Multi-Stakeholder Partnership Approach - https://goo.gl/s7FCWh

workshops will provide effective formats for land use planning, regulatory and incentive measures and capacity development to enhance integrated, evidence-based land use planning and policy development.

To carry out this activity and ensure long term sustainability, five new governance structures (implementation teams) will be developed and will be put in place to integrate across non-congruent administrative (Divisional Secretariat - DS) and hydrological (sub-catchment) boundaries as follows:

- The five sub-catchments on the east of the target catchment area (Amban Ganga, Puwakpitiya Oya, Thelgamu Oya, Kalu Ganga and Knuckles Ellewana Kanda Eastern Slope). These are well connected to one another and embrace the large DSs of Lagalla Pallegama and Wilgamuwa and the larger eastern part of the Naula DS (the rest is part of 3 below). Much of the area is less degraded than other parts of the overall catchment so the density of intervention is anticipated to be lighter than in other sub-basin units.
- The upland part of the Sudu Ganga sub-catchment including the Rattota and Ambanganga Korale DSs.
- The lower part of the Sudu Ganga sub-catchment including the Ukuwela, Matale and parts of Akurana and Naula DSs
- The Nalanda Oya sub-catchment embracing Pallepola and Yatawatta.
- The Heen Ganga and Hasalaka Oya sub-catchments in the south, comprising Udadumbara DS and part of Minipe DS.

The implementation teams will represent a sub-basin multi-stakeholder innovation platform relevant to the needs of the location/sub-basin, with contextualized composition according to the relevant government, civil society and private sector actors at the location (linked to Activity 3.2.1). They will develop land use plans for the sub-basin, based upon co-designed information systems with customized dashboards (Activity 3.1.2) that comprise both socioeconomic and biophysical information while providing a framework for monitoring the progress over time. Measurements done in-situ, climate and market real-time data and results obtained from laboratories on ground level samples by the project teams will be used to engage the stakeholders. For example, in the Kelani River Basin, community engagement with water quality suitability (drinking, bathing and aquatic life) have been used successfully with measurements on pathogens (sanitation practices), Nitrogen and Phosphorus (agriculture), Chemical Oxygen Demand (pollution of metals) and Biochemical Oxygen Demand (eutrophication related to low oxygen due to land based pollution) have been computed to illustrations (as in the figure) that communities can understand.

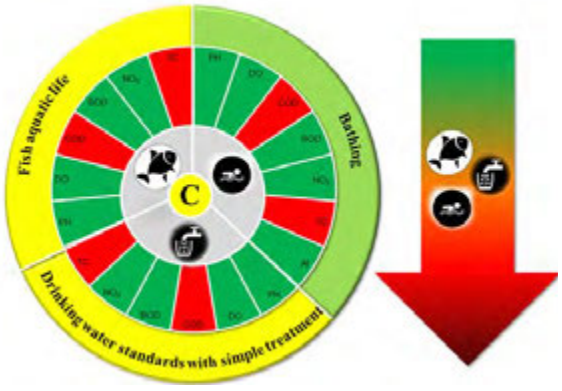


Figure 92: Water quality in land use planning

The implementation units will also co-ordinate the implementation of the PES mechanism, locally and the implementation of climate-adapted land and water management options at the local GN

level where local level innovation platforms will be constituted within existing GN structures to ensure a participatory 'grassroots' based co-design and local adaptation of options.

ii) Activity 3.1.2: Develop the SHARED (The Stakeholder Approach to Risk Informed and Evidence Based Decision Making) Information System to Support Land Use Planning, Climate Adaptation, Market Information and Monitoring of the Performance of Intervention Options

Information systems that can readily support integrated land use planning and adaptive implementation must house the relevant information while being both visually and virtually accessible. The information systems will be co-designed so that end users have significant input into the content and display of information. The customized systems will include high resolution landscape level socioeconomic and biophysical baselines along with other relevant and available information.

The information system will involve developing spatially explicit assessments of land degradation that are critical for the development of effective adaptation options and targeting interventions, while also providing a framework for monitoring the progress over time. This will comprise a landscape portal with dashboards; and establishment of a high-resolution baseline for planning and development of Apps enabling two-way grassroots interaction with the information system. One Land Degradation Surveillance Framework (LDSF) site will be established in each sub-basin implementation unit. The LDSF is being applied for assessments of land degradation processes, soil health and ecosystem health, more generally, in over 40 countries, especially in the global tropics, as part of the Ecosystem Health Surveillance Framework (EcoHSS) developed by ICRAF. By providing a robust indicator framework, advanced analytics and diagnostics (models), this framework will be key to the development of spatially explicit interventions to protect and restore ecosystem functions and adaptations. Land degradation hotspots (e.g. soil erosion and compaction) and soil health variables (e.g. soil organic carbon) will be mapped at high spatial resolutions (10 to 30m), by combining data collected from the LDSF sites with data from the global database. These assessments will build on national level assessments of erosion and SOC completed during project preparation, at moderate spatial resolution, and were developed using MODIS satellite imagery to assess changes in these indicators over the decade from 2002 to 2012.

iii) Activity 3.1.3: Development and refinement of SLM framework

This Activity will synthesize the SHARED information system to support land use planning, climate adaptation, market information and monitoring that will be developed under Activity 3.1.2. with the nested-scale multi-stakeholder innovation platforms for facilitating participatory engagement at the GN level that will be established under Activity 3.3.1.

Options (O) are what farmers, communities or others can do differently. The **contexts** (C) are the social, environmental and institutional situations of each stakeholder. "Option by Context Interactions" **(OxC)** is shorthand for the core empirical facts that:

a) for this area of Sri Lanka, contexts are very variable, whether considering individuals, farmer households, farms, rivers, forests or any other element of the landscape, and

b) suitable, valuable and acceptable options depend on context. Hence, while the principles to be applied may be applicable in much of the project area (eg “Increase rice cropping intensity”), the details of exactly how to do this will depend on the specific contexts where it is practiced, being adapted to local needs and constraints.

The OxC framework describes the process of design and implementation of these diverse and adapted options.

The Core 4 framework is the general scheme for implementing the OxC approach. It can be used for all aspects of the project that require intervention on the ground (water, crops, forest, value chains). The four steps are:

- Diagnosis: compiling information from available sources on the specific problems, where they are and who they affect.
- Principles: assembling the ideas and knowledge that can be brought to bear the problem.
- Local adaptation: putting the principles to work, usually requiring testing of alternatives using an action research or planned comparison approach.
- Scaling: putting the lessons learnt to work in more areas for more people.

The inputs to each of these stages are also summarized in Core 4 Framework. The outputs of each stage inform the next and lead to the project outputs, particularly 1.1 and 1.2. They also contribute knowledge products that can be used beyond the project.

The SHARED information system will provide high resolution landscape level baseline information for planning and implementation of activities and provide two-way interaction between land managers (smallholder farmers, plantations, local governments) and the project management. The information system will be compromised of both socioeconomic and biophysical data. This information system will be utilized by the GN level multi-scale stakeholder platform development preliminary lists of management options that are relevant to land managers (smallholder farmer, plantations, and plantation workers) and operational contexts. When compiling the preliminary menu list, emphasis will be place on SLM, sustainable intensification and achieving economic objectives of land managers. The preliminary list will be reviewed and revised by project partners with expertise in smallholder and plantation systems. The revised list of management options by operational context will be used in Activity 1.2.2 and 1.2.3. Feedback from smallholder farmers (Activity 1.2.2) and plantations companies and plantation workers (Activity 1.2.3) will be conveyed back to project partners involved in this Activity to enable refinement of the process used to develop the preliminary list of land management options.

7.6.2. Output 3.2: Integrated Rural Advisory Capacity Responsive to Developing Knowledge Base, Real Time Weather and Market Information

Current advisory capacity in the area can be improved significantly to results in a better informed well coordinated climate smart management system which will contribute to the overall objectives of the project.

i) Activity 3.2.1: Establishment of Nested-Scale Multi-Stakeholder Innovation Platforms from Sub-Basin to GN Scale

A key element of resilience enhancement of communities and ecosystems includes the engagement of relevant and diverse stakeholders across scales in the adaptation planning. This is aided through the utilization of online dashboards and structured engagement to facilitate stakeholder interaction and interrogation with evidence. Understanding how various stakeholders interact with each other, as well as obtain, share and utilize information/evidence in prioritizing practices that minimize potential negative environmental impacts is key to developing context-appropriate innovation platforms. For example, the SHARED process includes the co-development of online dashboards to provide an opportunity for stakeholders to visualize and assess the multiple dimensions of climate resilient agriculture, for example:

a) root-causes of key constraints (barriers) to adoption,
b) stakeholder networks and their connectivity, i.e., to inform upscaling activities;
c) prioritization of options by women, men and youth; and
d) important trade-offs between environmental impact and increased agricultural production.

In addition, the dashboard visualizes indicators of land health and climate variability in project areas to better understand and identify biophysical constraints. The SHARED methodology will be applied to engage stakeholders to integrate key insights, design suggestions, and visualizations for the appropriate end users. This will be initiated at the SHARED workshops, where specific interactive exercises will guide decision makers through a design process from conceptualizing key themes, grouping of themes into appropriate modules, based on decision making hierarchies and processes and with a commensurate process for prioritizing data, indicators and visualization options.

Based on priorities of the location, terms of reference will be established. Each will have a different composition according to the relevant government, civil society and private sector actors at the location. Multi-scale stakeholder innovation platforms will be linked across sub-basins to share information and learning related to adaption practices, innovations and the basin teams will interact with information systems through two-way apps and face to face opportunities. These will allow interactive learning and sharing down to the GN level. The multi-scale innovation platforms are key to co-design and the refinement of adaption options with farmers and land users.

The dashboards are designed from the outset using open source data and hosted on the ICRAF GeoScienceLab Landscape Portal (landscapeportal.org). This is to ensure scalability and to access spatial datasets stored with the portal. The open source, real time updating in the dashboard design is intended to ensure that users across national to local scales can access the data, with linked functionality and access on mobile devices. The open source principle in the dashboard design also intends for the dashboards to be embedded into decision-making processes, therefore, ensuring access and functionality beyond the life of the project.

ii) Activity 3.2.2: Develop local capacity for adaptive and sustainable land management

This activity addresses key capacity developments required across for Government to connect bottom up methods that ensure feasible options are developed; and top down rural advisory service RAS mechanisms that are required to make them, are widely available. This requires developing capacity to be able to operate a responsive and evidence-based rural advisory service that can incorporate developing knowledge and real-time information about changing conditions in the short-term (such as weather or pest outbreaks) and long-term (such as suitability of tree species in the context of climate change). The purpose of **training** is to ensure that all involved personnel are able to use the framework and tools (see 3.3.3). Training is needed at three levels;

- Project managers and principles, who need to understand the concepts and approaches being used. Short face-to-face training events are sufficient.
- Field officers who are responsible for implementing field activities. These will primarily be training-of-trainer events, requiring face-to-face events and distant backup.
- Farmers and others who will adopt new practices. These training events are conducted by those in the previous group.

iii) Activity 3.2.3: Development and production of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options

The adaptive and responsive options by context framework employed in the project requires simple guidelines and tools that make it easy for it to be taken up and used. The **tools** that will put the options by context framework into practice will be assembled from existing sources (mainly steps 1 and 2 shown in the Core 4 Framework in Activity 3.1.3) and developed specifically for this project (mainly steps 3 and 4 shown in the Core 4 Framework in Activity 3.1.3). They will consist of guides, checklists and frameworks for,

- using the data compiled from external sources or generated in previous stages;
- analyzing and interpreting the data; and
- making decisions on options to promote in particular circumstances.

Where appropriate, tools will be developed as interactive Smartphone Apps capable of suggesting likely options for situations utilizing georeferencing in the smartphone with information held in the information system that will be developed in 3.1.2. Information may include real-time weather and market information in addition to advice that they have been tried out in the project area. See for example the tree-finder App developed for Africa that shows the user data on the distribution of indigenous tree species in the natural vegetation type where the phone is located, combined with information on the products and services that different tree species can provide. It provides local community members, government agencies, private land owners etc. the information they need to select the appropriate tree species for the landscape restoration or agroforestry effort.

Section 8: Financial and Economic Analysis

8.1. Context

This economic analysis is related to the benefits that will be provided by the proposed project to the smallholder and subsistence farmers by

- improving their resilience related to farm and land management practices; and
- improving underlying ecosystems in the Knuckles/Amban ganga watersheds through participatory climate-smart landscape management while improving water availability to farmer families in the lowland command area at the same time and protecting and improving the public investment in the Moragahakanda multipurpose irrigation scheme.

As such, the GCF investment proposed will address observed increases in temperatures, changes in rainfall frequency and intensity, and extreme events that are causing extended droughts, frequent floods, landslides, and silting of reservoirs, which increase the vulnerabilities of small-scale farmers, plantation operations and the nature ecosystems on which they depend.

8.2. Methodology

8.2.1. Benefit Streams of the Investment

For the economic analysis, based on the 18 project interventions (Please see Annex: Outputs and Activities) identified though stakeholder consultations (Section 7), secondary information (Sections 2 and 4), and climate impacts (Section 3), the contributions of the 18 activities were grouped into five (5) broad benefit areas or benefit streams.

Table 38: Linkages GCF project activities to economic benefits

GCF Project Activity number (Section 7)	Benefit Stream (Economic)
1.1.1. Streamside protection and drainage management along roads	**Benefit Stream 1**: Reducing the impact of erosion and sediment on major reservoirs benefiting smallholder farmers to obtain the maximum usage of public investments
3.1.3. Development and refinement of SLM framework	
1.1.2. Rehabilitation and establishment of village tanks, ponds and irrigation networks	**Benefit Stream 2**: Water management and agriculture support for subsistence and downstream farmers for better productivity and to cope with climate induced economic damages
1.2.1. Increasing cropping intensity of irrigated rice in both upstream and downstream areas	
1.2.3. Restoration and intensification of sustainable plantations	
3.1.1. Develop an integrated land use policy and planning mechanism at sub-basin scale	

3.1.2. Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance	
3.2.1. Establishment of nested-scale multi-stakeholder innovation platforms from sub-basin to GN scale	
1.2.2. Intensification of Sustainable smallholder production	**Benefit Stream 3:** Upgrading of the value chain to support subsistence farmers
2.1.1. Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers	
2.1.3. Identification and implementation of value chain upgrading options	
2.2.1. Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms	
3.2.3. Development and production of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options	
1.1.3. Restoration of forest mosaic landscapes	**Benefit Stream 4:** Forest conservation, community forestry and tourism development
2.2.2. Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established	
2.2.3. Establish a monitoring system for PES schemes in the upstream catchment area	
2.1.2. Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands	**Benefit Stream 5:** Strengthening community-based organizations
3.2.2. Develop local capacity for adaptive and sustainable land management	

8.2.2. Assumptions Used in the Economic Analysis

Number of assumptions have been used to arrive at the financial numbers in the economic analysis as explained below. In order to do so, five benefit streams have been identified based on the project design (results chain).

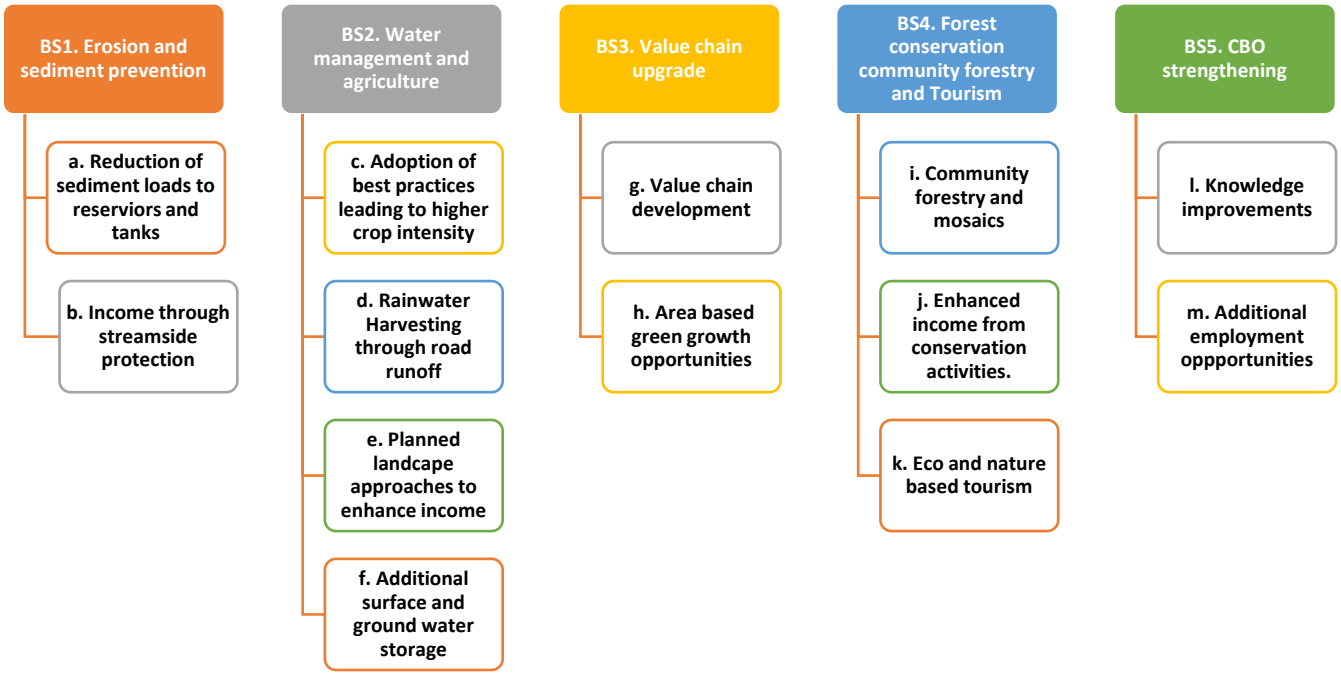


Figure 93: Categorization of multiple economic benefits under five main areas

Based on the above structure, the elaborated descriptions of the benefit streams, assumptions and the process adopted to arrive at costs and benefits are as follows.

Cost Benefit Stream 1. Erosion and Sediment Prevention

a) **Reduction of sediment loads to reservoirs and tanks:** Erosion across the Knuckles upper catchment is reduced by 50%; sedimentation of reservoirs reduced to a negligible level (<0.1 % loss of capacity per annum), directly benefitting the agriculture production capacity of 41,564 ha, i.e. 25% of the upstream area (link to Activities 1.1.1 on Streamside protection and drainage management along roads and 1.1.2 on rehabilitation and establishment of village tanks, ponds and irrigation networks). The Ambangaga development by GoSL/ADB and area tanks (96 village tanks; 18 large tanks; and 32 abandoned tanks) in the upstream area are at a risk of siltation due to climate influence. GCF Investment will assure the continued functionality of the reservoirs (currently annual siltation rate is >2%). GCF investment is expected to reduce the siltation rate to <1%. Agricultural benefits by the additional water

holding has been calculated for 41,564 ha. An unrelated benefit of water management is the ability to manage landslides by site specific drainage and infiltration.

It is estimated USD 50,000 could be saved from the Government's annual budget on tank de-siltation. It is assumed that 8 minor tanks, approximately out of 150 tanks require annual tank rehabilitation (approximately LKR Mn 1-2 per small tank) to cope with the existing siltation issue. The Government budgets on frequent de-siltation could be diverted in consultation with the proposed project for PES sustainability and direct support to subsistence farmers to expedite the economic development.

b) **Additional income through streamside protection:** Streamside protection will allow the communities to grow plants that have an economic value and protect the streamsides while obtaining an income from the harvest and related products. For example, areca nut, bamboo and certain type of timber can be planted in selected stretches of the over 2,000 km of stream network in the upstream area. This benefit is linked to Activity 1.1.1.

The total estimated benefits for the community nursery holders will be USD 100,000 per year.

Cost Benefit Stream 2. Water Management and Agriculture

c) **Adoption of best practices leading to higher crop intensity (from current 1.2 to over 1.7) in both upstream and downstream:** Approximately 61,000 farmers in the project area will be benefited from water management and climate-adapted agricultural practices (including estate workers) where the average cropping intensity for irrigated rice is expected to be >1.75. This benefit is linked to Activities 1.2.1 and 1.2.2. The smallholder farmers in those areas will increase the production from own consumption to market oriented.

On average a farmer has a land the size of 0.2-0.5 ha and the current monthly income/benefit from this land is calculated as LKR 6,000. After the project implementation, the income is expected to reach around LKR 15,000 per month where the project will support to increase the marginal benefit by LKR 9,000 at least for 3,300 farmer families. The total economic benefits per annum will be USD Mn 2.23.

d) **Rainwater harvesting through roadside drainage management:** Proper road maintenance and harvesting of rainwater in over 159 km of road length in the upstream area, in addition to the sediment control benefit identified in Benefit Stream 1, will enhance the groundwater recharge by reducing the runoff by at least 30%, leading to an increase in the area water budget. This benefit is linked to Activity 1.1.2.

It is estimated approximately 1.2 Mn water units (water units according to the National Water Supply and Drainage Board) could be collected per year through roadside drainage management. It is valued as USD 190,000.

e) **Planned landscape and land use approaches to enhance area income:** The landscape level planning covering 4,100 ha of tea; 2,710 ha of coconut; 2,250 ha of rubber; 2,090 ha of timber; 1,076 ha of pepper; and 102 ha of cinnamon at present in plantation areas can be optimized (intercropping and other changes) to generate better net benefits. This benefit involves Activity 1.2.3.

The main economic crops and other field crops significantly contribute to a healthy economy in a country. There are fluctuations in the global prices for these plantations and the proposed project will work with communities and plantation companies to eliminate the drawbacks of the production and the quality due to climate change impacts. The project will also help to better plan the land use and decide the extent of cultivations and identify suitable crops to intercrop with the economic crops, especially when cultivating the abandon and degraded lands. Overall these steps will benefit estate workers to enhance their living standards and the profit margins of the plantation companies. It is estimated that benefits worth of USD Mn 1.4 will be created for the sector.

f) **Additional surface and ground water storage through tank rehabilitation:** Community led partial de-siltation and rehabilitation of the 32 abandoned village tanks and 121 functional ponds and tanks within the upper catchment area will improve the living conditions of the families, especially women. At least 5,000 families are to be benefited.

Water for Irrigation and domestic purposes during dry spells is an issue for both upstream and downstream areas of the proposed project area. This issue has strong linkages with gender issues created as a result of climate change. Women are more vulnerable due to the lack of water to fulfil domestic needs. The calculation considered the number of hours spent by women to find water, by traveling long distances. Considering most vulnerable areas for drought and water availability, the tank rehabilitation will directly have an economic impact worth minimum USD 187,500 where the women can be involved in productive economic activities during the time they spent before to find water.

Benefit Stream 3. Value Chain Upgrade

g) **Value chain development:** GCF investments will generate an additional income to an estimated 5,000 families by way of value chain upgrading options in the upstream area (certification, quality assurance, processing and innovative marketing). Family income is expected to increase allowing the resilience to improve. New level of production and branding of products, named "Jurisdictional Area Approach" will be tested. New markets will be opened in the global market to “area brand” products linked to agriculture, tourism and services.

Through the project involvement on value chain development, the marginal income per family will be approximately LKR 3,500 per month. In total, USD Mn 1.25 could be calculated as the economic benefit created from this benefit stream.

h) **Area based green growth opportunities:** New approaches, technologies and low-carbon growth opportunities (also in line with Jurisdictional Area Approaches) can be utilized to enhance the value of products and services in the Knuckles area. Benefits due to price markup’s with branded products specific to the area will bring more resources into the hands of the people. This benefit is linked to Activity 2.1.2.

The chain of issues related to upstream agriculture production by subsistence farmers is climate change and productivity → low quality and less production → disadvantages in global competition → low demand → low income for subsistence farmers. This chain will be changed with the support of the project, as climate resilient high-quality production → crop intensification → competitive advantages i.e standards, green approaches, etc. → high global demand → high income for subsistence farmers. It is estimated approximately USD 800,000 worth of marginal economic benefits will be created.

Benefit Stream 4. Forest Conservation, Community Forestry and Tourism

i) **Community forestry and mosaics including economically viable environmental conservation activities in nearly 126,000 ha (41,900 ha dense forest, 21,900 ha open forest and 62,200 scrub (degraded grassland):** In the upstream area this will lead to opportunities to grow/market super foods, spices, medicinal plants and other niche products. These products and sustainable harvesting opportunities could contribute to the transformational climate resilience, significantly, and provide opportunities to develop public, private, people initiatives. The additional ecosystem services due to this greening will also be significant, but not counted in the computation. This benefit is connected to Activity 1.1.2.

Sri Lanka is importing herbals for domestic needs mainly from India and other Asian countries. The project area has an extended forest cover that can be protected and conserved involving communities, especially subsistence farmers. One of the issues for subsistence farmers is the land inadequacy. Therefore, the proposed project will facilitate the releasing of lands to communities under close monitoring of Community based Forestry Organizations and the Forest Department. Non-Timber Forest Resources such as fruits, tree parts only for herbal production could be extracted in systematic ways. These products could be coupled with the opportunities created by tourism and value chain development for agriculture production. It is estimated USD 800,000 of economic benefits will be created for the country per annum.

j) **Enhanced income for communities from conservation activities:** GCF related investments will transform employment opportunities to a higher level so that communities will appreciate and engage also minimizing the outward migrations. Currently climate change impacts and other hardships on subsistence farmers who engage in agriculture are being influenced by the benefits of migration due to the risks associated with farming. To make a paradigm shift of this perception, high attractive opportunity schemes will be introduced through labour-oriented adaptation activities. It is estimated that a large number of people could be attracted for adaptation and conservation related interventions if they are motivated by a reasonable daily wage.

It is observed that making conservation an economically viable livelihood is of great importance. The daily rate for communities who support conservation activities will be approximately USD 20 per day, which is a very competitive rate in Sri Lanka to attract more youth, especially even well-educated people as a part-time engagement. It is calculated that an additional USD 200,000 will go to the hands who seek good employment in the area.

k) **Eco and nature-based tourism:** This will generate economic advantages for communities through high-value tourism based on nature, culture and heritage in the area plus seasonal changes of waterfalls and other nature related features. New trends in research and medicinal tourism can be explored as well. The private sector (tour operators and companies) is a key along with promotional systems *via* multiple media.

The communities and authorities could get the involvement of tourists in conservation activities and promote conservation, climate change adaptation, climate resilient community products—especially herbals, fruits, dried fruits and Knuckles branded products—among the tourists. It is

estimated that USD 500,000 will be additionally generated to the economy through these new diversifications of tourism products.

Benefit Stream 5. CBO Strengthening

l) **Knowledge improvements related gains:** Nearly 300,000 households will receive integrated rural advisory capacity responsive to develop their knowledge base, real-time weather and market information. Timely information to farmers on climate, weather and commodity products will help farmers to plan against droughts, crop damages and income reductions due to excessive rain and market irregularities. This benefit is related to Activity 3.2.2 and involve the assumptions that the Government will not require to pay compensation for disaster affected families on crop damages due to drought or intensified rains.

The benefits created from learning and obtaining knowledge are hard to quantify in financial values. However, it can be calculated from the side of compensation on disasters. For the past decade, the GoSL has paid billions of rupees as compensation for the disaster victims in Sri Lanka, especially the farmers who lose their cultivation due to floods and droughts. Monthly compensation per family is LKR 10,000. It is estimated that the project will have an impact on at least more frequent disaster victims who will be benefited, and actions can be taken to manage their crop and cultivation according to climate forecasts. USD 700,000 per annum could be saved at least for 11,200 frequently affected farmers in Matale if they adapt themselves by managing the crop. The saved money could be pumped back to the economy as investments.

m) **Additional employment opportunities to communities in service delivery**: Services on environmental monitoring, information collection and reporting, internet services, telemarketing, tour guiding, and many opportunities will emerge needing communities to improve their technical and communication skills. These services will change the area service delivery quality and quantity, significantly.

In parallel to the above-mentioned economic development, the supporting services are also increased. For example, local tour guides associations, internet cafes, coffee shops, fruit drying centres, recruitment agencies etc. will be established. It is estimated that at least USD 100,000 worth of marginal service development in the area could be expected.

8.3. Economic Viability of the Project

8.3.1. Investment / Inputs

The investments/inputs to reach each benefit is summarized below based on the inputs through relevant activities contributing to each benefit stream.

Table 39: Cost streams related to proposed interventions

Year	Cost Stream 1: Erosion and sediment prevention (USD Mn)		Cost Stream 2: Water management and agriculture support for subsistence and downstream farmers (USD Mn)		Cost Stream 3: Value chain upgrade to support subsistence farmers (USD Mn)		Cost Stream 4: Forest conservation and community forestry and Tourism Development (USD Mn)		Cost Stream 5: Strengthening Community Based Organizations (USD Mn)	
	GCF	GoSL	GCF	GoSL	GCF	GoSL	GCF	GoSL	GCF	CBO
1	0.81	0.5	2.81	0.05	2.06	1.67	0.48	1.03	0.48	
2	0.81	0.5	2.81	0.05	2.06	1.67	0.48	1.03	0.48	
3	0.81	0.5	2.81	0.05	2.06	1.67	0.48	1.03	0.48	
4	0.81	0.5	2.81	0.05	2.06	1.67	0.48	1.03	0.48	
5	0.81	0.5	2.81	0.05	2.06	1.67	0.48	1.03	0.48	
6	0.81	0.5	2.81	0.05	2.06	1.67	0.48	1.03	0.48	
7		0.5		0.05		1.67		1.03		0.25
8		0.5		0.05		1.67		1.03		0.25
9		0.5		0.05		1.67		1.03		0.25
10		0.5		0.05		1.67		1.03		0.25
11		0.5		0.05		1.67		1.03		0.25
12		0.5		0.05		1.67		1.03		0.25
13		0.5		0.05		1.67		1.03		0.25
14		0.5		0.05		1.67		1.03		0.25
15		0.5		0.05		1.67		1.03		0.25
16		0.5		0.05		1.67		1.03		0.25
17		0.5		0.05		1.67		1.03		0.25
18		0.5		0.05		1.67		1.03		0.25
19		0.5		0.05		1.67		1.03		0.25
20		0.5		0.05		1.67		1.03		0.25

8.3.2. Benefits in Financial Values

Table 40: Expected benefits generated within 20 years

Yr.	Benefit Stream 1: Erosion and sediment prevention (USD Mn)	Benefit Stream 2: Water management and agriculture support for subsistence and downstream farmers (USD Mn)	Benefit Stream 3: Value chain upgrade to support subsistence farmers (USD Mn)	Benefit Stream 4: Forest conservation and community forestry and Tourism Development (USD Mn)	Benefit Stream 5: Strengthening Community Based Organizations (USD Mn)
1					
2					
3	0.15	4.0	2.0	1.5	0.8
4	0.15	4.0	2.0	1.5	0.8
5	0.15	4.0	2.0	1.5	0.8
6	0.15	4.0	2.0	1.5	0.8
7	0.15	4.0	2.0	1.5	0.8
8	0.15	4.0	2.0	1.5	0.8
9	0.15	4.0	2.0	1.5	0.8
10	0.15	4.0	2.0	1.5	0.8
11	0.15	4.0	2.0	1.5	0.8
12	0.15	4.0	2.0	1.5	0.8
13	0.15	4.0	2.0	1.5	0.8
14	0.15	4.0	2.0	1.5	0.8
15	0.15	4.0	2.0	1.5	0.8
16	0.15	4.0	2.0	1.5	0.8
17	0.15	4.0	2.0	1.5	0.8
18	0.15	4.0	2.0	1.5	0.8
19	0.15	4.0	2.0	1.5	0.8
20	0.15	4.0	2.0	1.5	0.8

8.3.3. Sensitivity for Cost and Benefit Changes

Table 41: Financial ratios calculated based on economic benefits analysis

	Discount rate of 6%		Discount rate of 10%		IRR
	NPV (USD Mn)	BC	NPV (USD Mn)	BC	
Base case	41	2.01	21	1.59	21%
Cost by 10%	37	1.83	5	1.10	18%
Benefits by 10%	33	1.81	16	1.43	18%
Cross sensitivity	29	1.65	21	1.59	15%

8.4. Sensitivity Analysis and NPV

Discounting rates: to obtain an idea of the actual or the net contribution to the economy of Sri Lanka by the proposed GCF investments, the economic analysis uses discounting rates 6% and 10%. The rationale behind the identification of these discounting rates is that the general inflation in Sri Lanka fluctuate within the range of those two values. i.e. in 2017 according to the Colombo Price Index prepared by the Central Bank of Sri Lanka, the annual inflation was 7%. However, it is possible to keep the inflation rate at a healthy level to the economy, therefore, the Government's fiscal policies will be aimed to keep the figure in single digits as per the standards of developed countries or rapidly developing countries.

The analysis delivered that the Internal Rate of Return (IRR) for the base case at 21%. The possibilities of cost increases for the input/project activities and deviations from the assumptions used in the computation of IRR may occur due to increases in Government taxes on goods and services, difference between actual and estimated values, seasonal impacts (weather and emergencies) and market supply and demand context etc.

To test the sensitivity, a perturbation of under 10% increase of base case value was introduced and yet the project generated an IRR of 18%. On the other hand, to test the sensitivity of potential changes on the benefit side, primarily due to potential weak support from partners than expected, changes in external environment such as disasters, access barriers, lack of community participation etc. a 10% reduction of benefits was introduced. The project still generated an IRR of 18%.

At the worst-case scenario, where the cost increase and benefit reduction could be experienced simultaneously at a level of 10% on each side of the cost benefit computation, the project was able to deliver an IRR of 15%.

The estimated costs are for six years and the benefits calculated are for 20 years. The Net Present Value of Benefits are higher than the NPV of costs. Therefore, it is observed that the proposed project has a very healthy economic analysis result and the investment risk is very minimal.

Section 9: Project Formulation Process

9.1. Government Led Priority Identification

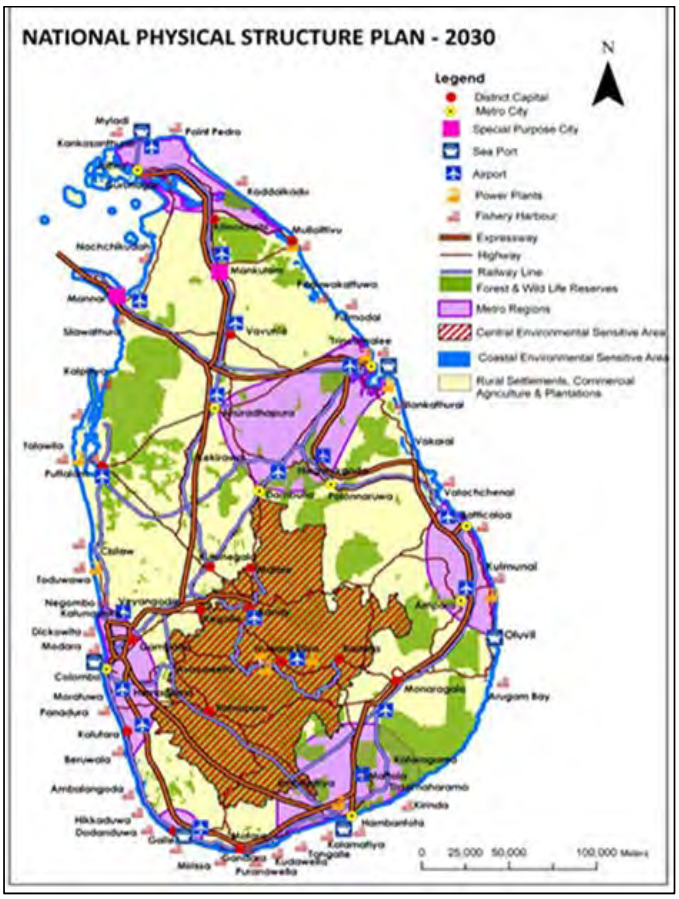


Figure 94: National Physical Structure Plan – 2030

The project proponent, the Ministry of Mahaweli Development and Environment (MMD&E) in Sri Lanka identified catchment protection as a critical measure to meet the challenges of climate change. This decision was supported by the national priorities identified in the National Physical Structure Plan 2030, developed by the National Physical Planning Department (NPPD).

The National Physical Plan indicates the need to conserve and protect the Central Highlands as the area plays a key role in the hydropower, drinking and irrigation of water and serve as a livewire for industries, tourism and many socioeconomic activities.

The same idea is adopted in the "Green (Haritha) Lanka Strategy and Action Plan 2030" by the MMD&E.[27]

The value of highland protection was further validated at the national consultation on "Land Health is National Wealth Workshop in 2017[28]" held between 11-13 October, 2017 in Colombo attended by over 100 people, including Sri Lanka's leading experts and stakeholders—from the government, academia, private sector, and multilateral organizations—from all aspects of agriculture, plantations, forests, soils, water and energy management.

Endorsed by the President of Sri Lanka, the workshop produced an Action Plan to improve the health of the nation's land and other natural resources. MMD&E adopted the strategy to be the area of co-operation for investments by GCF. The National Consultation was supported by the World Agroforestry Institute (ICRAF) among others. As such, "Land Health" consultations resulted in the initial momentum to formulate this project focusing on part of the central region around the Knuckles conservation area and climate impacts to that area and the areas benefiting from the environmental services provided by the Knuckles mountain area.

[27] Green Lanka Strategy and Action Plan (MMDE, 2017) (https://www.dropbox.com/s/yx5ah1tudj38igw/Green%20%28Haritha%29%20Lanka%20National%20Action%20Plan%202015-2022.docx?dl=0)
[28] Workshop Report on Land Health is national Wealth (2017) ((https://www.dropbox.com/s/v7sdtwtdnmmyf6x/Land%20Health%20is%20National%20Wealth%20Outcome%20Report.pdf?dl=0)

9.2. Strategic Approach for Technical Assistance

To operationalize the Central Highland Protection idea and to capitalize on the potential GCF investments to address climate concerns towards the protection of vulnerable populations depending on the Knuckles ecosystem affected by the climate change, in 2017, the Government of Sri Lanka (GoSL) through MMD&E requested the World Agroforestry Centre (ICRAF) to work with the GCF agency, International Union for Conservation of Nature – IUCN to formulate an investment proposal to leverage Government and Non-Government initiatives in the area with GCF investments for climate adaptation.

The ICRAF with the support of IUCN Sri Lanka undertook the formulation of the GCF investment proposal and selected the Knuckles area as the strategic focus area along with the irrigated downstream area that is benefitted by conservation activities in the water catching Knuckles upstream area.

IUCN's association with ICRAF was beneficial as IUCN already had a sound base by working in the project area. For example, selected work in the Central Highlands where IUCN is involved are:

a. Knowledge Enhancement in Central Highlands World Heritage Sites with HSBC, MMD&E, DWC and FD as partners: https://www.iucn.org/asia/countries/sri-lanka/enhancing-education-and-awareness-central-highlands
b. Biodiversity assessment in the Moragahakanda and Kalu Ganga funded by MMD&E: https://www.iucn.org/asia/countries/sri-lanka/biodiversity-plan-moragahakanda-and-kalu-ganga-agriculture
c. Watershed conservation in the Knuckles Conservation Forest funded by HSBC Bank: https://www.iucn.org/asia/countries/sri-lanka/watershed-conservation-and-restoration-knuckles-conservation-forest

9.3. Design of the Project

ICRAF led the technical design of the project with IUCN Sri Lanka playing a local counterpart role in information gathering, strategic technical inputs and logistical support. In the design, three key agency combinations were identified as arrangement to coordinate and operationalize the project, as elaborated in the "management arrangement section."

a. The Ministry of Mahaweli Development and Environment (the National Designated Authority, NDA)
b. IUCN as the Accredited Entity (AE)
c. MMD&E, ICRAF and IUCN as the lead Executing Agencies (EA) with IUCN providing the operational support to the Project Management Unit (PMU). IUCN operation as AE and EA are firewalled at the regional level with IUCN Regional Office and Head Office playing the AE role with IUCN SL country office supporting the PMU and selected EA functions.

The project design was supported by individual meetings with Govt. technical agencies, Non-Governmental agencies, technical experts and universities and others coordinated by MMD&E and IUCN with ICRAF formulating the logical approach for the GCF investment project. The design of the project was discussed with key local Govt., NGO and Private Sector agencies to clarify the relevance, practical issues and feasibility as a climate adaptation intervention.

Based on the inputs, the project was developed to respond to three GCF adaptations with the title “Strengthening Climate Resilience for Subsistence Farmers and Agricultural Plantation Communities Residing in the Vulnerable River Basins, Watershed Areas and Downstream of the Knuckles Mountain Range Catchment of Sri Lanka.” The GCF adaptation areas covered are:

a) most vulnerable people and communities
b) health and well-being, and food and water security and
c) ecosystem and ecosystem services.

Based on the technical design of the project, the MMD&E, ICRAF and IUCN SL consortium met virtually and in person the GCF Secretariat to develop the initial draft of the design in April 2017. The Office of the President of Sri Lanka has been aware and involved with the proceedings of the project design and has expressed support. The private sector, environmental organizations, and local governance and community-based organizations have been involved in the design and have expressed their support to play direct and indirect roles in the implementation.

In summary, the project design makes direct interventions in the upstream area to help people adapt to climate change by managing their land and water more sustainably and profitably. This improves livelihoods of people in the upstream catchment (200,330 female and 183,750 male) while also contributing through the environmental protection of the catchment (166,250 ha) to maintain the irrigation water supply to the downstream area (506,260 ha; 122,150 of which are irrigated rice), where the project intervenes with advice on climate smart agriculture to ensure that efficient use is made of the water in downstream agriculture, thereby benefiting the very climate vulnerable dry zone population (489,680 female and 469,440 male). The project, therefore, has an overall reach of 672,520 ha and 1,343,220 people.

9.4. Consultative Process Adopted

Prior to the project formulation, a number of field level vulnerable groups have been consulted, including, village communities and plantation workers. Consultations with plantation management and communities held in “Elkaduwa Plantations” in the project area helped to understand how climate variability (rainfall intensity and shifts) affect the income sources and the extent of soil erosion losses. Efforts to establish forest gardens helped to understand the drivers of deforestation, climate impacts on soil erosion under different vegetations etc. The consultative session also included a visit to the “Matale Sudu Ganga” area on degraded lands and the “Riverstan” area in relation to grasslands.

Consultations with upstream area communities in the project area was conducted with the “Pitawala” community representatives (about 50 numbers) from four village communities; namely, Pitawala, Atanwala, Rathkinda and Puwakpitiya, where both men and women participated. Community leaders who participated highlighted the climate influence in their livelihoods, primarily the impact on subsistence agriculture. Discussions revealed the reduced crop intensity in the area (less than 1) due to the lack of water, which in turn is aggravated due to climate change.

Communities expressed about the lack of price assurance, post-harvesting loses, transport issues, and the lack of value addition opportunities, aggravated by climate challenge. Further, the smaller land size, averaging between 0.5 to 1 hectare per family do not provide the economics of scale for farming and are particularly vulnerable to climate change. In addition,

climate induced high winds in the area made the farmers restrict farming work to one season from the traditional two seasons. Even during the season that they cultivate, the harvest is wind damaged and are sometimes faced with the lack of water or more water due to shifts in cultivation seasons.

Consultations with the downstream communities in project area occurred with the communities in the Hettipola town area in the downstream project area. Farmers use water brought to them through canals from the upstream catchment through the Moragahakanda Reservoir or Bowatenna Dam. Issues highlighted included wells drying due to long spells of dry days, primarily due to climate change, and increasing difficulty in obtaining a safe drinking water supply, forcing them to consume irrigation water. Irrigation water is contaminated with pesticides, fertilizer and dissolved minerals. In the area, there are over 2,000 Chronic Kidney Disease (CKD) patients reported, possibly due to the poor water quality. Populations consuming rainwater has less CKD incidents.

Plantation communities in the Knuckles conservation area consulted included community members residing in Eluwana area (includes Hettipola, and Laggala-Pallegama DS divisional areas). This community reported having less CKD issues with 117 patients, probably due to the higher quality of water in the areas. Their requirement is reliable household water supplies based on harvested rainwater for irrigation and drinking.

Tamil speaking populations and communities in Tea Plantations consulted in tea areas reported a lack of funds to invest on water treatment and water efficient methods, as a climate adaptation measure. Due to the lack of water, some of the tea estates are being converted to cinnamon and other export crops, leading to further land degradation. It was observed that export-oriented spices can grow as an under growth in plantations to improve the income of communities. Enasal and Cardamom are two traditional spices that bring good revenue, however, the farmers need initial capital for irrigation and processing of produce to prevent post-harvest losses as well as to provide value added products that will be long-lasting, nutritious, and hygienic. Potential landslides due to climate induced high intense rain is a factor of concern by the communities, in plantations, as well.

During the project formulation, a series of meetings were held between ICRAF, IUCN and potential partner agencies, at the IUCN office in Colombo as well as at the MMD&E office. During the meetings, the potential partner agencies have presented the ideas proposed under each component and highlighted the expertise the partner agencies can bring to the project. Based on the discussions, a set of partner agencies have been selected to be included in the project design.

9.5. Selection of Partnering Agencies

The nature of the activities and the demonstrated desire/motivation and the technical and management capacity of the agencies determined the selection of partners for the project design and implementation. The following table indicate the envisaged roles for selected agencies.

Table 42: Stakeholder Analysis

Agency	Engagement approach
Department of Agrarian Development (DAD)	As the key agency in minor irrigation tanks and based on earlier experience with IUCN, DAD will help communities to repair the village tanks and ensure organic farming and optimal water resource use is practiced. DAD will be primarily responsible for activity 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks.
Department of Agriculture (DOA)	The main objectives of the DOA is to maintain and increase productivity and production of the food crop sector in Sri Lanka. To that extent, the department is involved in research, providing internet and phone based extension services (www.krushiradio.lk; www.krushiradionews.lk etc.; crop forecast information system (Croplook) via publications and internet; Agro-Technology Park demonstrating agronomic practices as well as conservation methods; production of seed and planting material; regulatory services related to plant quarantine; soil conservation and pesticides etc. DOA manages the Rice Research and Development Institute, Field Crops Research and Development Institute, Horticultural Crops Research and Development Institute and six technical service centers—Seed Certification and Plant Protection Centre, Seed and Planting Material Development Center, Extension and Training Centre, Socio Economics and Planning Center, Natural Resource Management Center, and Progress Monitoring and Evaluation Unit. DOA strength will be used in activities 1.2.1: Increasing cropping intensity of irrigated rice in both upstream and downstream areas; 1.2.2: Intensification of Sustainable smallholder production; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; and 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands
Mahaweli Authority of Sri Lanka (MASL)	MASL oversees the Mahaweli River Development Programme and the Authority's focus spans to the development of the region as well. Most of the project area falls under the jurisdiction of MASL and the Authority will provide irrigation facilities and monitor ecosystem services and is in charge of hydro dams and large irrigation projects balancing drinking, power generation and agriculture needs. Activities relevant to MASL include 1.1.1: Streamside protection and drainage management along roads; 1.1.2 Rehabilitation and establishment of village tanks, ponds and irrigation networks; 1.2.2: Intensification of Sustainable smallholder production; and 1.2.3: Restoration and sustainable intensification of plantations. In addition, MASL will be involved in setting up of the management groups in the lower catchment.
Irrigation Department (ID)	The Irrigation Department is the foremost authority in all matters related to irrigation including that of developing land and other water resources for agriculture, hydro power, flood control, domestic use, industrial use and agriculture development. ID is involved in developing irrigation and drainage facilities for cultivable lands, the management of water for sustainable agriculture and also provisioning necessary phases and irrigation and water related needs of major to medium irrigation schemes and projects. ID's involvement in the project includes; 1.1.1 Streamside protection and drainage management along roads; and 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks.
Forest Department (FD)	The Forest Department is strongly associated with the protection of the valuable forest landscape in the island by enforcing necessary regulations against deforestation, unauthorized logging, destruction of landscape etc. The Forest Department Research Unit will help to maintain and monitor the forest cover changes. FD will provide support for activities 1.1.3: Restoration of forest mosaic landscapes and 1.2.3: Restoration and intensification of sustainable plantations.

Survey Department of Sri Lanka (SD)	SD is the authority in charge of geodetic information of the island. It will be instrumental in mapping and carrying out the necessary surveys to facilitate the activities of the project, such as 1.1.3: Restoration of forest mosaic landscapes; 1.2.3: Restoration and intensification of sustainable plantations; 2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area ; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
Central Environment Authority (CEA)	CEA is the main authority in Sri Lanka dedicated to the protection of the environment. The main objective of the organization is to protect, manage and enhance the environment. CEA is also involved extensively in pollution prevention and control. CEA inputs will be valuable in activities 1.1.1: Streamside protection and drainage management along roads; 2.1.1: Product development with private sector parties; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; 2.1.3: Enterprise and business development to exploit green growth opportunities; 2.2.2Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established; and 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale.
Gem and Jewellery Research Institute	The Research Institute of Gem and Jewelry is a dedicated arm that conducts surveys on gems in Sri Lanka along with necessary research. It will be involved in activities 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers 2.1.3: Enterprise and business development to exploit green growth opportunities and 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale.
Geological Survey and Mines Bureau (GSMB)	GSMB is in charge of mapping the locations suitable for mining, providing mining related services, regulating exploration, extraction, value addition and transportation and trading of minerals. GSMB work is related to activities 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks; 2.1.3: Enterprise and business development to exploit green growth opportunities; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
Water Resource Board (WRB)	WRB is in charge of ground water resources in the country and provides guidance in sustainable harvesting of ground water resources while administering regulations and laws on assessing, conserving, harnessing, developing and utilizing water resources. WRB will be involved in activities related to 1.1.1: Streamside protection and drainage management along roads; 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options; and 3.3.2: Training in methods and tools for adaptive and participatory co-design of adaptation options.
Dept. of Meteorology (DOM)	DOM is responsible for weather and climatological services to the country. Dept of Meteorology observes and collates weather elements, maintain climatological databases, issues early warnings and advisories on weather related events, encourage study and research in meteorology, climatology, climate change and allied subjects, and organize and contribute to public awareness programs. As such, DOM will be instrumental in 1.2.1: Increasing cropping intensity of irrigated rice in both upstream and downstream areas; 1.2.2: Intensification of Sustainable smallholder production; and 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.

Disaster Management Centre (DMC)	The main activities of DMC include planning preparedness, dissemination of early warning for the vulnerable population, emergency response, coordination of relief and post disaster activities in collaboration with other key agencies. Project is closely connected to drought response actions of DMC. Hence DMC will support in the activities such as 1.1.1: Streamside protection and drainage management along roads; 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options; 3.3.1: Establishment of nested-scale multi-stakeholder innovation platforms from sub-basin to GN scale; and 3.3.2: Training in methods and tools for adaptive and participatory co-design of adaptation options.
Natural Resources Management Centre (NRMC) of the Dept. of Ag.	The Natural Resources Management Centre (NRMC) focuses on enhancing the use of land and water resources, based on science, to improve national agricultural productivity in a sustainable manner. As such, the main research areas of the institute include soil conservation and watershed management, land suitability evaluation, agro-meteorology and climate change, geo-informatics and remote sensing, productivity enhancement, soil and water quality assessments and on-farm water management—all of which are instrumental in the planning of the activities. NRMC maintains the Agro-Technology Park in Peradeniya, one of the best conservation planning demonstration sites. NRMC will play a key role in the project and provide support to activities 1.1.1: Streamside protection and drainage management along roads; 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks; 1.1.3: Restoration of forest mosaic landscapes; 1.2.1: Increasing cropping intensity of irrigated rice in both upstream and downstream areas; 1.2.2: Intensification of Sustainable smallholder production; 1.2.3: Restoration and intensification of sustainable plantations; 2.2.2: Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established 2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; 3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options; 3.1.3: Development and refinement of SLM framework; 3.3.1: Establishment of nested-scale multi-stakeholder innovation platforms from sub-basin to GN scale; 3.3.2: Training in methods and tools for adaptive and participatory co-design of adaptation options; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Centre for Agriculture Research and Policy (CARP)	The priorities of the CARP include advising the co-coordinating and consolidating efforts within Sri Lanka and funding research projects/programs and promoting scientific research linkages in prioritized areas. As such, the CARP will participate, contribute and benefit from the results of all activities of the project. CARP's main role would be to upscale the outcomes of the GCF investment.
Genetics and Plant Breeding Division of Dept. of Export. Agriculture	The Genetics and Plant Breeding Division is involved in developing high yielding and high-quality agricultural corps specifically for export purposes. As such, it will be involved in activities such as 1.2.2: Intensification of Sustainable smallholder production; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands 2.1.3: Enterprise and business development to exploit green growth opportunities; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Tea Board	Tea Board is in charge of promoting tea, ensuring necessary regulations especially in terms of exports, defining, protecting and certifying the regional origins of Ceylon tea, Monitoring and controlling the quality and purity of tea exported from Sri Lanka including pricing and market information. Tea Board will be involved in 1.2.3: Restoration and intensification of sustainable plantations; 2.1.1: Product

	development with private sector parties; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; and 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms.
Tea Smallholders Development Authority (TSHDA)	The TSHDA is responsible for small holdings in the country and play a key role in productivity, marketing and welfare of the tea smallholders. TSHDA will be involved in 1.2.2: Intensification of Sustainable smallholder production; 1.2.3: Restoration and intensification of sustainable plantations; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; and 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms.
Tea Research Institute (TRI)	TRI provide facilities to undertake research in cultivation and processing, commercializing research, technology dissemination, advocacy and raising awareness etc. TRI will play a key role in activities related to 1.2.2: Intensification of Sustainable smallholder production; 2.1.1: Product development with private sector parties; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Rubber Control Department of Ministry of Plantation? (Department of Rubber Development)	Rubber Control Development regulates the rubber production related inputs and facilitate technology and marketing of rubber outputs. It will be involved in 1.2.2Intensification of Sustainable smallholder production; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2. Processing, storage, quality assurance, certification and collective marketing of agricultural production; and 3.3.3. Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Rubber Research Institute (RRI)	Responsible for research and development on all aspects of rubber cultivation and processing including awareness and education. The RRI will be providing inputs to activities such as 1.1.3: Restoration of forest mosaic landscapes; 1.2.2: Intensification of Sustainable smallholder production; 1.2.3: Restoration and intensification of sustainable plantations; 2.1.1: Product development with private sector parties; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; 2.1.3: Enterprise and business development to exploit green growth opportunities; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
Coconut Research Institute (CRI)	The role of CRI and its divisions is related to the development of the coconut industry in Sri Lanka. The CRI promotes collaborative research with other National Institutes and Private Sector Organizations. The Institute has 11 Research Divisions and five Service Divisions capable of adding value in activities 1.2.2: Intensification of Sustainable smallholder production; 1.2.3: Restoration and intensification of sustainable plantations; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; 2.1.3: Enterprise and business development to exploit green growth opportunities; 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.

National Botanical Gardens Department	The Department is instrumental in implementing Fauna and Flora Protection Ordinance and Botanical Gardens Ordinances. They also prepare, monitor and assess policies, programs and projects related to the subjects of sustainable development, wildlife, botanical gardens and zoological gardens. Other responsibilities of the department include the preparation of sustainable measurements and environmental indicators, conservation of the flora of Sri Lanka, maintenance of the botanical gardens in Sri Lanka and development of the floriculture in Sri Lanka, conservation of wildlife resources in Sri Lanka, enacting necessary measurements to promote eco-tourism in the island etc. As such, the department will provide inputs for activities on 1.1.3: Restoration of forest mosaic landscapes; 1.2.2: Intensification of Sustainable smallholder production; 2.1.3: Enterprise and business development to exploit green growth opportunities; 2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area; and 3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
Education Department	As the core department charged with the education of the future generation of Sri Lanka, the department's ability to reach the children to create awareness and promote sustainable practices will be valuable in spreading the benefits of the project. Education Department will be engaged in project activities through the Environment Pioneer Programme; environment monitoring activities and observing and learning from all activities of the project. The Dept., teachers and students will be specifically involved in activities such as 3.3.2: Training in methods and tools for adaptive and participatory co-design of adaptation options and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options, among other things. The project will provide exposure tours to students to learn different aspects of sustainable development, environment monitoring etc.
National Planning Department (NPD)	NPD is committed to policy development, planning and implementation, to accelerate Sri Lanka's economic growth and social progress. As such, their involvement in the project will be manifold especially in the front of social development, reaching out to communities and enabling development activities to take place under the project. Maintenance of accounting and financial analysis system for effective utilization of Foreign Aid, review of economic development polices, strategies and programs, appraisal of project proposals submitted by line agencies etc. NPD will be a direct beneficiary of the project outcomes and it will be helpful in mainstreaming the project findings in national planning, budgeting and monitoring. NPD can specifically be involved in understanding the national implications in 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks; 1.1.3: Restoration of forest mosaic landscapes; 1.2.2: Intensification of Sustainable smallholder production; 1.2.3: Restoration and intensification of sustainable plantations; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.3: Enterprise and business development to exploit green growth opportunities; 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms s; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
External Resources Department (ERD)	ERD is responsible for the quality assurance of the use of external funding and to optimize the use of investments from different sources. In the project, ERD will help to upscale the findings of the project in other projects and to negotiate resources to do so.
Department of National Budget (NBD)	As NPD and ERD, the NBD is also a part of the national financial mobilization mechanism, including the priority decisions targeting finances. NBD will facilitate the co-financing allocations and play a key role in upscaling the findings during the project. NBD will help to facilitate the promotion of Payment for Ecosystem Services (PES) models in national processes.

Industrial Technology Institute (ITI)	ITI is the national agency supporting innovations in industrial development. ITI undertakes contract, testing, investigation and research, for improving product quality, technical processes and methods used in industry, and for discovering new processes and methods to be used in industry. Creating awareness, imparting knowledge and investing in research to better improve industries will enable them to be involved in activities such as 1.2.2: Intensification of Sustainable smallholder production 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; 2.1.3: Enterprise and business development to exploit green growth opportunities; 3.3.2: Training in methods and tools for adaptive and participatory co-design of adaptation options; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Institute of Post-harvest Technology (IPHT)	IPHT is responsible for research related to quality improvement of products, diversification of value-added products and development of post-harvest machinery and processing technologies. During the project, IPHT will work in activities such as, 1.2.1: Increasing cropping intensity of irrigated rice in both upstream and downstream areas; 1.2.2: Intensification of Sustainable smallholder production; 2.1.1: Product development with private sector parties; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands 2.1.3: Enterprise and business development to exploit green growth opportunities; 3.3.2: Training in methods and tools for adaptive and participatory co-design of adaptation options; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Horticultural Research Development Institute (HRDI), Dept. of Agriculture	HRDI will work in the project to promote alternate sources of income to families who rely on one crop or one activity. Homegardens, and ornamental flower/plant cultivation could be promoted within communities with proper guidance and training. As such HRDI will be involved in activities such as 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.3: Enterprise and business development to exploit green growth opportunities; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Agrarian Training Centre of Dept. of Agriculture (HARTI)	HARTI is responsible for socioeconomic research relating to the use of land and water in Sri Lanka and it is also involved in providing relevant training to farmers, field workers and managers in both the state and non-state sectors. In the project, HARTI will play a role in leading the efforts to carry out socioeconomic related monitoring and reporting from baselines to progress while sharing its long-experience in annual work plan development and sharing the project experiences in the national planning processes.
Land Use Policy Planning Department (LUPPD)	LUPPD is responsible for the development of land use plans at district and divisional levels including mapping. LUPPD is cost sharing and co-financing the project through its in-kind and technical inputs. LUPPD offices at the national and sub-national levels will participate in project activities throughout the project period, specifically in activities 1.1.1: Streamside protection and drainage management along roads; 1.1.2 Rehabilitation and establishment of village tanks, ponds and irrigation networks; 1.1.3: Restoration of forest mosaic landscapes; 1.2.2: Intensification of Sustainable smallholder production; 1.2.3: Restoration and intensification of sustainable plantations; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.

National Building Research Organization (NBRO)	NBRO is the specialized Government agency, under the Ministry of Disaster Management for all landslide related expertise. The project area has a number of landslide prone areas and the project activities are also involved in modifications to the hydrologic regimes in the upper catchment area. As such, NBRO expertise will be used in activities such as 1.1.1: Streamside protection and drainage management along roads; 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
Road Development Authority (RDA) and Provincial RDA	RDA is responsible for the maintenance and development of road networks including the planning, designing and the construction of new highways, bridges and expressways to augment the existing road network. During the project the RDA is involved in 1.1.1: Streamside protection and drainage management along roads and 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
Ministry of Social Welfare and Samurdhi Authority	Samurdhi Authority is responsible for empowering low-income groups by providing funds for investments and welfare. Equipped with specific schemes and programs devoted to different levels of rural and urban societies. The same beneficiaries (as outlined in the Section on socioeconomics) will be involved as participants benefiting in activities such as 1.1.1: Streamside protection and drainage management along roads; 1.1.2 Rehabilitation and establishment of village tanks, ponds and irrigation networks; 1.1.3: Restoration of forest mosaic landscapes; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; 2.1.3: Enterprise and business development to exploit green growth opportunities; 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms; and 3.1.3Development and refinement of SLM framework; 3.3.1: Establishment of nested-scale multi-stakeholder innovation platforms from sub-basin to GN scale; 3.3.2: Training in methods and tools for adaptive and participatory co-design of adaptation options; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Dept. of Wildlife Conservation (DWC)	DWC is responsible for wildlife conservation elements such as protection, research, education, sustainable use and benefit sharing of the resources. During the project, DWC will be involved in activities such as 1.1.3: Restoration of forest mosaic landscapes; 1.2.3: Restoration and sustainable intensification of plantations; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.2.2: Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established ; 2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; and 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options.
Ministry of Plantation Industries and Plantations in the project area namely the Elkaduwa Plantations, Janatha Estate Development Board and State Plantations Corporation – Midlands; Opalgala; Harepark; Private Sector Plantations – Midcar; Meezan etc.	Ministry of Plantation Industries is responsible for policies on subsidies to the plantation industries and the project area has tea and rubber plantations. The Ministry and individual estates that will be involved in the project in multiple areas depend on the location of the plantation. Illustrative activities will include 1.1.3: Restoration of forest mosaic landscapes; 1.2.2: Intensification of Sustainable smallholder production; 1.2.3: Restoration and intensification of sustainable plantations; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; 2.2.2: Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established ; 2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area; 3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale; 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and

	monitoring of the performance of intervention options; 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
Sustainable Energy Authority of Sri Lanka (SEA)	SEA promotes renewable energy development and use. The main objective of the authority is to ensure energy security, increase indigenous energy and improve the energy efficiency rank. In the project, the SEA will help the project to promote solar, wind and other biomass related energy production, storage and use to help the project activities including the greening of the area-based products.
Ministry of Primary Industries - Dept. of Export Agriculture	The Dept. of Export Agriculture is in charge of organizing and promoting cultivation and processing of Export Agricultural Crops. It undertakes conducting agronomic, post-harvest, economic and market research, organizing production and providing quality plants and planning material, administering assistance schemes, training, conducting crop protecting action, promoting the usage of fertilizer, assisting in organizing and arranging marketing, etc. As such during the project, the Dept. will be instrumental in 1.2.2: Intensification of Sustainable smallholder production; 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers; 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands; 2.1.3: Enterprise and business development to exploit green growth opportunities; 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms; 2.2.2: Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established; 3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options; 3.3.1: Establishment of nested-scale multi-stakeholder innovation platforms from sub-basin to GN scale; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.
District Secretariats in the Project Area	Project activities will be coordinated closely with the District Secretariats and District Planning Units. The project area is mostly covered by the districts of Matale, Kurunegala and Anuradhapura. District Secretaries or officials of delegated authorities will participate in the Project Board Meetings where Results Based Annual Work Plans and budgets will be discussed and approved. In those districts, the District Agriculture Committees (DACs) will be used to disseminate the project progress.
Divisional Secretariat Divisions (DSD) Offices in the Project Area	Project area involves 40 DS divisions and 1,084 GN (Village level) Divisions. Development officers attached to the Divisional Secretariat Offices will play a key role in the Strategic Teams identified in the project implementation arrangements. They will be part of all project activities and the type and extent of activities will very depend on the area of the DSD.
Universities	Universities will play a lead role in mobilizing technical assistance, providing field level study support through graduate student research and providing support in project monitoring activities, especially the actions related to PES, Water Quality and simple modelling of environment flows. Universities will benefit through the project activities as the project provides opportunities for university staff, research and students to work hands on with project activities. Project area is in close proximity to number of universities with different expertise. University of Peradeniya, Rajarata (North Central Province) University based in Anuradhapura, Wayamba (North-Western Province) University based near Kurunegala are the closest but there is expertise the project can mobilize from other universities such as University of Sabaragamuwa; University of Sri Jayawardenapura; University of Colombo; University of Kelaniya; Open University of Sri Lanka etc. In addition, there are possibilities of partnering with Universities outside of Sri Lanka through the Sri Lankan universities.
Rainforest Rescue International (RRI)	RRI is a leading Non-Governmental Organization extensively involved in analog forestry and establishing forest corridors. The RRI maintain two research and educational facilities on landscape restoration and development. RRI expertise was used in the project

	conceptualization and during the project RRI will help in training and capacity building and monitoring the Analogue Forestry related implementation.
Institute of Policy Studies (IPS)	IPS is a Government Think Tank carrying out policy related studies including climate change, ecosystems and health. IPS will be mobilized to help in the case study development, project monitoring and developing material for national level upscaling and mainstreaming of project results.
Institute of Fundamental Studies (IFS)	IFS based in Kandy is a resource agency for geology, flora and water chemistry related work. IFS's capacity will be mobilized by the project in appropriate areas specifically to work with ICRAF led component 3 activities.
International Water Management Institute (IWMI)	IWMI headquartered in Colombo, Sri Lanka is a resource agency for climate impact assessments on agriculture, water resource management, environment flows and ecosystem-based adaptation. IWMI maintains several databases that can be tailored to support project activities. IWMI's landscape modelling capacity would be useful in evaluating the impact of the project interventions. Specific roles for IWMI will be in the project activities such as 3.1.2: Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options; 3.3.1: Establishment of nested-scale multi-stakeholder innovation platforms from sub-basin to GN scale; and 3.3.3: Development of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options.

10. Section 10: Environment and Social Management Systems

10.1. Environment and Social Context

The aim of the project is to generate resilient livelihoods by increasing the capacity needed to adapt to climate induced changes in critical upstream and downstream rural communities of the Knuckles mountain range areas in Sri Lanka including the protection of the ecosystem service flows that connect them. The project includes activities around land management for irrigation agriculture, plantations and forest reserves (Component 1), promotion of sustainable/green value chains and payment for ecosystem services (Component 2) and strengthening institutional capacity for land management (Component 3).

Main environment concerns in the activities of Component 1 include vegetation management to control run-off and enhance infiltration along roads, rehabilitation of village ponds for water harvesting, climate smart farming techniques for rice production, increasing efficiency of irrigation, fertilizer and integrated pest control, promoting agroforestry, homegardens and analogue forest through a menu of services including crop diversity, access to germplasm, nurseries, cultivation practices; restoration and sustainable intensification of plantations through conversion of under-performing crops into food gardens, agroforestry practices including intercropping with high-value short-rotation horticultural crops. Under Component 2, the project will strengthen the capacity of farmers and collective groups as enterprises through advice and training in areas, such as agri-processing, product development, branding and certification. Component 3 aims to promote inclusive and evidence-based land use planning processes.

The project is expected to have highly positive environmental impacts while the impacts on the local communities are also expected to be highly positive, particularly in terms of water and food security and alternative income-generating options. However, some environmental and social risk issues have been identified. It is not expected that any of the identified risks would likely cause significant adverse environmental and/or social impacts; most of the risk issues are preliminarily judged as low risk areas; very few are moderate, and it is expected that they can be readily addressed through good management practices and mitigation measures.

10.2. Environment and Social Governance Frameworks

Environment Governance in the country is facilitated by the National Environmental Act, No. 47 of 1980 with the last amendment as Act. No. 53 of 2000. The National Environment Policy was developed in 2003. The policy and institutional framework for social and environmental issues are linked to the national level frameworks outline in Table 34.

Table 43: Policy, legal and institutional framework for social and environmental matters

Policy/ law/ regulation	Provisions for environmental and social management	Relevance to the project	Institutions responsible for implementation
National Policy on Climate Change 2012	Provides directions for key investments to be made on climate mitigation and adaptation. The development projects can seek the opinion of an expert group towards climate resilience.	The project is based on adaptation approaches prescribed in the policy to minimize the threats due to climate induced challenges to subsistence farmers. The project addresses the adaptation capacity related to water security.	Climate Change Secretariat of the MMD&E
National Adaptation Plan (NAP) for Climate Change Impacts in Sri Lanka (2016-2015)	Identifying adaptation options, actions and performance indicators for each vulnerable sector, including food security, water resources, ecosystems and biodiversity, and export development. Performance indicators cover environment and social aspects as well.	Project implements sections of the NAP by improving adaptive capacity of vulnerable groups while developing institutional capacity of the Govt. agencies to implement NAP.	Climate Change Secretariat of the MMD&E
Sri Lanka's National REDD+ Investment Framework and Action Plan (NRIFAP, 2017)	Proposed to work with forest and watershed restoration, sustainable natural resource management and governance, enhancement of land productivity and improvement of agroforestry models, that contain environment and social safeguards and ecosystem benefit sharing.	Project is based on the drivers of deforestation and forest degradation identified in the NRIFAP and pilot best practices (forest enhancement, soil conservation etc.) that can be upscaled further through the NRIFAP approach.	Climate Change Secretariat of the MMD&E
National Policy on the Protection and Conservation of Water Sources, their Catchments and Reservations in Sri Lanka (gazette no.1894/3-Dec.2014 by Land Ministry)	Land use policy planning unit is empowered to adopt best practices to protect the catchments and adopt environment and social aspects. The policy is monitored by a national steering committee comprised of multiple agencies and academia.	The project uses a catchment protection approach and is very much in line with the National Policy on the Protection and Conservation of Water Sources and their Catchment. Land Degradation Surveillance Framework (LDSF) will be established in each sub-basin implementation unit. The LDSF is being applied for assessments of land degradation processes, soil health and ecosystem health in over 40 countries in the global tropics as part of the Ecosystem Health Surveillance Framework (EcoHSS) that will strengthen the catchment protection.	LUPPD as the Secretariat for coordination; Irrigation Department on protection of river banks and flow and sediment monitoring; National Water Supply and Drainage Board (WSDB) in developing and institutionalizing
National Biodiversity Strategy and Action plan (NBSAP)	Address/advocate biodiversity conservation strategies and interventions covering 19 Aichi targets that also include promotion of Payments for Ecosystem Services (PES).	The project uses, and pilot tests the PES concept. Project interventions are in line with NBSAP recommendations to the ecosystems prevailing in central hills and intermediate slopes.	Biodiversity Secretariat of the MMD&E

Policy/ law/ regulation	Provisions for environmental and social management	Relevance to the project	Institutions responsible for implementation
National Wetlands Policy of 2004	Covers environment services and regulatory functions of wetlands.	The project, although based in central hills uses a number of directives and technical aspects of wetland management in the areas of improving drainage and streamside stabilizations.	Sri Lanka Land Reclamation and Development Corporation (SLLRC)
Water Resources Board Act No. 29 of 1964 (as amended as Act 42 of 1999)	Prevention of water pollution and attempting to reverse habitat loss.	The project addresses water pollution from sedimentation, weak water sanitation issues plus introduce green practices that limits water pollution.	Water Resources Board of Sri Lanka
National Biosafety Policy of 2005	Provides the overall framework in which adequate safety measures are introduced to minimize possible risks to human health and the environment while extracting maximum benefits from any potential that modern biotechnology may offer.	Project supports to understand the plant genetic characteristics and value addition options by way of research and development.	Department of Agriculture
National Policy on Elephant Conservation and Management of 2006	Ensure the long-term survival of the elephant in the wild in Sri Lanka through the mitigation of the human-elephant conflict.	The project work on land use, plans to minimize the Human Elephant Conflicts.	Department of Wildlife Conservation
National Land Use Policy of 2007 using the National Action Programme for Combating Land Degradation in Sri Lanka (2015-2024)	Ensures proper land use, food security, economic development and the maintenance of the productivity of the land at a higher level. It also provides a path for the protection, conservation and sustainable use of the land resource of the country and offers an appropriate and ideal framework that will best meet the needs of the present generation while safeguarding the land resource for the future generation as well.	Project extensively works on changing the land use patterns and landscape improvements to ensure food safety, economic development of subsistence farmers while ensuring the sustainability of ecosystem services. The project promotes sustainable systems such as System of Rice Intensification (SRI) practices to increase rice production with minimal artificial inputs. The introduction of new tools incorporating GIS technology and other biophysical data and socioeconomic data and facilitating decision making processes to take place at smaller scales in the project.	Ministry of Mahaweli Development and Environment (Land Use division)
Soil Conservation Act No. 25 of 195 Last Amendment: Act No. 24 of 1996	Soil erosion damages water ways that become sedimented, thus degrading aquatic habitats. This act, therefore, indirectly supports biodiversity by preventing habitat degradation.	The project supports minimization of streamside erosion, land-based erosion and sediment loads from road infrastructure. The project also promotes holistic farming practices such as analog forestry, which produce both food crops, tree products and environmental services are another novel practice that would be introduced to the area with the intention of reclaiming marginal farmlands. Land degradation hotspots (e.g. soil erosion and compaction) and soil health variables (e.g. soil organic carbon) will be mapped at high spatial resolution (10 to 30m), by	Natural Resource Management Center of Dept. of Agriculture

Policy/ law/ regulation	Provisions for environmental and social management	Relevance to the project	Institutions responsible for implementation
		combining data collected from the LDSF sites with data from the global database. These assessments will build on national level assessments of erosion and SOC done during project preparation at moderate spatial resolution that were developed using MODIS satellite imagery to assess changes in these indicators over time.	
Mines and Minerals Act No. 33 of 1992. Last Amendment: Act No. 66 of 2009	This act ensures minimizing the degradation of habitats and culturally and naturally important sites due to mining through sustainable harvesting of mineral resources.	The project improves the coordination of agencies responsible for mining land and natural resources by enhancing the knowledge on soil-water-climate interactions and the effect of mining on climate change adaptation.	Geological Surveys and Mines Bureau
Control of Pesticides Act No. 33 of 1980 (as amended). Last Amendment: Act No. 31 of 2011	Ensures the human and environmental safety in pesticide use by controlling the imports, distribution and use of pesticides.	The project supports enhancing awareness and education on low input farming including pesticide use.	Registrar of Pesticides (control of pesticides act)
Fauna and Flora Protection Ordinance, No. 02 of 1937 Last amendment: Act No. 22 of 2009	This policy ensures biodiversity conservation through protection of habitats and species.	The project promotes species conservation, traditional knowledge and monitor the biodiversity enhancements as a result of project activities. Restoration of landscapes and wildlife corridors in plantations will also add value to biodiversity conservation by the project.	Department of Wildlife Conservation (DWC)
Forest Ordinance, No 16 of 1907, with last amendment: Act No.65 of 2009.	Directly protects forests and species within forests.	The project aims to restore degraded forests within protected areas and fragmented forests. Forest rehabilitation activities would be further practiced with the intention of protecting watersheds. A Forest Landscape Restoration (FLR) approach would be taken where an inclusive and devolved natural resource management regime would be practiced.	Forest Department
National Forest Policy (1995)	Provides directions for safeguarding natural forests of the country to conserve biodiversity, soil and water resources. The forests under the jurisdiction of the FD have been reclassified and placed under four management systems ranging from protection, non-extractive use, management of multiple use forests for sustainable production of wood and management of forests with community participation.	The project promotes Forest Landscape Restoration (FLR) that also engages local communities. Land use planning activities of FLR programs are conducted through multi-sectoral and multi-level governance mechanisms with a focus on ecosystem service delivery while integrating diversity of restoration technologies across the landscape to optimise livelihood and environmental outcomes. Grassland restoration activities would also be attempted by this program (which is a conservation	Forest Department

Policy/ law/ regulation	Provisions for environmental and social management	Relevance to the project	Institutions responsible for implementation
		measure which has not been successfully conducted in Sri Lanka).	
National Wildlife Policy of 2000	The policy deals with government mechanisms to conserve wildlife resources through promoting conservation, maintaining ecological processes and life sustaining systems, managing genetic diversity and ensuring sustainable utilization and sharing of equitable benefits arising from biodiversity. It emphasizes the need for effective protected area management with the participation of local communities.	The project supports stabilization of wildlife corridors and habitats in the upstream catchment area and prevention of wildlife related conflicts from land uses in downstream areas.	Dept. of Wildlife Conservation
The National Environmental Policy of 2003	The policy promotes sound management of the environment while balancing social and economic development needs. It aims to manage the environment by linking together the activities, interests and perspectives of different stakeholders with equitable sharing of benefits and costs. The policy supports securing land tenure rights including user rights on state land and long-term tenure for chena farmers. It is open to alternative mechanisms and policy tools to provide incentives while minimizing compliance costs to benefit the environment, the society and the economy. It emphasizes participation, transparency and public accountability in the management of natural resources.	The project activities improve land tenure and best practices adopted for landscapes and land uses. Also, the project uses a Sub-Basin Management strategy that will bring multiple stakeholder entities in improving the environmental management with proper monitoring, capacity building and enforcement. Project supported databases, knowledge products and engagement tools are expected to ensure the sustainability of environment management in the areas of interventions including green practices, introduced during the project. Rural Advisory Services (RAS) and multi-stakeholder platforms—which would facilitate inter-institutional and intra-institutional collaboration—would further support this policy	Ministry of Mahaweli Development and Environment (Planning Division)
The National Heritage Wilderness areas Act, No 03 of 1988	Directly protects habitats.	The project area also includes the Knuckles Heritage area. The community engagement and the capacity building efforts by the project will help to reduce encroachments and degradation practices in the Heritage Area.	MMD&E
The National Environmental Act, No.47 of 1980 Last amendment: Act. No. 53 of 2000	Supports biodiversity conservation by controlling pollution and requiring mitigatory measures for development projects through mandatory EIAs.	The project supports many elements to promote and adopt elements in the environment act. The project supports Small and Medium Industries and Export Oriented business to adopt low-input, green processing and storage methods minimizing the industrial pollution.	Central Environment Authority
Plant Protection Act No. 35 of 1999	The Central Environmental Authority (CEA) is responsible for the enforcement of the provisions of this Act. Ensures control and management of Invasive Alien Species (IAS).	The project supports awareness and education on IAS and help programs by sub-basin teams to mainstream the eradication of IAS while focusing on FLR efforts.	Biodiversity Secretariat

Policy/ law/ regulation	Provisions for environmental and social management	Relevance to the project	Institutions responsible for implementation
Felling of Trees (Control) Act No. 9 of 1951 Last amendment: Act No 1 of 2000	Supports the protection of threatened tree species.	The landscape planning in plantations, homegardens and other areas supported by the project will carry the knowledge on tree species to be protected and build the capacity of Govt. officers to ensure the protection of the same.	Forest Department
Urban Development Authority Law 1978 Last Amendment: Act No. 41 of 1988	Ensures the protection of habitats and promote conservation in urban environments and areas under the jurisdiction of the Urban Development Authority.	The project may not work directly in urban settings; however, the project supports activities such as roadside improvements, streamside restorations, conservation of landscapes and will help to develop several pilot measures that the Urban Development may use while creating Urban-Rural synergy. The project supports nurseries and other small businesses can support urban related conservation.	Urban Development Authority
Frameworks implementing host country's obligations under international law			
International Plant Protection Convention (1951) Ratified in 1952	The Convention provides for the protection of local floral biodiversity from pests and invasive species.	Project supported awareness and education activities will enhance the knowledge of the beneficiaries and strengthen the Sub-basin Management teams and innovative platforms in the project on management and control of IAS.	Seed Certification and Plant Protection Centre, Department of Agriculture
Convention on Wetlands (Ramsar Convention) (1971) Ratified in 1970	Conserves wetland and wetland associated species by encouraging the conservation of wetland habitats.	Project supported Forest Landscape Restoration (FLR) activities aimed promoting several land use and landscape management practices to better conserve wetland habitats. The knowledge based, and environment monitoring will add value to wetland related conservation by the project.	Department of Wildlife Conservation
United Nations Convention Concerning the Protection of the World Cultural and Natural Heritage (1972) Ratified: 1980	Promotes the conservation of biodiversity in natural heritage sites by promoting the conservation of such sites.	The project includes Knuckles Heritage and Conservation area. Eco-tourism promotion and other conservation practices are aimed at minimizing the pressure on the Knuckles environment and its ecosystems.	Sri Lanka UNESCO National Commission, Ministry of Education
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973) Ratified: 1979	Protects species from being over harvested and traded on international markets.	Project supported Human-Elephant-Conflict minimization and education and awareness through Sub-Basin teams, will help to enhance the need and usefulness of CITES objectives.	Department for Wildlife Conservation

Policy/ law/ regulation	Provisions for environmental and social management	Relevance to the project	Institutions responsible for implementation
Convention on the Conservation of Migratory Species (also known as CMS or Bonn Convention) (1979) Ratified in 1990	Protects migratory species.	Bird watching is a popular tourist activity, especially as the relevant authorities plan to introduce nature trails.	Department of Wildlife Conservation
United Nations Convention on Biological Diversity (CBD) (1992) ratified in 1994	Promotes conservation and sustainable use of biodiversity.	The project activities on catchment protection, forest landscape restorations and conservation of wildlife corridors and promotion of eco-tourism will help to improve biodiversity conservation in the area. The improved environment monitoring and controls in the long-term ensure the sustainability of biodiversity resources.	MMD&E
United Nations Framework Convention on Climate Change (UNFCCC) (1992) Ratified in 1993	There is a sector action plan on biodiversity and ecosystems as well as the coastal and marine sector in the NCCAS (2015).	The project promotes both mitigation and adaptation components of UNFCCC by ensuring green practices and restoring landscapes and improving the coping capacities of vulnerable in terms of adaptation (this is the primary objective of the project too).	MMD&E
Cartagena Protocol on Bio Safety (2000) Ratified in 2004	Safeguards biodiversity from living modified organisms resulting from modern biotechnology.	The project supported research and development will ensure safeguards to biodiversity while engaging students, communities and officials on this new subject.	MMD&E

10.3. Environment and Social Risks

The risks cannot be ascertained in more depth at this stage, as the exact sites for field interventions have not been identified yet, and due to the fact that decisions on specific interventions will be determined in a participatory process together with the respective local stakeholders.

In the project proposal, generic types of activities have been established, though, and a first high-level assessment of their potential negative social and environmental impacts were undertaken. The results are depicted in Table 34 on the following page. A first appraisal of the significance of the identified risks has been made taking into account the estimated likelihood of impacts occurring and the severity/magnitude of potential impacts—following the classification guidance presented in Table 35 below.

Table 44: Impact potential and level

Description	**Magnitude (Mg)**		
Likelihood (Lk)	Minor (1)	Medium (2)	Major (3)
Almost Certain (4)	Moderate	High	High
Likely (3)	Moderate	Moderate	High
Possible (2)	Low	Moderate	Moderate
Unlikely (1)	Low	Low	Moderate

In addition to establishing significance in the Table 36 below, it also provides recommendations for mitigation measures.

As the assessment is done based on generic activities, without knowing further details and the location of activities, the table needs to be understood as indicative; its purpose is to provide a general guidance for the detailed design of the interventions.

Table 45: Impact prediction and proposed mitigating measures						
Planned activities	**Risk Issues/negative Impacts**	**Lk** [29]	**Mg** [30]	**Significance**	**Explanation**	**Mitigation measures**
Standard on Involuntary Resettlement and Access Restrictions						
1.1.3: Restoration of forest mosaic landscapes (in protected areas and forest fragments)	Reforestation is likely to require restricting the use of specific areas by local communities for cattle grazing, firewood and other livelihood needs, at least temporarily.	3	2	Moderate		This triggers the Standard and will be addressed by following the Standard's provisions. See Section 7 for further details
1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks	Loss of economic assets of individuals or communities due to the potential need of land acquisition to construct new ponds/ tanks.	1	1	Low	Impacts are considered not very likely as the project will focus mostly on rehabilitating existing ponds; if new ones are needed, these will be of very small size and only built in case the private land owner wishes so.	Any land acquisition will require formal agreement with respective land owners (communities, private land-owners). User rights of harvested water will need to be clarified; where land belongs to the individuals, compensations may be needed (e.g. in case benefits from water use don't outweigh loss of land).
Standard on Indigenous Peoples						
The Standard is not triggered as the field consultations carried out during the design phase did not confirm the presence of indigenous peoples in the project site, e.g. of communities belonging to the Vedda indigenous group. The baseline study during the inception phase, however, will need to provide for a more in-depth analysis of the social diversity context at the scale of the intervention sites including an assessment whether any groups would meet IUCN's broad criteria for the Standards (e.g. tribal peoples or traditional peoples whose social, cultural, and economic conditions distinguish them from other sections of the national community and whose status is regulated wholly or partially by their own customs or traditions and whose livelihoods are closely connected to ecosystems. See further explanation in sections 2 and 4).					
Standard on Cultural Heritage						
1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation network	Excavations and movement of earth as part of construction of new ponds/tanks or of the irrigation network might risk encountering or even damaging cultural resources, in particular if they are unknown/buried.	2	2	Low	The risk is considered low given the small-scale nature of the interventions.	Guidelines will be in place and communicated to the entities executing the work to prevent damage on resources. Chance Find procedures (template available in the Standard) will be communicated to prevent damage on hidden/buried resources.
1.2.2: Intensification of Sustainable smallholder production 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth	Potential risk of farming or enterprise management practices promoted by the project not being compatible with cultural norms and values.	1	1	Low	The risk is considered not very likely as the project provides options that households/farmers can choose from in accordance to their conditions.	The risk will be assessed by the social baseline analysis and associated community consultation during the inception phase of the project. Targeted beneficiaries are involved in the fine-tuning of activities.

[29] Llikelihood
[30] Magnitude

Table 45: Impact prediction and proposed mitigating measures						
Planned activities	**Risk Issues/negative Impacts**	**Lk** [29]	**Mg** [30]	**Significance**	**Explanation**	**Mitigation measures**
opportunities for small holder farmers in the uplands						
Standard on Biodiversity and Sustainable Use of Resources						
1.1.3: Restoration of forest mosaic landscapes (in protected areas and forest fragments) 1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation network	Restoration works if not managed appropriately, could lead to habitat disturbance and erosion, the latter with risks of causing loss of top soil and landslides; also, rehabilitation or construction of water holding bodies in hill slopes might pose a risk of leading to landslides.	2	1	Low	Restoration will ultimately prevent erosion, but short-term impacts are possible.	Use of small-scale, low-invasive machinery and vehicles, maintaining clear boundaries for vegetation clearance and management of retained vegetation, construction of natural barriers or micro bunds along the contour to control erosion and landslides.
2.1.3: Identification and implementation of value chain upgrading options for smallholder and subsistence farmers engaged in climate smart agriculture	Value chain operations when located in or close to natural habitat can affect biodiversity (e.g. through waste disposal) or through overuse of living natural resources.	2	2	Moderate		Guidelines on waste management will be provided; where operations use living natural resources (e.g. NTFP), guidance will be provided to control unsustainable use. Adherence will be monitored.
1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation network	Risk of negatively affecting water dynamics through containment and diversion of surface water (e.g. drainage management along roads, tanks/ponds, irrigation).	2	TBD	Moderate	The risk is considered possible but not very likely as the project plans to monitor ground water re-charge.	Potential impacts on the water cycle within and also beyond the geographical scale of the project will be thoroughly reviewed during the inception phase to ensure that whilst potential benefits can be created through better management of water, that potential negative impacts are taken into account and appropriately addressed.
1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation network 2.1.3: Identification and implementation of value chain upgrading options for smallholder and subsistence farmers	Risk of affecting water quality of surface or groundwater (e.g., contamination, increase of salinity) through irrigation or run-off from agricultural or through waste water discharge from value chain activities.	2	3	Moderate		During inception phase this risk will undergo further review; including determining whether water quality monitoring would be required for certain interventions. Guidelines on waste water management will be provided.

Table 45: Impact prediction and proposed mitigating measures						
Planned activities	**Risk Issues/negative Impacts**	**Lk** [29]	**Mg** [30]	**Significance**	**Explanation**	**Mitigation measures**
engaged in climate smart agriculture						
1.2.3: Restoration and intensification of sustainable plantations 1.2.2: Intensification of Sustainable smallholder production	Risk of species developing invasive behavior when promoting climate adapted species based on suitability modelling with downscaled climate change predictions.	2	3	Moderate		Risk assessment and protocol following IUCN guidelines on Environment and Social Management Systems.
1.2.3: Restoration and intensification of sustainable plantations 1.2.2: Intensification of Sustainable smallholder production	Risks from pesticide application, in case, the advisory services funded by the project might consider advice on targeted application of pesticides in order to reduce damage from pest infestations.	2	1	Low	The use of pesticides and associated risks is possible but not very likely as the project aims at reducing agrichemical use (e.g. promotion of weed control through mechanical hand weeders). However, climate change might increase the prevalence of pests and the need for pesticides. The magnitude of impacts from pesticide application is considered minor as the project would only advise on very targeted application (e.g. integrated pest control based on real time weather and pest incidence data).	The provisions of the Standard will be implemented, and Section 7 specifies how to determine the circumstances when a pest management plan or a technique risk assessment (TRA) would be required.
Negative Social Impacts						
Different activities	Risk of negatively affecting human rights (e.g., right to self-determination, access to food, drinking water, to health, or cultural rights), in particular of vulnerable groups (e.g. landless, elderly, disabled or displaced people, ethnic minorities, people living in poverty, marginalised or discriminated individuals or groups); including risk of contributing to their discrimination or marginalisation.	2-3	3	Moderate	Risks (other than impacts from access restriction which are covered on the Standard) seem possible to likely. However, as project design will only be finalized during inception phase, probability and magnitude cannot be fully assessed at design stage.	The social baseline study and associated consultations with relevant groups will provide in-depth knowledge of the social stratification on the intervention site (caste and class/income, gender, ethnicity etc.) in order to allow identification of vulnerable groups and assessment of potential negative impacts. When designing project activities in detail, it will be ensured that vulnerable groups have access to relevant project benefits (e.g. training, advisory services etc.), that these services are adequately designed to meet their needs and that their participation is not hindered by logistical or financial barriers or by any form of social stigmatisation or exclusion.

Table 45: Impact prediction and proposed mitigating measures						
Planned activities	**Risk Issues/negative Impacts**	**Lk** [29]	**Mg** [30]	**Significance**	**Explanation**	**Mitigation measures**
Different activities	Risk of inadvertently creating or aggravating inequalities between women and men or adversely impacting the situation or livelihood conditions of women or girls.					The social baseline analysis will provide for enhancing the existing gender analysis by local gender data. Associated consultations with women and women groups in the intervention sites will not only provide for better understanding of potential risks and for developing measures to mitigate such risks, but also seek opportunities for complementing the gender action plan (GAP).
Different activities	Risk of stirring or exacerbating conflicts among communities, groups or individuals; for instance, through issues related to land tenure or through unjustified preferential treatment of people or social groups in terms of access to resources/ services (e.g. access to irrigation water, to training and enterprise advisory service etc.).					During the inception phase risks related to ethnic diversity and power-relations and of activities inadvertently leading to tensions between ethnic groups, in particular between the Tamils ethnic minorities and the Sinhalese majority, will be assessed, in consultation with representatives of relevant groups. Selection of beneficiaries for support activities (e.g. training on agricultural practices, provision of crop types, product development, business services such as certification, quality assurance, processing and collective marketing) will be done in a transparent way with clear eligibility criteria to avoid unintended discrimination. Land use planning mechanism promoted under Component 3 should ensure that ethnic minorities are appropriately represented in the multi-stakeholder platforms created by the project.

There are multiple approaches on environmental safeguards and policies relevant to the project stipulated by the Government of Sri Lanka, GCF and IUCN. The following table summarizes the relevant approaches and identify gaps and recommendations to be adopted during the project.

Table 46: Comparison of safeguard approaches

GCF E&S Safeguards	IUCN ESMS Procedures and Standards	Governement Policy	Main Gaps and Recommendations
PS1: Assessment and management of environmental and social risks and impacts PS2: Labour and working conditions PS3: Resource efficiency and pollution prevention PS4: Community health, safety and security	• **ESMS Manual** provides an integrated methodological approach to identifying and managing environmental and social impacts and opportunities. • Selection of measures based on **mitigation hierarchy** using four stages: (i) screening of impacts; (ii) scoping and assessment of impacts; (iii) development of environmental management plans, and (iv) monitoring and review. • ESMS Questionnaire provides for identifying social and environmental risks that are not covered by ESMS Standards (including labour and working conditions, pollution risks and Community health, safety and security issues); • **Stakeholder engagement and Grievance mechanism** established as ESMS principles; detailed procedures for capturing affected peoples' concerns through an effective grievance mechanism.	Environmental and social risks of the new developments are handled by the Environment Impact Assessment process for projects and programs. In the recent past the Strategic Environment Assessment (SEA) Process has been identified as a prerequisite for area-based development and the SEA legislation is now being finalized.	• SEA process can be easily finalized and approved by the Cabinet of Ministers. • The Govt. institutions, NGOs, Media, Academics and public can be trained in different types of SEAs and how public inputs can be taken in during SEAs. • There are information gaps on spatial variability of necessary parameters, such as water quality, flow patterns and others needed for successful SEAs and EIAs, including climate measurements. More investments to get the minimum data needs satisfied in the country for scientific planning and baseline development is proposed.
PS5: Land acquisition and involuntary resettlement	**Standard Involuntary Resettlement and Access Restrictions**	Govt. has processes and procedures in place for land acquisition and involuntary re-settlements. After the 30-year long conflict most processes and procedures have been re-evaluated and modified.	There are areas that can be improved such as compensation mechanisms for involuntary settlements after acquisitions.
PS6: Biodiversity conservation and sustainable management of living natural resources	**Standard on Biodiversity Conservation and Sustainable Management of Living Natural Resources** • ESIA/targeted assessments and mitigations needed for following risk issues (as per screening): ➢ development of (even small) infrastructure or activities that may cause disturbance to specific elements of biodiversity/areas of high biodiversity value;	As indicated in there are a multitude of approaches for biodiversity conservation. The strategy is provided in the National Biodiversity Strategy and Action Plan 2030. Further, many other frameworks exist in the country that support this aspect.	• The main gap that exists in this area is the scientific monitoring capacity to baseline the situations and monitor the changes. • Lack of baselines, in adequate resources for assessments and monitoring and the lack of high-level technologies is contributing to the gap. • It is recommended to invest in methods, data

GCF E&S Safeguards	IUCN ESMS Procedures and Standards	Governement Policy	Main Gaps and Recommendations
	➢ introduction or reintroduction of species where risks are identified that species develop invasive characteristics; ➢ harvesting of wild living resources (e.g. NTFP) with risks of unsustainable use of living natural resources or when affecting traditional use systems. • Forest restoration projects need to maintain or enhance biodiversity and ecosystem functionality. • Plantation projects need to demonstrate that they are environmentally appropriate, socially beneficial and economically viable. • Where biocides are unavoidable, need of an appropriate pest management planning process, including risk assessment and disclosure of a Pest Management Plan, where relevant.		collection, storage and retrieval systems while enhancing the stakeholder capacity to access, use, analyse and interpret the data. • Some techniques use remote sense and satellite facilities needing partnerships with NASA, EU and other agencies. • Awareness of biodiversity and living resources is another gap that is identified in NBSAP as well as during other project implementations. Identification and understanding the value of conservation is missing. • Biodiversity conservation and payment for ecosystem services are not linked and institutionalize. Mainstreaming this aspect in country accounting, budgeting and planning systems is recommended.
PS7: Indigenous peoples	**ESMS Standard on Indigenous Peoples** • Social analysis carried out by a social scientist and in consultation with affected groups to identify impacts and develop culturally appropriate mitigation measures; • Ensure full and meaningful participation of indigenous peoples in all activities affecting them (positively or negatively); • FPIC for any intervention affecting their rights and access to their lands, territories, waters and resources; • Equitable sharing of benefits from conservation activities among all stakeholders.		

GCF E&S Safeguards	IUCN ESMS Procedures and Standards	Governement Policy	Main Gaps and Recommendations
PS8: Cultural heritage	**ESMS Standard on Cultural Heritage** • If risks are identified, ESIA will be guided by competent professionals with consultation of relevant groups such as local communities, government authorities, relevant civil society organisations, local experts and traditional knowledge holders; • Chance Find procedures • Equitable benefit sharing in cases where use of cultural heritage generates economic and social benefits; • Adherence to FPIC when projects affect cultural heritage to which communities have legal (including customary) rights.	• Government has established norms for cultural heritage related environment concerns implemented by the CEA and the Dept. of Archaeology. • FPIC has been proposed and capacity building conducted under UNREDD. It is yet to be practiced legally.	• Capacity building gaps exist in estimating the potential environment and social impacts on cultural and heritage related standard implementation. • Lack of baseline data and training on the use of new concepts and technologies needs additional investments and capacity development. • FPIC is a new area to the country and agency and community capacities to practice FPIC is not available and recommended.

Section 11: Gender Assessment and Action Plan

11.1. Gender and Climate Change

Climate change impact women and men differently. Women have heavier domestic responsibilities (e.g. Collection of firewood, water, household management, etc.) compared to men and are more often the greater victims of a changing climate. The burden of meeting these responsibilities increase substantially with various manifestations of climate change. In addition to this, higher rates of poverty and weaker access to resources further contribute to the climate change vulnerability of women (GCF, 2018[31]). Gender inequalities and norms limiting women's access to and control of resources, such as land, capital and technical services, can hinder their capacities to navigate the challenges of a changing climate (Brody et al. 2008; Rodenberg, 2009), and can also result in the imbalanced division of labor, lower income, lesser livelihood opportunities, fewer legal rights, less mobility and less political and professional representation (GCF, 2014; GCF, 2018)[32].

The different cultural, domestic and economic roles that women and men play in their households and communities, influences their knowledge and their access to resources, both of which are key determinants of their adaptive capacities and the strategies they use to cope with changing climate and resource availability (Djoudi and Brockhaus 2011)[33]. Furthermore, while both women and men are integral players in natural resource management, men often have greater opportunity to participate in intervention mechanisms as well as to contribute towards decision making processes on the sustainable development of forest and tree resources as opposed to women.

There is ample evidence, which demonstrate that climate policies and actions that fail to meaningfully address gender issues, pose risks undermining gender equality as well as jeopardize efficiency and long-term sustainability of other targets. At the same time, potential synergies exist between addressing gender inequality and environmental (including climate) objectives. All this makes the integration of gender a priority for development projects, especially to those addressing enhancements to the adaptive capacity of vulnerable groups.

Accordingly, GCF has adopted a gender sensitive approach and summarized the same in the GCF gender policy as follows:

1. Ensure that through a gender-sensitive approach, the Fund will achieve greater and more sustainable climate change results, outcomes and impacts, in an efficient manner;
2. Ensure that women and men will equally benefit from activities supported by the Fund;
3. Address assessed potential project/program risks to women and men associated with adaptation and mitigation activities financed by the Fund;
4. Contribute to reducing the gender gap of climate change-induced social, economic and environmental vulnerabilities; and

[31] GCF. 2018. Mainstreaming gender. Green Climate Fund. https://www.greenclimate.fund/how-we-work/mainstreaming-gender
[32] GCF. 2014. Gender Policy and Action Plan. GCF/B.08/19. Green Climate Fund. https://www.google.com/search?q=gcf+gender+policy+and+action+plan&ie=utf-8&oe=utf-8&client=firefox-b and GCF. 2018. Mainstreaming gender. Green Climate Fund. https://www.greenclimate.fund/how-we-work/mainstreaming-gender
[33] Djoudi H, Brockhaus M. 2011. Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali. International Forestry Review 13(2): 123-135.

5. Build women and men's resilience to climate change.

To operationalize the gender policy, six fundamental principles has been introduced by GCF.

- *Commitment* to gender equality and equity;
- *Inclusiveness* in terms of applicability to all the Fund's activities;
- *Accountability* for gender and climate change results and impacts;
- *Country ownership* in terms of alignment with national policies and priorities and inclusive stakeholder participation;
- *Competencies* throughout the Fund's institutional framework; and
- *Equitable* resource allocation so that women and men benefit equitably from the Fund's adaptation and mitigation activities.

On the other hand, women as well as men, empowered through knowledge and resources appropriately, can significantly contribute towards combating climate change. Shifting the paradigm towards low-emission and climate-resilient development pathways—which is the Fund's mandate—requires many individual and collective decisions by communities and institutions. A gender-sensitive approach is, therefore, part of the paradigm shift sought through Fund investments (GCF, 2014; GCF, 2018)[34].

This gender assessment is developed focusing the geographic area and the context that led to the development of the proposal submitted to GCF under the title "Strengthening Climate Resilience for Subsistence Farmers and Agricultural Plantation Communities Residing in the Vulnerable River Basins, Watershed Areas and Downstream of the Knuckles Mountain Range Catchment of Sri Lanka." The assessment provides an overview of existing gender inequalities in Sri Lanka, with special emphasis on the agricultural and natural resource sectors—the two most relevant areas for the project that is being developed. Further, the gender analysis identifies and analyzes the gender-related issues that are relevant to the project while supporting the potential gender mainstreaming opportunities considered for implementation by the project. The assessment is based on key global and local literature, referenced, and observations made during field visits, and discussions with agriculture and natural resource professionals working in Sri Lanka.

11.2. Gender Context in Sri Lanka

According to the Gender Inequality Index (GII), Sri Lanka possesses more gender equality in comparison to other South Asian countries. Sri Lanka's Human Development Index (HDI) in 2013 was 0.750, with a gender inequality-adjusted HDI of 0.643. In the same year, the country's Gender Inequality Index (GII)—which measures gender inequality based on reproductive health, empowerment (political participation and education), and labor market participation—was 0.383. This score denotes that *inequality between women and men* across the above-mentioned three broad social aspects is relatively low in Sri Lanka. However, the country ranks only 75th among

[34] GCF. 2014. Gender Policy and Action Plan. GCF/B.08/19. Green Climate Fund. https://www.google.com/search?q=gcf+gender+policy+and+action+plan&ie=utf-8&oe=utf-8&client=firefox-b and GCF. 2018. Mainstreaming gender. Green Climate Fund. https://www.greenclimate.fund/how-we-work/mainstreaming-gender

187 countries in HDI, demonstrating that further progress is required to achieve gender parity (ADB and GIZ, 2015; UNDP, 2014; Ratnayake, undated)[35].

In terms of health, women represent slightly over half (51.5%) of the Sri Lankan population. Sri Lanka has provided free universal health services for the last 70 years, resulting in an increased life expectancy. Women have greater longevity than men, 79.6 years compared to 72.4 years. Universal healthcare has enabled the country to greatly reduce the prevalence of certain health issues, which were previously more common. HIV infection rate is very low (0.1%), malaria is no longer a major hindrance and the country is considered polio-free. Furthermore, institutional births, postnatal care and immunization are all now standard. At the national level, female feticide and infanticide have not been reported, a sharp contrast to other regional neighbors, although higher female mortality rates are reported in poor or otherwise disadvantaged areas. Additionally, the lower nutritional status of women and inadequate access to health care can be associated with these poor and disadvantaged areas—most of which are rural agricultural areas (ADB and GIZ, 2015)[36].

In the education sector, women in Sri Lanka have had voting rights since the 1930s. Free schooling and related support for textbooks, uniforms, scholarships, subsidized transport and school meals have facilitated the achievement of gender parity in primary, secondary and university education. Female students have a higher enrollment and graduation rate in secondary education, resulting in better performance on national level examinations. This trend continues at the university level where female enrollment is 57.8% out of the total number of students enrolled. Female students represent 70% of those enrolled in arts/law; 50–70% in medicine, dentistry, veterinary science, agriculture, management, and commerce; and 30–20% in computer, information and communication technology (ICT), engineering; and architecture. ICT and engineering are fields that are slated to gain more importance as Sri Lanka transitions to an information and service-based economy. As such, strategies should be developed to increase the number of women professionals in those sectors. Educational achievements have enabled some university graduate women to reach high levels of success in their professional fields (ADB and GIZ, 2015; Ratnayake, undated)[37].

In the economic scenario, Sri Lanka's annual growth rate averaged 5.9% between 2009 and 2017. Similarly, the country achieved a major decline in poverty between 2002 and 2009; from 23% to nine percent of the population. Despite this impressive growth, pockets of poverty continue to exist, with women not benefiting equally from this economic growth. The labor market is heavily segmented and offers a limited economic opportunity for most women. Even professional women face horizontal and vertical barriers that limit their access to decision-making along with higher salary positions. Across economic sectors, women continue to have less access to quality jobs, are generally paid less and face more limitations compared to men in the same position. Women tend to be more strongly represented in the low-paid and laborious industries, including in the agricultural and informal sectors.

[35] Asian Development Bank, Deutsche and Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. 2015. Country gender assessment, Sri Lanka: An update. Mandaluyong City, Philippines: Asian Development Bank; United Nations Development Programme (UNDP). 2014. *Human Development Report 2014, Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience*. New York; Ratnayake, R. Undated. Gender issues in agriculture Sri Lanka. www.lankajalani.org/wp-content/uploads/2015/03/Gender-Issues-in-Agriculture.pdf

[36] Asian Development Bank, Deutsche and Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. 2015. Country gender assessment, Sri Lanka: An update. Mandaluyong City, Philippines: Asian Development Bank

[37] Asian Development Bank, Deutsche and Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. 2015. Country gender assessment, Sri Lanka: An update. Mandaluyong City, Philippines: Asian Development Bank; Ratnayake, R. Undated. Gender issues in agriculture Sri Lanka. www.lankajalani.org/wp-content/uploads/2015/03/Gender-Issues-in-Agriculture.pdf

Half of women workers are engaged in the informal sectors, where pay, benefits and security are all relatively low; they are concentrated, as mentioned above, in low productivity and low-income agriculture and plantation sectors with limited to no opportunities for promotion. Many women work in unpaid areas, such as family agriculture and labor, including in the collection of products from forests and other natural ecosystems. Compared to men, women also have more restricted access to capital, agricultural inputs, technical and market information and extension services (Malhotra and DeGraff, 1997; ADB and GIZ, 2015; Trading Economics, 2018; Wikipedia, 2018b)[38].

11.3. Agriculture and Natural Resource Management

As in most rural based local economies, Sri Lankan women and men have different roles and responsibilities in activities related to agriculture and natural resource management. There are tasks that are shared by both genders and then there are those that are dominated by either women or men. This results in the evolution of unique gender-based knowledge, experiences and strategies related to resource management and operational aspects, that may be unknown, unrecognized or inadequately supported by the other gender. To approach agricultural and natural resource management from a balanced and informed basis, it is imperative to ensure an equitable involvement by both genders, despite their different roles. As such, the empowerment through development interventions and obtaining inputs from both, women and men, has to be done in such a way that the medium- to long-term value creation, appreciation and synergy are harnessed by both genders through project activities.

The proposed project focuses on different agricultural and natural resource systems involved in irrigated rice, annual horticultural systems, homegardens, plantations, and forest and natural resource management. Gender roles in spice gardens and analogue forests are similar to homegardens. To enhance the resilience of these systems and the rural communities associated with them through the adoption of climate-smart adaptive management options, women and men require gender sensitive interventions in the areas as illustrated below:

- Awareness and capacity building regarding participatory governance of climate adaptation establishments and information portals, environmental services, and micro-finance mechanisms;
- Capacity building and assistance with the adoption of climate-adapted water flow control and storage practices;
- Capacity building and assistance with the implementation of climate-adapted agricultural and natural resource management practices for the systems; and
- Assistance with product development and branding, implementation of value-adding processing, and the development of agriculture-based small-scale enterprises.

[38] Malhotra, A and DeGraff, DS. 1997. Entry versus success in the labor force: Young women's employment in Sri Lanka. World Development. 25 (3): 379–394. doi:10.1016/S0305-750X(96)00114-3; Asian Development Bank, Deutsche and Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. 2015. Country gender assessment, Sri Lanka: An update. Mandaluyong City, Philippines: Asian Development Bank; Trading Economics. 2018. Sri Lanka GDP Growth Rate. https://tradingeconomics.com/sri-lanka/gdp-growth; Wikipedia. 2018. Gender inequality in Sri Lanka. https://en.wikipedia.org/wiki/Gender_inequality_in_Sri_Lanka#Patriarchal_society

To extend gender sensitivities and to focus and assure that women have equitable access to project resources, services and activities the following approach will be applied:

1) Seek inputs regarding planning. Implementation and priorities of women community leaders and partners who are respected locally, by government agencies and other partners;
2) Plan activities to meet time availability, location restrictions, and specific priorities of women;
3) Organize women's groups and women only activities, if necessary, to provide an environment conducive for women to participate, share their knowledge and learn more effectively; and
4) Facilitate and promote women's access to key resources, such as land and Agroforestry products.

Experience demonstrates that the above approach will strengthen women's involvement and knowledge, as well as, enhance their confidence regarding their knowledge of agricultural and natural resource management options, build their leadership and decision-making capacities, and strengthen their resolve to contribute to public discussions.

11.3.1. Irrigated Agriculture

In irrigated systems, rice is the single most important crop in Sri Lanka, occupying approximately one-third of the country's arable land. Rice is important for both food security and income generation and provides approximately half of the calorie intake of the average Sri Lankan. Both women and men are involved in rice cultivation. Together, women and men are responsible for the land preparation, field clearing, field pond maintenance, canal cleaning, water management, and sowing. Men are responsible for ploughing, field levelling, application of agricultural chemicals, weeding, fencing and protection, thrashing, transportation, and selling rice yields in town. Women are responsible for nursery production, transplanting, harvesting and farm gate sales. Women make these important contributions to rice production, while also being responsible for household management and child rearing. Sri Lanka is blessed with favorable growing conditions for rice. Two crops per annum should be possible in most rice growing areas. However, unfortunately, the inadequate water supplies have reduced the 'cropping intensity' in most rice production areas to one or less. This results in under-employment or under-utilization of the family labor and a lack of food security for subsistence farmer families and communities (Ratnayake, undated)[39].

11.3.2. Horticulture

The climatic conditions of the Sri Lankan highlands are conducive to the cultivation of a broad range of annual horticultural species. Crops commonly cultivated in these systems include kidney beans, beets, chilies, big onions, green gram, cabbages, bitter gourd, pumpkin, tomato, okra, eggplant, luffa, and long beans. These crops are commonly produced by farmer families on small landholdings, most often at the subsistence level. Each farm cultivates a diverse set of crops under low input and rain-fed conditions where irrigation may be used if water is accessible. Crop selection is based on household preference and perceived local market demand. Yields per farm

[39] Ratnayake, R. Undated. Gender issues in agriculture Sri Lanka. www.lankajalani.org/wp-content/uploads/2015/03/Gender-Issues-in-Agriculture.pdf

per crop are of limited quantity and used for food security and sales in local markets. Gender roles in annual horticultural systems are similar to those in irrigated rice systems. Together, women and men conduct land preparation, field cleaning, sowing, application of agricultural chemicals, weeding, and selling yields in town. Men are solely responsible for fencing and protection. Women are responsible for nursery production, transplanting, harvesting and farm gate sales. As with rice production, women contribute to annual horticultural production while also being the primary household manager and family caregiver (Ratnayake, undated)[40].

11.3.3. Homegardens

A homegarden is a diverse multiple-species, land-use system that combines horticultural crops, perennial crops, livestock and occasionally fish, in areas adjacent to rural homes. These systems produce multiple products and environmental services. The composition, structure and management of homegardens vary greatly according to the household characteristics and management objectives. From originally being a subsistence agricultural system, most homegardens have evolved into a commercial orientation with products used for both home consumption and to raise income through market sales. As homegardens are part of the home, maintenance is part of the household work, giving women greater influence over the system. Generally, women are responsible for most management decisions and implementation, including species preference, cultivation, harvesting and use of the product. Tree and vegetable nurseries are often established in homegardens. The responsibilities of men focus on activities that are labor intensive, such as soil or biomass transfer, deep cultivation work, and harvesting timber. Usually, women cultivate a large variety of annual and perennial crops that yield product for household use.

11.3.4. Plantations

The plantation sector in Sri Lanka cultivates a large number of globally traded perennial commodities, including tea, coconut, rubber, timber and spices, such as cardamom, cinnamon, pepper, cloves, and nutmeg. These crops are export commodities that make important contributions to the Sri Lankan economy. The plantation sector employees, both women and men, and laborers are primarily of Tamil ethnicity. Women make significant contributions to the sector, but are paid lower wages, worked for longer hours and have minimal access to facilities. Downturns in the plantation sector over the last few years has resulted in under-employment of plantation laborers, further stressing these workers, who are at the lowest level of the formal economy sector already. They have limited access to land, housing, savings, and basic infrastructure. To improve their economic conditions, female laborers are seeking employment beyond the plantations, primarily as domestic servants within and outside of the country (ADB and GIZ, 2015). However, job opportunities are limited; additional options are needed to provide attractive opportunities for plantation laborers, both women and men.

11.3.5. Forest and Natural Resource Management

Besides their significant role in agricultural production and household management, women also play and have a critical role in terms of forest protection and management. Many basic needs (water, fuelwood, fruits, vegetables, spices and other non-timber forest product--NTFPs) of a

[40] Ratnayake, R. Undated. Gender issues in agriculture Sri Lanka. www.lankajalani.org/wp-content/uploads/2015/03/Gender-Issues-in-Agriculture.pdf

household are collected in or near forests. Women are key managers of forest resources and are also the main victims of deforestation and degradation. Recognizing this fact, project managers should take steps to ensure meaningful participation of women in activities related to community forest and natural resource management.

Experience suggests that while men often organize and lead community-based forest management and protection committees and activities, women are effective and active group members. Women share the role of forest monitoring with men, often conducting the monitoring task when collecting non-timber forest products (NTFPs) for household use. In contrast, men often prioritize utilizing forest resources for timber harvesting or for collecting other high-value forest products. Since women prioritize the NTFP and environment service roles of the forest, they feel a strong moral obligation to protect the forest and monitor forest fires and illegal activities. Forest officials may be unaware of the role that women perform in forest monitoring. Women often report their observations to their husbands or close male family members, who in turn pass the information onto forest officials. While often unseen, women play an important role in forest protection as they are main beneficiaries of the forests and have the most to lose from forest degradation. However, women have limited direct power in the protection of forests (Forest Department, 2016)[41].

Women play a greater role in forest rehabilitation. They dominate nursery and seedling production activities, including seed and other germplasm selection and collection; soil preparation; sowing and seedling production; watering and maintenance; seedling sales; and revenue management. The key roles of men in nursery management are site preparation and soil/supply transportation. Women do not hesitate to take the lead in nursery management and are often considered better nursery managers due to their time availability and attention to detail. Enrichment planting activities are generally shared by women and men. Men conduct the heavier labor activities, site clearing, site preparation, and transporting seedlings. The planting and maintenance of seedlings generally falls on to the role of women (Forest Department, 2016)[42].

The design, development and management of farmers' woodlots (FWLs) is an important community forest activity that serves public environment goals of landscape restoration and addresses farmers' livelihood objectives by producing priority species (both annual and perennial) for household use and market sales. Community groups can secure a 25-30-year lease for a

[41] Forest Department. 2016. Sri Lanka Community Forestry Programme and Gender and Social Inclusiveness. Community Forestry Program, Forest Department
[42] Forest Department. 2016. Sri Lanka Community Forestry Programme and Gender and Social Inclusiveness. Community Forestry Program, Forest Department

Story from: Sri Lanka Community Forestry Program, Forest Department

Ms Thakshila, [29], of Sellabawa, got married in 2006 and lives with her husband who works as a Carpenter, and their two sons–of ages 7 and 4, in a house which had been constructed after their marriage. Her father-in-law was a member of the Community Based Organization (CBO) in the past. But Thakshila's family did not receive the CBO membership, as her husband was always seen going out of the village for his daily earnings.

After a period of time, Thakshila began attending the CBO meetings, also representing her father-in-law. In 2015, Thakshila was assigned as the Secretary to the CBO by a member, but she did not want to accept the position as she had never worked in any societies before. However, with the encouragement received from the other members, as well as from her family, she accepted the position and began functioning as the Secretary of the CBO.

"When they nominated me, I did not think that I could do this, and it was not an easy task. But the members, and also my father-in-law advised me to accept the post. I had studied only up to Ordinary Level and I am a woman; women like to keep everything in perfect order. Therefore, I too began changing the report and record books, taking of meeting minutes, and the work pattern of the CBO. Now, at the CBO, we have learnt and know how to work in a village, and talk to, and bargain with government officers. As women, we were able to show our work, and how we work in our village and also obtain loan facilities for the village". "I feel that we women members are behind the success of this CBO", she finally stated.

degraded forest land, often Chena land, from the Forest Department to establish an FWL. Both, women and men play significant roles in FWL establishment and management. Both genders share the role of intercropping FWLs with annual horticultural crops during the first 4-5 years. As with forest rehabilitation activities, women take the lead in seedling production and planting activities and men in site preparation and transportation. Experience indicates that inequity in management decisions can undermine women's participation in FWLs. To increase the effectiveness and socioeconomic benefits of the FWLs, and all forest management related activities, it is important from the beginning of activities to acknowledge the equitable involvement of both women and men. Selection of species, annuals and perennials, should be shared by women and men to assure that all priorities are addressed (Forest Department, 2016)[43].

Story from: Sri Lanka Community Forestry Program, Forest Department

One of the notable activities of the Community Forestry Program of the Forest Department is the Farmers Woodlots (FWL), where19 members [7Males +12Females] were given FWL. Among six FWL receivers, who were randomly selected and interviewed during the mission, it was learnt that five of them have at least one-acre highland while the other was still living in an irrigation tank reservation and had very recently obtained a piece of land from the government. All have encroached around two and a half to three-acre government land including forest land for chena cultivation. They had also received around half-acre forest land through the agreement as FWLs, and each one of them had earned over LKR 26,000 per year from the FWL by planting cowpea, sesame seeds, etc. Out of the six who were interviewed, four women had signed the agreements with the FD, encouraged by their husbands.

The most significant finding was how a woman [Sonali], who received an FWL to her name, hailing from a landless family and living in an irrigation tank reservation, had paid a fine of LKR 15,000 in the year 2012 for forest land encroachment. Sonali, while sobbing revealed that in 2012, when they were in the encroached land, officials of the FD rounded them up. Although she was pregnant at the time, she had run into the thick jungle but had eventually been caught by the officers, and her husband had been produced before courts and fined LKR 15,000. Receiving an FWL has not only changed their entire life but now there is no fear of arrest either. What more, they also have a piece of land to cultivate for a living.

Apart from Sonali, there were two other women who received FWLs to their names. They too had to pay a fine to the courts for encroachment; one had paid LKR 5,000 in 2007 and the other had paid LKR 30,000 in 2012.

[43] Forest Department. 2016. Sri Lanka Community Forestry Programme and Gender and Social Inclusiveness. Community Forestry Program, Forest Department

11.4. Project Related Gender Elements

The project covers both urban and rural areas with several agricultural and production settings including the estates (tea, rubber and export crops) (Table 8 and 9) as described in detail in Section 2 on project area characteristics and Section 4 on socioeconomic features in the project area.

Table 47: Gender related information in 2012

District	Matale	Anuradhapura	Kurunegala	Puttalam
No of Divisional Secretariat Divisions	11	16	04	01
No of Grama Niladhari Divisions	577	418	85	04
No of males	232,834	419,019	91,067	1,846
No of females	249,332	436,019	95,973	1,717
Urban Population	25,428 (M) 26,723 (F)	18,222 (M) 18,334 (F)	NA	NA
Rural Population	178,558 (M) 190,518 (F)	400,797 (M) 418,651 (F)	91,067 (M) 95,973 (F)	1,846 (M) 1,717 (F)
Estate Sector Population	20,633 (M) 22,966 (F)	NA	NA	NA

Source: Dept. of Census and Statistics, 2012 National Census

The gender concerns under each activity (18 activities in total) that led to the Gender action plan at the end of this section are discussed next.

i) Activity 1.1.1: Streamside Protection and Drainage Management Along Roads

These conservation measures are focused on the linear stream and road networks that support actions at both community and individual household level. Key inputs include:

- Vegetation management to control runoff and enhance infiltration (this will have benefits in reducing reservoir spill—dam safety, and sedimentation and thereby downstream irrigation supply); soil health management (soil C, water retention, biotic function) and focus on streamside management.
- Drainage management along roads and in relation to other soil disrupting construction activities (to prevent run-off and increase groundwater recharge, take water off rather than allowing it to accumulate down the hill) with community management to maintain dykes and clear silt.

Water for domestic purposes is crucial for families headed by women or widowed with children, and housewives, in order to prepare and serve food, for drinking and other hygiene requirements. During climate induced extreme conditions, such as a drought, women are more vulnerable as they are the ones who usually have to travel long distances to collect water for their families. This results in having less time for women to concentrate on child nutrition, their education and also to engage in additional income generating activities that will aid to achieve a better life. The efforts undertaken by the project will contribute to sustain the water sources in terms of quality and quantity, mainly in the upper catchment and also in downstream areas as well.

ii) Activity 1.1.2: Rehabilitation and Establishment of Village Tanks, Ponds and Irrigation Networks

This will involve rehabilitation and development of village level ponds and irrigation channels (including both direct rainwater harvesting and tapping stream networks). Actions will focus on thematic mapping of areas suitable for practicing various rainwater harvesting options, such as village tanks and farm ponds; construction and rehabilitation of farm and village ponds and the irrigation networks connecting them to field agriculture. Also included are the monitoring of water flow and quality, stream erosion and ground water re-charge at GN level.

Village level organizations are to be formed or strengthened through the project activities to engage the community in the maintenance of new streams, stream protection measures, drainages etc. Participation of women in these activities is expected to be high, based on past development project experiences. The project will support to empower women and youth leadership in these community organizations and organize and mobilize the village to sustain the project initiatives.

iii) Activity 1.1.3: Restoration of Forest Mosaic Landscapes

This activity focuses on restoring degraded forests within protected areas and forest fragments; re-growing forests in priority areas in supply of ecosystem services, especially watershed protection; and the planting of trees outside forests for improved sustainability and livelihoods. The project will employ a Forest Landscape Restoration (FLR) approach in the forest mosaic landscape areas adjoining protected areas.

Involving in forestry activities, especially in a community forestry aspect, provides opportunities for women to support their families to earn an additional income while contributing to the conservation of forests. The incentives or income options for daily labor in a forestry program includes producing plants in their domestic nurseries and having a land from the Government to grow commercially valuable timber species under farmer woodlots.

iv) Activity 1.2.1: Increasing Cropping Intensity of Irrigated Rice in both Upstream and Downstream Areas

This activity focusses on the development of smart farming techniques to grow appropriate climate adapted varieties and make efficient use of irrigation water and fertilizer (maximizing use of organic inputs and recycling) as well as employing integrated pest control mechanism based on real time weather and pest incidence data. Traditional irrigation methods, such as furrow irrigation (FI) and continuous flooding irrigation (CI) result in high water loss. Water saving irrigation methods, improve water use efficiency (WUE). The System of Rice Intensification (SRI) that the project will promote is a climate-smart and yield-increasing system that is being utilized by more than 10 million smallholder farmers in over 55 countries. The innovation combines several agronomic practices to boost yields while reducing the use of purchased inputs and water.

Due to prolonged dry spells and insufficient water for agriculture, farmers hardly cultivate two seasons per year. This results in a considerable pressure on the family income. It was observed in rural areas that women migrating for foreign employment is triggered by a lack of income for the family to fulfill the requirements of their children, especially in terms of education and housing.

Ensuring farmers' income through increasing cropping intensity will lead to more revenue for families and reduce the economic pressure on women and children.

v) Activity 1.2.2: Intensification of Sustainable smallholder production

This will focus on options for sustainable intensification of homegardens, analog forests, spice gardens and annual horticultural crops in the upstream catchment. Key intervention areas are:

- Enhancing species diversity to reduce climate, biophysical and market vulnerability;
- Strengthening farmers' access to the best-available quality germplasm of priority climate-resilient species, varieties and cultivars that match local biophysical and soil conditions;
- Developing individual and group tree nurseries to empower farmers to independently produce high quality seedlings of priority species;
- Promoting thinning to achieve recommended spacing, remove unproductive trees, remove low value species, and increase the vigor and productivity of the remnant stand;
- Promoting pruning to remove unproductive branches, improve tree vigor and productivity, and increase light levels for industry intercrops;
- Promoting intercropping with annual crops to improve overall system productivity;
- Promoting the production and use of organic mulch and fertilizers to rehabilitate soils, improve water recharge, and produce products for the green economy;
- Exploring the feasibility of drip irrigation for high-value tree crops to improve water use efficiency and increase tree vigor and productivity.

Cash crop cultivation and analog forest concepts are sustainable solutions to conserve forests while providing opportunities for families, especially women.

vi) Activity 1.2.3: Restoration and intensification of sustainable plantations

This will include tea, coconut, rubber, timber and large-scale cultivation of spices and will also include the development of landscape planning at estate level and the development of food forests to address food security of estate worker families, some of them, having entered into contract farming arrangements with estate companies

Women labor is emphasized in the estate sector, especially in Matale when compared to other districts selected for the project. Poverty has become a significant social issue, and labor unions are demanding an increase to the daily wage for labor from the plantation management. However, the primary commercial crop prices in the global markets are fluctuating and is a sensitive issue to the profit of the companies. There are many abandoned lands in the estate sector that belongs to the Government and private sector, which are not being utilized due to cost factors. The project will focus on planting forest plants along with commercial crops with the support of the estate community when lands are released by landlords. The harvest could be sold back to the factory and the factory will also benefit due to zero operational costs incurred.

vii) Activity 2.1.1: Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers

This involves detailed Geo-referenced maps of existing agricultural value chains (cash crops, spices, herbs and fruits) to capture their current lengths (vertical upstream to downstream) and breadths (horizontal links to input and service sectors as well as the National System of Innovation—NSI) as well as the identification of respective intra-governance structures.

- Establishment of modes of regular market analyses and trade regimes conducive to green production and processing methods as well as products;
- Identification of Sri Lanka's agricultural value chains in national, regional and global markets;
- Scoping opportunities of rent appropriation and comparative advantage with respect to agricultural value chains.

Women who seek opportunities to engage in income generating activities could benefit from the value chain development support of the project. As all women cannot engage in cultivation, many can find opportunities to add value to the agriculture production. Some of these value addition opportunities may include green packaging, organic fertilizer, climate resistant seed preparation, nursery management, transport, food processing etc.

viii) Activity 2.1.2: Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small holder farmers in the uplands

This involves the development of capacity to operate farms and collective groups as business enterprises. It involves providing support to actors to set up soft institutions where needed (based on Activity 2.1.1).

Upon willingness of the community, especially women, a group of women led enterprises on green agriculture could be promoted within the provisions of this activity. In villages, women development associations are available, and these committees can be re-established as women enterprises.

ix) Activity 2.1.3: Identification and Implementation of Value Chain Upgrading Options for Smallholder and Subsistence Farmers Engaged in Climate Smart Agriculture

This involves the joint analysis (linked to Activities 1.2.1-3) and pursuit of meeting buyers' critical success factors and of value chain upgrading options with respect to products, processes, functions, inter-sectoral relationships, institutions (linked to Activity 2.1.2) and new (green) technologies to achieve greater value chain efficiencies and market penetration of existing value chains, the participation in new value chains and/or the exiting from unprofitable or environmentally unsustainable value chains.

- Development of new products and services
- Targeted branding of existing products and establishment of a Green Sri Lanka national brand that benefits climate smart agriculture
- Obtaining appropriate third-party certification and quality assurance
- Improvement of production, harvesting, post-harvest management, storage and transport technologies

Farmers who engage in climate smart agriculture will be provided with efficient supply chains supported by the project. This will lead to obtaining feedback from markets to producers where new product development and technologies could be encouraged. This process will help to improve and establish pop up innovations and new products under woman led enterprises. The project has potential to support women entrepreneurs to reach global markets.

x) Activity 2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms

This will involve a robust socioeconomic and ecological baseline and supporting information that will become the core evidence of provisioning of ecosystem services (output-based payments) and address additional concerns to reduce the cost of policy implementation. This will comprise the basic appraisal of ecosystem services (ES) that are economically valuable and ES providers practicing environmentally protective best practices in the upstream catchment, including their livelihood options and local conservation knowledge. Potential smallholders as PES participants will be selected after considering their opportunity costs, farming systems and other socioeconomic profiles and by applying behavioral economic methods, such as reverse auctions.

Spatially explicit assessments of conservation and green agriculture that contribute to land stability and water use efficiencies in terms of quality and quantity will be captured under this activity. The project could have a category in the spatial assessment to highlight women's contribution to sustain ecosystem services. This will lead to the provision of PES allocations to continue the work done by women's groups.

xi) Activity 2.2.2: Setting up a PES intermediary body as a part of the multi-stakeholder platform, and its governance system established

The intermediary body will be a committee within the nested-multi-stakeholder platform and involve establishing an adaptive rural advisory services (RAS) facility to support adoption of catchment protection practices as well as prioritized promotion of best fit practice matched to a local context. Intensive facilitation needs to be employed to ensure that the committee members understand their roles, have sufficient capacity, and can monitor, evaluate, upscale and replicate the PES.

The project could advocate the Government to develop criteria to incorporate the gender and social inclusiveness perspectives to the PES governance and monitoring system, i.e. deciding a percentage of women to be supported through PES, to continue and enhance the actions of the community for sustainable agriculture.

xii) Activity 2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area

This involves establishing a monitoring system for PES schemes that comprise of both socioeconomic and ecological criteria and indicators. The monitoring system will determine the performance of ES providers in accessing ES rewards, financially and non-financially.

- Scoping of watershed, problems, criteria and indicators

- Capacity strengthening activities for local stakeholders on how to monitor, evaluate and develop criteria and indicators

Issues due to climate change, frequently faced by women, are to be monitored by the proposed system that will be established to monitor PES. For instance, the availability of water for domestic purposes during prolonged dry spells, water use efficiency initiatives that contribute to effective water management, contribution of village ponds and tanks maintained by farmer associations headed by female officials and the contributions made by female government officers on utilizing PES focusing on sustainable ecosystem services.

xiii) Activity 3.1.1: Develop an Integrated Land Use Policy and Planning Mechanism at Sub-Basin Scale

To carry out this activity and to ensure long-term sustainability, five new governance structures (implementation teams) will be developed and put in place to integrate across non-congruent administrative (Divisional Secretariat - DS) and hydrological (sub-catchment) boundaries.

One of the gender perspectives of this activity will be the proper representation of both male and female members in all five teams mentioned above. The five sub-basin areas are to be managed as inter sub-basin and intra sub-basin approaches. The respective management teams shall sensibly identify climate issues and the level of impact of the said issues on gender.

xiv) Activity 3.1.2 Develop the SHARED Information System to Support Land Use Planning, Climate Adaptation, Market Information and Monitoring of the Performance of Intervention Options

The information system will involve developing spatially explicit assessments of land degradation that are critical for the development of effective adaptation options and targeting interventions, while also providing a framework for monitoring progress over time. Both socioeconomic and biophysical information will be integrated.

- Five LDSF baseline surveys with associated satellite image analysis
- Implementation of five sub-basin information portals and dashboards
- Development of an interface to connect sub-basins to an integrated upstream catchment portal

In designing the portals and their interfaces for users, a user requirement identification needs to be conducted, consulting different gender groups among government officers, farmers, entrepreneurs, etc. to improve the usage of the portals to be designed. There shall be easy access to the portals, regardless of the gender and more help desk support will be provided to clarify the queries of the users.

xv) Activity 3.1.3: Development and refinement of SLM framework

This activity will synthesize information to support land use planning, climate adaptation, market information and monitoring with the nested-scale multi-stakeholder innovation platforms for facilitating participatory engagement at the GN level. Activity will produce an organized set of

intervention options for land and water management, tailored to a range of local contexts occurring in the project area.

Farmers (both genders) are to be informed about sustainable land use management strategies as well as intensification of crops that will lead to a higher income. This same system could be used to provide instructions to women who were encouraged to start cultivation with less prior experience.

xvi) Activity 3.2.1: Establishment of Nested-Scale Multi-Stakeholder Innovation Platforms from Sub-Basin to GN Scale

A key element of resilience enhancement of communities and ecosystems includes the engagement of relevant and diverse stakeholders across scales in adaptation planning. This is aided through the utilization of online dashboards and structured engagement to facilitate stakeholder interaction and interrogation with evidence.

Understanding how various stakeholders interact with each other, as well as obtain, share and utilize information/evidence in prioritizing practices that minimize potential negative environmental impacts, are key to developing context-appropriate innovation platforms.

- Root-cause analysis of key constraints (barriers) to adoption of best practices
- Mapping stakeholder networks and their connectivity to inform upscaling activities
- Prioritization of options by women, men and young people
- Trade-off analyses between environmental impact and increased agricultural production

xvii) Activity 3.2.2: Develop local capacity for adaptive and sustainable land management

This activity addresses key capacity developments that are required across the government to connect the bottom up methods that ensure feasible options are developed and top down Rural Advisory Service (RAS) mechanisms that are required to make them widely available. This requires developing capacity to be able to operate a responsive and evidence-based RAS that can incorporate developing knowledge and real time information about changing conditions in the short term (such as weather or pest outbreaks) and long-term (such as suitability of tree species in the context of climate change).

The officers engaged in the project, especially field level officers, including Government officers are required to follow the trainings organized by the project in order to provide rural advisory services to the community members successfully. It is expected to maintain a balanced participation of both genders when selecting trainers and community members.

xviii) Activity 3.2.3: Development and production of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options

The adaptive and responsive options by the contextual framework employed in the project, requires simple guidelines and tools that easily enables for the material to be taken, understood and used at grass roots level.

When designing the tools to share the knowledge generated throughout the project activities, the user needs of different genders are to be considered. Also, when deciding the knowledge sharing tools, concerns of both men and women are to be addressed as well. For example, if we are to assume that smartphone apps cover more males and less females and a series of newspaper articles cover more females and less males, both tools are to be used.

11.5. Gender Action Plan for the Project

Purpose of the Project Gender Action Plan

The purpose of the project's Gender Action Plan is to provide a time-bound framework to implement the project's activities and achieve the outputs, results and outcomes in a gender-sensitive and equitable manner that contributes to reducing the gender gap in climate change-induced social, economic and environmental vulnerabilities. This approach will facilitate the achievement of the GCF impacts the project is designed to address, namely:

- Increased resilience of the most vulnerable communities;
- Increased resilience of ecosystems and ecosystem services, and
- Increased resilience of health, well-being and water and food security.

The action plan provides all implementing partners, accredited entity, and the national designed authority with a tool and a process to monitor and evaluate the project's:

- *commitment* to gender equality and equity;
- gender *inclusiveness* in terms of activity implementation;
- *accountability* for gender and climate change results and impacts; and
- *equitable* of resource allocation so that both, women and men benefit from project implementations.

Table 48: Gender action plan

Activities related to Gender and Social Inclusiveness	Indicators and Targets	Timelines	Responsibilities
Integrated sub-basin level governance mechanism for climate adaptation establishment	• Assessment on the number of female politicians and Government officers related to each sub-basin • At least 75% of them were empowered on climate adaptation	Start in year one 2nd quarter and end in year two 3rd quarter	IUCN[44], MMDE[45], LA[46], DS[47]

[44] International Union for Conservation of Nature
[45] Ministry of Mahaweli Development and Environment
[46] Respective Local Authority
[47] Respective District Secretariat/Divisional Secretariat

Climate adaptation information portals at the sub-basin scale established	• Farmers are aware and youth groups are trained on usages • At least 50% of the above farmers and youth groups are females	Start in year two 2nd quarter and end in year three 3rd quarter	IUCN, MMD&E, MOA[48], Consulting Agency
• Environmental service (rewards, payments, or service provision) and micro-finance mechanisms and adaptive rural advisory services established; • Farmers and communities adopt climate adapted water flow control and storage practices across landscapes	No of benefiting farmers At least 50% are female farmers	Start in year two 3rd quarter and end in year five 3rd quarter	IUCN, MMD&E, LA, DS. MOA
Farmers adopt climate adapted agricultural management practices across landscapes	• No of farmers benefited. • At least 50% of them are female farmers	Start in year two 2nd quarter up to project end	IUCN, MMD&E, MOA
Sub-basin innovation platforms to monitor the performance of climate adaptation options	At least 30% of innovations are by women, and the women involved in innovation and entrepreneurship are promoted	Start in year two 2nd quarter up to project end	IUCN, MMD&E, MOA, MOT[49]
Product development and branding to generate and capture greater value for rural people	At least 30% of new product developments and brand development are by women	Start in year three 2nd quarter up to project end	IUCN, MMD&E, MOA, MOT, EDA[50]
Farmers and local entrepreneurs add value to products through certification, quality assurance, processing and collective action	At least 25% of smallholder enterprises are led by a woman entrepreneur to achieve quality and certification	Start in year three 2nd quarter up to project end	IUCN, MMD&E, MOA, MOT, EDA
Enterprise and business development to exploit green growth opportunities	At least 25% of smallholder enterprises are led by a woman entrepreneur to achieve green growth opportunities	Start in year three 2nd quarter up to project end	IUCN, MMD&E, MOA, MOT, EDA
Climate and market information systems for adaptive irrigation and agricultural management established	• No of farmers and smallholders benefited • At least 50% of the above are female	Start in year three 3rd quarter up to project end	IUCN, MMD&E, MOA, MDM[51], EDA, MPI[52]
Farmers adopt climate-smart agricultural practices to make more efficient use of irrigation water	• No of farmers adopted climate-smart agriculture practices • At least 50% of the above are female	Start in year three 4th quarter up to project end	IUCN, MMD&E, MOA,

[48] Ministry of Agriculture
[49] Ministry of Science and Technology
[50] Export Development Authority
[51] Ministry of Irrigation, Water Resources and Disaster Management
[52] Ministry of Primary Industries

Annexures

Socioeconomic Status

	Own Land		Owned by an Organization		Owned by an Individual		In partnership		Total	
DSD	Farmers	Extent (Ac)	Farmers	Extent (Ac)	Farmers	Extent (Ac)	Farmers	Extent (Ac)	Farmers	Extent (Ac)
Minipe	11,823	21,656	49	84	47	196	14	18	11,933	21,953
Udadumbara	5,144	14,908	9	24	47	111	33	96	5,233	15,138
Pathadumbara	7,503	6,241	15	38	21	66	48	37	7,587	6,382
Akurana	4,727	4,117	24	58	20	42	10	4	4,781	4,221
Galewela	13,313	25,120	165	310	108	225	193	552	13,779	26,207
Dambulla	12,812	29,599	144	354	171	678	410	876	13,537	31,506
Naula	6,020	13,454	72	116	48	148	82	180	6,222	13,898
Pallepola	5,582	10,478	16	129	45	91	42	66	5,685	10,765
Yatawatte	4,687	7,800	12	51	30	51	21	44	4,750	7,946
Matale	5,588	7,603	21	42	84	235	56	177	5,749	8,058
Ambanganga Korale	3,588	5,069	9	38	26	39	33	42	3,656	5,188
Laggala-Pallegama	2,996	7,794	11	11	34	153	16	63	3,057	8,019
Wilgamuwa	6,938	15,735	19	33	50	134	38	98	7,045	16,000
Rattota	8,714	8,968	38	84	44	100	40	50	8,836	9,201
Ukuwela	5,400	7,166	30	91	45	115	115	146	5,590	7,520
Giribawa	7,895	19,557	17	24	88	187	39	104	8,039	19,872
Galgamuwa	12,656	26,773	30	46	80	266	490	923	13,256	28,008
Ehetuwewa	6,645	16,767	7	16	39	141	103	193	6,794	17,116
Polpithigama	19,874	46,745	131	349	188	466	236	591	20,429	48,151
Galenbidunuwawe	11,321	39,139	15	26	109	271	317	1,300	11,762	40,735
Galnewa	8,100	16,054	11	12	34	104	93	165	8,238	16,335
Ipalogama	7,473	16,280	39	84	54	213	15	61	7,581	16,638
Kahatagasdigiliya	9,167	32,446	37	66	140	351	46	186	9,390	33,049
Kekirawa	11,156	26,268	33	40	133	405	68	170	11,390	26,883
Mihintale	6,220	19,822	7	28	61	227	24	51	6,312	20,127
Nachchadoowa	4,701	11,714	5	23	18	54	31	88	4,755	11,879
Nochchiyagama	9,427	29,237	12	35	51	210	41	93	9,531	29,575
Nuwaragam Palatha East	5,952	9,452	18	38	277	752	22	71	6,268	10,312
Palagala	8,272	19,238	11	10	49	164	234	414	8,566	19,827
Palugaswewa	3,684	11,051	8	17	33	150	21	69	3,746	11,287
Rajanganaya	7,655	14,191	2	1	29	96	35	65	7,721	14,353
Thalawa	13,222	30,754	25	52	90	401	53	189	13,390	31,396
Thambuttegama	7,686	15,898	17	23	97	247	31	109	7,831	16,278
Thirappane	6,582	21,938	9	22	49	183	39	186	6,679	22,329
Total	272,523	609,032	1,068	2,375	2,439	7,272	3,089	7,477	279,118	626,152

Farmer Population by Gender – 2014

	Age 10-19		Age 20-29		Age-30-39		Age 40-49		Age 50-59		Age 60 or above		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Minipe DSD	6	1	442	97	2,046	286	2,745	354	2,503	497	2,341	695	10,083	1,930
Udadumbara DSD	1	1	114	16	814	80	1,171	135	1,084	188	1,282	366	4,466	786
Pathadumbara DSD	1	2	73	21	596	140	1,235	294	1,661	371	2,992	934	5,858	1,762
Akurana DSD	5	1	49	13	380	67	906	159	1,161	252	1,303	516	3,804	1,008
Galewela DSD	11	3	377	50	2,069	269	3,207	458	3,001	690	2,597	1,085	11,262	2,555
Dambulla DSD	12	1	594	87	2,449	342	3,138	422	3,105	587	2,239	589	11,537	2,028
Naula DSD	3	-	153	27	807	98	1,460	147	1,554	252	1,397	346	5,374	870
Pallepola DSD	1	-	102	12	662	70	1,229	151	1,370	281	1,407	435	4,771	949
Yatawatte DSD	3	-	71	18	503	57	930	124	1,152	248	1,275	383	3,934	830
Matale DSD	1	1	84	22	544	124	1,055	227	1,282	342	1,532	557	4,498	1,273
Ambanganga Korale DSD	1	-	66	22	500	65	772	112	821	210	809	283	2,969	692
Laggala-Pallegama DSD	1	-	111	16	578	33	737	53	711	100	644	101	2,782	303
Wilgamuwa DSD	5	1	309	43	1,347	139	1,641	165	1,528	288	1,239	363	6,069	999
Rattota DSD	6	-	202	37	1,021	173	1,751	321	1,923	436	2,180	812	7,083	1,779
UkuwelaDSD	3	-	49	20	494	82	968	180	1,252	295	1,706	574	4,472	1,151
Giribawa DSD	10	1	305	107	1,501	298	1,760	289	1,624	363	1,376	408	6,576	1,466
Galgamuwa DSD	6	2	393	180	2,257	654	2,792	638	2,578	699	2,225	835	10,251	3,008
Ehetuwewa DSD	1	1	164	33	1,115	157	1,587	213	1,462	356	1,294	417	5,623	1,177
Polpithigama DSD	11	1	646	150	3,495	495	4,487	671	4,287	1,176	3,653	1,369	16,579	3,862
Galenbidunuwawe DSD	9	2	442	63	2,384	222	2,870	301	2,341	440	2,062	673	10,108	1,701
Galnewa DSD	3	-	281	62	1,675	204	1,925	296	1,699	378	1,357	360	6,940	1,300
Ipalogama DSD	4	1	261	37	1,373	176	1,808	283	1,553	411	1,277	405	6,276	1,313
Kahatagasdigiliya DSD	7	-	440	61	2,030	253	2,178	332	1,762	425	1,399	503	7,816	1,574
Kekirawa DSD	5	1	400	62	2,152	238	2,543	389	2,417	561	1,999	691	9,516	1,942
Mihintale DSD	3	1	290	49	1,223	146	1,535	254	1,256	305	903	348	5,210	1,103
Nachchadoowa DSD	5	1	187	22	938	105	1,075	168	937	274	825	286	3,967	856
Nochchiyagama DSD	2	1	459	49	1,873	234	2,257	354	1,751	473	1,543	570	7,885	1,681
Nuwaragam Palatha East	4	2	204	48	1,016	202	1,492	302	1,258	358	1,088	386	5,062	1,298
Palagala DSD	6	1	390	47	1,621	181	1,969	289	1,775	387	1,488	445	7,249	1,350
Palugaswewa DSD	1	2	179	34	734	131	864	144	659	147	639	212	3,076	670
Rajanganaya DSD	1	-	271	29	1,391	148	1,695	297	1,443	368	1,517	593	6,318	1,435
Thalawa DSD	8	3	627	84	2,594	363	3,115	487	2,541	657	2,201	747	11,086	2,341
Thambuttegama DSD	7	1	296	34	1,434	165	1,836	302	1,540	348	1,410	458	6,523	1,308
Thirappane DSD	2	1	326	47	1,398	195	1,541	225	1,240	309	1,050	374	5,557	1,151
Total	**155**	**33**	**9,357**	**1,699**	**47,014**	**6,592**	**62,274**	**9,536**	**58,231**	**13,472**	**54,249**	**18,119**	**230,580**	**49,451**

Educational Qualifications by Gender

		No Schooling		Grade 5 or below		Grade 6-10		GCE (O/L) or equivalent		GCE (A/L) or equivalent		University Degree		Total	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Kandy	Minipe DSD	505	294	3,350	617	4,047	576	1,477	317	574	109	130	17	10,083	1,930
	Udadumbara DSD	355	160	1,515	254	1,473	186	733	119	321	59	69	8	4,466	786
	Pathadumbara DSD	89	82	776	329	1,721	543	1,782	468	1,166	291	324	49	5,858	1,762
	Akurana DSD	78	115	747	307	1,405	296	873	157	523	111	133	22	3,804	1,008
Matale	Galewela DSD	212	142	2,572	812	4,569	869	2,615	462	1,018	226	276	44	11,262	2,555
	Dambulla DSD	328	135	2,907	571	4,937	767	2,315	373	825	149	225	33	11,537	2,028
	Naula DSD	173	63	1,467	272	1,968	279	1,106	170	498	71	162	15	5,374	870
	Pallepola DSD	104	73	1,281	270	1,978	322	835	164	456	103	117	17	4,771	949
	Yatawatte DSD	97	49	972	226	1,306	241	926	165	522	122	111	27	3,934	830
	Matale DSD	149	85	716	240	1,250	327	1,232	332	870	242	281	47	4,498	1,273
	Ambanganga Korale DSD	179	121	1,029	252	991	169	565	100	186	41	19	9	2,969	692
	Laggala-Pallegama DSD	94	45	930	100	1,116	98	405	42	200	13	37	5	2,782	303
	Wilgamuwa DSD	336	169	2,372	385	2,054	255	893	136	330	47	84	7	6,069	999
	Rattota DSD	267	198	1,917	543	2,642	538	1,361	309	738	160	158	31	7,083	1,779
	Ukuwela DSD	92	46	869	295	1,274	288	1,211	300	865	192	161	30	4,472	1,151
Kurunegala	Giribawa DSD	185	134	1,864	464	2,784	453	1,088	268	523	127	132	20	6,576	1,466
	Galgamuwa DSD	256	181	2,788	846	4,074	982	2,068	678	903	299	162	22	10,251	3,008
	Ehetuwewa DSD	140	82	1,392	391	2,106	352	1,291	235	598	113	96	4	5,623	1,177
	Polpithigama DSD	468	278	4,717	1,346	7,203	1,365	2,789	612	1,193	237	209	24	16,579	3,862
Anuradhapura	Galenbidunuwawe DSD	170	102	2,298	528	4,194	575	2,299	330	962	142	185	24	10,108	1,701
	Galnewa DSD	120	56	1,728	433	3,152	462	1,295	235	532	97	113	17	6,940	1,300
	Ipalogama DSD	148	83	1,288	363	2,493	469	1,423	219	738	152	186	27	6,276	1,313
	Kahatagasdigiliya DSD	116	118	1,487	456	3,080	531	2,290	340	739	108	104	21	7,816	1,574
	Kekirawa DSD	160	110	1,726	497	4,632	825	1,850	317	897	158	251	35	9,516	1,942
	Mihintale DSD	84	66	838	277	2,056	369	1,519	276	582	100	131	15	5,210	1,103
	Nachchadoowa DSD	67	51	880	222	1,569	330	924	168	433	75	94	10	3,967	856
	Nochchiyagama DSD	151	124	1,703	548	3,766	645	1,600	243	574	103	91	18	7,885	1,681

	Nuwaragam Palatha East DSD	32	55	690	252	2,021	487	1,252	285	795	173	272	46	5,062	1,298
	Palagala DSD	202	88	1,765	431	2,963	449	1,519	258	681	106	119	18	7,249	1,350
	Palugaswewa DSD	48	36	718	191	1,484	274	583	120	199	40	44	9	3,076	670
	Rajanganaya DSD	107	68	1,636	513	2,928	579	1,147	194	432	73	68	8	6,318	1,435
	Thalawa DSD	198	109	2,449	704	5,073	909	2,309	421	904	179	153	19	11,086	2,341
	Thambuttegama DSD	190	100	1,777	493	2,439	366	1,435	253	569	88	113	8	6,523	1,308
	Thirappane DSD	161	78	1,181	349	2,144	400	1,387	232	571	87	113	5	5,557	1,151
	Total	**6,061**	**3,696**	**56,345**	**14,777**	**92,892**	**16,576**	**48,397**	**9,298**	**21,917**	**4,393**	**4,923**	**711**	**230,580**	**49,451**

Percentage of Farmer Population (5 years and over) by educational qualifications – 2014

		No Schooling		Grade 5 or below		Grade 6-10		GCE (O/L) or equivalent		GCE (A/L) or equivalent		University Degree		Total	
		No	%	No	%	No	%	No	%	No	%	No	%	No	%
Kandy	Minipe DSD	799	7	3,967	33	4,623	38	1,794	15	683	6	147	1	12,013	100
	Udadumbara DSD	515	10	1,769	34	1,659	32	852	16	380	7	77	1	5,252	100
	Pathadumbara DSD	171	2	1,105	15	2,264	30	2,250	30	1,457	19	373	5	7,620	100
	Akurana DSD	193	4	1,054	22	1,746	36	1,030	21	634	13	367	8	4,812	100
Matale	Galewela DSD	354	11	3,384	16	5,438	19	3,077	19	1,244	16	320	17	13,817	18
	Dambulla DSD	463	15	3,478	17	5,704	20	2,688	17	974	12	258	14	13,565	17
	Naula DSD	236	8	1,739	8	2,247	8	1,276	8	569	7	177	9	6,244	8
	Pallepola DSD	177	6	1,551	7	2,300	8	999	6	559	7	134	7	5,720	7
	Yatawatte DSD	146	5	1,198	6	1,547	6	1,091	7	644	8	138	7	4,764	6
	Matale DSD	234	7	956	5	1,577	6	1,564	10	1,112	14	328	17	5,771	7
	Ambanganga Korale DSD	300	10	1,281	6	1,160	4	665	4	227	3	28	2	3,661	5
	Laggala-Pallegama DSD	139	4	1,030	5	1,214	4	447	3	213	3	42	2	3,085	4
	Wilgamuwa DSD	505	16	2,757	13	2,309	8	1,029	6	377	5	91	5	7,068	9
	Rattota DSD	465	15	2,460	12	3,180	11	1,670	10	898	11	189	10	8,862	11
	Ukuwela DSD	138	4	1,164	6	1,562	6	1,511	9	1,057	13	191	10	5,623	7
Kurunegala	Giribawa DSD	319	5	2,328	4	3,237	3	1,356	2	650	2	152	2	8,042	3

	Galgamuwa DSD	437	7	3,634	6	5,056	5	2,746	4	1,202	3	184	2	13,259	5
	Ehetuwewa DSD	222	4	1,783	3	2,458	2	1,526	2	711	2	100	1	6,800	2
	Polpithigama DSD	746	12	6,063	10	8,568	8	3,401	5	1,430	4	233	3	20,441	7
Anuradhapura	Galenbidunuwawe DSD	272	6	2,826	7	4,769	6	2,629	7	1,104	7	209	7	11,809	7
	Galnewa DSD	176	4	2,161	5	3,614	5	1,530	4	629	4	130	4	8,240	5
	Ipalogama DSD	231	5	1,651	4	2,962	4	1,642	4	890	6	213	7	7,589	4
	Kahatagasdigiliya DSD	234	5	1,943	5	3,611	5	2,630	7	847	5	125	4	9,390	5
	Kekirawa DSD	270	6	2,223	5	5,457	7	2,167	5	1,055	7	286	9	11,458	6
	Mihintale DSD	150	3	1,115	3	2,425	3	1,795	5	682	4	146	5	6,313	4
	Nachchadoowa DSD	118	2	1,102	3	1,899	3	1,092	3	508	3	104	3	4,823	3
	Nochchiyagama DSD	275	6	2,251	5	4,411	6	1,843	5	677	4	109	4	9,566	5
	Nuwaragam Palatha East DSD	87	2	942	2	2,508	3	1,537	4	968	6	318	10	6,360	4
	Palagala DSD	290	6	2,196	5	3,412	5	1,777	4	787	5	137	4	8,599	5
	Palugaswewa DSD	84	2	909	2	1,758	2	703	2	239	2	53	2	3,746	2
	Rajanganaya DSD	175	4	2,149	5	3,507	5	1,341	3	505	3	76	2	7,753	4
	Thalawa DSD	307	6	3,153	7	5,982	8	2,730	7	1,083	7	172	6	13,427	7
	Thambuttegama DSD	290	6	2,270	5	2,805	4	1,688	4	657	4	121	4	7,831	4
	Thirappane DSD	239	5	1,530	4	2,544	3	1,619	4	658	4	118	4	6,708	4
	Total	**9,757**	**220**	**71,122**	**295**	**109,513**	**323**	**57,695**	**262**	**26,310**	**226**	**5,846**	**198**	**280,031**	**585**

Percentage of Farmer Populations by Age Group

		Age 10-19		Age 20-29		Age 30-39		Age 40-49		Age 50-59		Age 60 or above		Total	
		Total No	%	Total No	%	Total No	%	Total No	%	Total No	%	Total No	%	Total No	%
Kandy	Minipe DSD	7	0	539	4	2,332	19	3,099	26	3,000	25	3,036	25	12,013	100
	Udadumbara DSD	2	0	130	2	894	17	1,306	25	1,272	24	1,648	31	5,252	100
	Pathadumbara DSD	3	0	94	1	736	10	1,539	20	2,032	27	3,226	42	7,620	100
	Akurana DSD	6	0	62	1	447	9	1,065	22	1,413	29	1,819	38	4,812	100
Matale	Galewela DSD	14	26	427	17	2,338	19	3,665	19	3,691	17	3,682	16	13,817	18
	Dambulla DSD	13	25	681	28	2,791	23	3,560	19	3,692	17	2,828	13	13,565	17
	Naula DSD	3	6	180	7	905	7	1,607	8	1,806	8	1,743	8	6,244	8
	Pallepola DSD	1	2	114	5	732	6	1,380	7	1,651	8	1,842	8	5,720	7
	Yatawatte DSD	3	6	89	4	560	5	1,054	6	1,400	7	1,658	7	4,764	6
	Matale DSD	2	4	106	4	668	5	1,282	7	1,624	8	2,089	9	5,771	7
	Ambanganga Korale DSD	1	2	88	4	565	5	884	5	1,031	5	1,092	5	3,661	5
	Laggala-Pallegama DSD	1	2	127	5	611	5	790	4	811	4	745	3	3,085	4
	Wilgamuwa DSD	6	11	352	14	1,486	12	1,806	9	1,816	9	1,602	7	7,068	9
	Rattota DSD	6	11	239	10	1,194	10	2,072	11	2,359	11	2,992	13	8,862	11
	Ukuwela DSD	3	6	69	3	576	5	1,148	6	1,547	7	2,280	10	5,623	7
Kurunegala	Giribawa DSD	11	6	412	6	1,799	4	2,049	3	1,987	3	1,784	2	8,042	3
	Galgamuwa DSD	8	5	573	8	2,911	7	3,430	5	3,277	4	3,060	3	13,259	5
	Ehetuwewa DSD	2	1	197	3	1,272	3	1,800	3	1,818	2	1,711	2	6,800	2
	Polpithigama DSD	12	7	796	11	3,990	9	5,158	7	5,463	7	5,022	6	20,441	7
Anuradhapura	Galenbidunuwawe DSD	11	8	505	5	2,606	6	3,171	6	2,781	6	2,735	7	11,809	7
	Galnewa DSD	3	2	343	4	1,879	5	2,221	5	2,077	5	1,717	4	8,240	5
	Ipalogama DSD	5	4	298	3	1,549	4	2,091	4	1,964	5	1,682	4	7,589	4
	Kahatagasdigiliya DSD	7	5	501	5	2,283	6	2,510	5	2,187	5	1,902	5	9,390	5
	Kekirawa DSD	6	4	462	5	2,390	6	2,932	6	2,978	7	2,690	7	11,458	6
	Mihintale DSD	4	3	339	4	1,369	3	1,789	4	1,561	4	1,251	3	6,313	4

	Nachchadoowa DSD	6	4	209	2	1,043	3	1,243	3	1,211	3	1,111	3	4,823	3
	Nochchiyagama DSD	3	2	508	5	2,107	5	2,611	5	2,224	5	2,113	5	9,566	5
	Nuwaragam Palatha East DSD	6	4	252	3	1,218	3	1,794	4	1,616	4	1,474	4	6,360	4
	Palagala DSD	7	5	437	5	1,802	4	2,258	5	2,162	5	1,933	5	8,599	5
	Palugaswewa DSD	3	2	213	2	865	2	1,008	2	806	2	851	2	3,746	2
	Rajanganaya DSD	1	1	300	3	1,539	4	1,992	4	1,811	4	2,110	5	7,753	4
	Thalawa DSD	11	8	711	7	2,957	7	3,602	7	3,198	7	2,948	8	13,427	7
	Thambuttegama DSD	8	6	330	3	1,599	4	2,138	4	1,888	4	1,868	5	7,831	4
	Thirappane DSD	3	2	373	4	1,593	4	1,766	4	1,549	4	1,424	4	6,708	4
	Total	**188**	**180**	**11,056**	**197**	**53,606**	**246**	**71,820**	**280**	**71,703**	**292**	**71,668**	**319**	**280,031**	**585**

Number of Farmers and Land Share (Acres) by Divisional Secretariat – 2014

	Below 1ac		1-2 ac		2-3 ac		3-4 ac		4-5 ac		5-7 ac		7-9 ac		9-10 ac		10-15 ac		15-20 ac		Above 20 ac	
	No*	Total Ac	N	Total Ac	No	Total Ac	No	Total Ac	No	Total Ac	No	Total Ac	No	Total Ac	No	Total Ac	No	Total Ac	No	Total Ac	No	Total Ac
Minipe DSD	3,488	1,888	4,325	5,518	2,118	4,781	1,067	3,444	427	1,809	288	1,608	152	1,199	52	480	71	915	10	169	5	142
Udadumbara DSD	1,017	555	1,381	1,825	1,000	2,291	664	2,172	384	1,645	398	267	175	1,344	55	512	122	1,422	35	582	21	523
Pathadumbara DSD	5,712	2,314	1,274	1,608	347	785	110	362	57	244	52	292	30	226	10	92	16	191	8	135	4	132
Akurana DSD	3,519	1,195	780	999	252	582	116	385	49	211	41	237	19	151	8	76	18	204	8	136	2	46
Galewela DSD	4,539	2,417	4,353	5,579	2,420	5,472	1,092	3,591	542	2,308	468	2,632	209	1,612	48	446	90	1,042	38	637	18	470
Dambulla DSD	2,551	1,443	4,459	5,673	3,029	6,783	1,474	4,788	801	3,393	737	4,093	259	1,948	76	704	130	1,513	23	393	26	739
Naula DSD	1,323	754	1,972	2,506	1,369	3,093	714	2,321	355	1,520	312	1,740	108	848	21	194	54	611	10	174	6	137
Pallepola DSD	2,143	1,178	1,806	2,336	863	1,988	346	1,145	193	830	170	966	76	604	24	225	63	732	20	338	16	423
Yatawatte DSD	2,247	1,204	1,347	1,812	504	1,179	260	878	142	619	131	754	57	454	11	104	42	495	17	288	6	158
Matale DSD	3,386	1,561	1,260	1,596	533	1,218	228	752	93	404	113	636	50	389	15	139	59	682	21	372	13	309
Ambanganga Korale DSD	1,604	739	1,124	1,389	554	1,249	201	661	68	291	65	357	17	132	5	47	16	188	4	71	3	62
Laggala-Pallegama DSD	418	233	917	1,187	779	1,731	414	1,340	225	953	204	1,156	66	510	12	112	36	417	7	118	7	263
Wilgamuwa DSD	1,089	593	2,122	2,714	1,645	3,714	1,445	4,675	410	1,733	236	1,315	55	426	17	155	35	390	8	133	6	152
Rattota DSD	5,792	2,585	2,023	2,546	573	1,305	194	654	73	318	92	525	51	405	8	75	38	440	11	181	7	167
Ukuwela DSD	3,194	1,532	1,407	1,808	512	1,182	196	656	101	436	89	503	42	331	16	150	49	591	11	181	6	151
Giribawa DSD	1,472	814	2,309	2,880	1,666	3,749	1,070	3,448	618	2,606	560	3,151	191	1,474	58	535	90	1,064	5	85	3	67
Galgamuwa DSD	3,110	1,675	3,967	4,979	2,787	6,239	1,710	5,473	728	3,098	656	3,650	172	1,316	46	427	67	763	9	149	7	240
Ehetuwewa DSD	1,446	792	1,848	2,474	1,140	2,641	1,142	3,659	475	2,039	469	2,656	142	1,081	38	357	76	890	11	185	13	342
Polpithigama DSD	3,984	2,235	6,268	8,006	4,544	10,126	2,320	7,528	1,329	5,652	1,203	6,747	1,198	3,205	84	781	225	2,598	40	667	22	606
Galenbidunuwawe DSD	1,215	723	2,650	3,517	2,255	5,205	1,680	5,559	1,294	5,547	1,445	8,251	700	5,391	192	1,784	316	3,671	50	816	12	270
Galnewa DSD	2,462	1,329	2,443	3,242	1,204	2,791	1,304	4,091	315	1,337	328	1,841	119	913	18	168	35	412	9	148	3	64
Ipalogama DSD	1,884	1,060	2,525	3,240	1,359	3,062	730	2,386	403	1,714	372	2,083	160	1,236	46	425	90	1,046	16	280	4	105
Kahatagasdigiliya DSD	1,315	722	2,105	2,746	1,566	3,582	1,209	3,972	914	3,912	1,094	6,243	585	4,530	169	1,570	334	3,871	74	1,247	25	653
Kekirawa DSD	3,329	1,778	2,800	3,659	1,599	3,795	1,861	5,880	589	2,523	774	4,379	284	2,220	60	555	137	1,576	15	257	10	260
Mihintale DSD	1,305	707	1,442	1,818	1,040	2,334	664	2,168	531	2,264	633	3,558	304	2,344	95	879	229	2,670	43	711	27	676

Nachchadoowa DSD	1,346	696	1,290	1,652	839	1,915	487	1,599	268	1,148	299	1,690	124	957	38	355	94	1,101	26	439	12	327
Nochchiyagama DSD	2,154	1,123	1,701	2,201	1,280	2,988	1,812	5,740	789	3,356	1,002	5,709	401	3,099	109	1,013	233	2,709	61	1,018	24	620
Nuwaragam Palatha East	2,644	1,311	1,848	2,253	920	2,010	399	1,294	218	922	175	970	97	737	14	128	27	316	14	247	4	126
Palagala DSD	1,920	1,043	2,461	3,204	1,598	3,639	1,294	4,146	573	2,441	479	2,685	151	1,150	36	335	67	788	14	230	6	165
Palugaswewa DSD	658	369	938	1,189	648	1,488	472	1,558	342	1,458	386	2,161	152	1,170	39	365	82	951	19	318	10	260
Rajanganaya DSD	2,660	1,390	2,026	2,644	1,580	3,671	754	2,431	357	1,516	252	1,400	61	470	20	183	29	342	9	156	5	150
Thalawa DSD	4,063	2,141	3,020	3,969	1,686	3,935	2,579	8,087	661	2,803	831	4,667	296	2,274	84	775	161	1,825	25	420	21	499
Thambuttegama DSD	3,075	1,583	1,019	1,383	689	1,712	2,346	7,166	176	745	347	1,929	98	766	23	211	42	472	11	196	5	114
Thirappane DSD	907	520	1,652	2,169	1,138	2,622	930	3,050	651	2,788	716	4,067	364	2,813	96	892	196	2,272	42	723	16	413
Total	**82,971**	**42,202**	**74,862**	**96,321**	**46,036**	**104,857**	**33,284**	**107,059**	**15,151**	**64,583**	**15,417**	**84,918**	**6,965**	**47,725**	**1,643**	**15,249**	**3,369**	**39,170**	**724**	**12,200**	**375**	**9,831**

**No: Number of farmers*

Land parcel size and ownership distribution

	Below 1ac		1-2 ac		2-3 ac		3-4 ac		4-5 ac		5-7 ac		7-9 ac		9-10 ac		10-15 ac		15-20 ac		Above 20 ac	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Minipe DSD	2,640	848	3,584	741	1,935	183	977	90	401	26	271	17	137	15	47	5	76	5	15	-	10,083	1,930
Udadumbara DSD	795	222	1,142	239	855	145	602	62	347	37	357	41	161	14	49	6	105	17	53	3	4,466	786
Pathadumbara DSD	4,322	1,390	997	277	290	57	90	20	50	7	45	7	29	1	7	3	16	-	12	-	5,858	1,762
Akurana DSD	2,729	790	642	138	209	43	102	14	45	4	33	8	14	5	6	2	16	2	8	2	3,804	1,008
Galewela DSD	3,537	1,002	3,517	836	2,019	401	941	151	485	57	417	51	178	31	42	6	77	13	49	7	11,262	2,555
Dambulla DSD	1,981	570	3,711	748	2,653	376	1,308	166	727	74	674	63	244	15	70	6	125	5	44	5	11,537	2,028
Naula DSD	1,085	238	1,668	304	1,178	191	648	66	333	22	287	25	94	14	18	3	50	4	13	3	5,374	870
Pallepola DSD	1,715	428	1,523	283	732	131	308	38	168	25	146	24	68	8	23	1	56	7	32	4	4,771	949
Yatawatte DSD	1,816	431	1,139	208	414	90	220	40	125	17	114	17	47	10	7	4	37	5	15	8	3,934	830
Matale DSD	2,577	809	1,016	244	416	117	186	42	78	15	92	21	47	3	10	5	48	11	28	6	4,498	1,273
Ambangangа Korale DSD	1,273	331	905	219	460	94	170	31	61	7	59	6	16	1	4	1	14	2	7	-	2,969	692
Laggala-Pallegama DSD	343	75	818	99	714	65	383	31	212	13	190	14	63	3	12	-	33	3	14	-	2,782	303
Wilgamuwa DSD	919	170	1,771	351	1,443	202	1,233	212	374	36	223	13	48	7	15	2	30	5	13	1	6,069	999
Rattota DSD	4,501	1,291	1,700	323	470	103	167	27	63	10	84	8	39	12	7	1	35	3	17	1	7,083	1,779
Ukuwela DSD	2,471	723	1,158	249	421	91	167	29	88	13	67	22	31	11	13	3	41	8	15	2	4,472	1,151
Giribawa DSD	1,030	442	1,805	504	1,399	267	945	125	552	66	519	41	179	12	54	4	86	4	7	1	6,576	1,466
Galgamuwa DSD	2,125	985	2,971	996	2,210	577	1,441	269	645	83	583	73	158	14	43	3	61	6	14	2	10,251	3,008
Ehetuwewa DSD	1,039	407	1,498	350	961	179	1,009	133	420	55	439	30	129	13	35	3	72	4	21	3	5,623	1,177
Polpithigama DSD	2,982	1,002	4,966	1,302	3,723	821	1,991	329	1,157	172	1,057	146	382	40	75	9	193	32	53	9	16,579	3,862
Galenbidunuwawe DSD	903	312	2,135	515	1,929	326	1,491	189	1,148	146	1,321	124	646	54	182	10	295	21	58	4	10,108	1,701
Galnewa DSD	1,826	636	2,111	332	1,056	148	1,186	118	285	30	306	22	110	9	17	1	33	2	10	2	6,940	1,300
Ipalogama DSD	1,406	478	2,066	459	1,176	183	652	78	358	45	331	41	142	18	41	5	85	5	19	1	6,276	1,313
Kahatagasdigiliya DSD	975	340	1,660	445	1,316	250	1,028	181	795	119	976	118	527	58	144	25	304	30	91	8	7,816	1,574

Kekirawa DSD	2,531	798	2,303	497	1,389	210	1,579	282	525	64	712	62	266	18	59	1	128	9	24	1	9,516	1,942
Mihintale DSD	1,040	265	1,160	282	831	209	554	110	456	75	545	88	266	38	88	7	208	21	62	8	5,210	1,103
Nachchadoowa DSD	987	359	1,034	256	711	128	435	52	245	23	281	18	121	3	35	3	85	9	33	5	3,967	856
Nochchiyagama DSD	1,630	524	1,310	391	1,032	248	1,554	258	682	107	915	87	362	39	96	13	225	8	79	6	7,885	1,681
Nuwaragam Palatha East	2,024	620	1,461	387	753	167	345	54	185	33	160	15	84	13	12	2	21	6	17	1	5,062	1,298
Palagala DSD	1,459	461	2,024	437	1,403	195	1,140	154	531	42	442	37	136	15	33	3	62	5	19	1	7,249	1,350
Palugaswewa DSD	482	176	739	199	534	114	403	69	299	43	347	39	136	16	36	3	72	10	28	1	3,076	670
Rajanganaya DSD	1,950	710	1,674	352	1,369	211	656	98	321	36	232	20	56	5	20	-	26	3	14	-	6,318	1,435
Thalawa DSD	3,054	1,009	2,455	565	1,448	238	2,231	348	586	75	772	59	274	22	78	6	148	13	40	-	11,086	2,341
Thambuttegama DSD	2,427	648	874	145	605	84	1,969	377	158	18	325	22	90	8	23	-	37	5	15	1	6,523	1,308
Thirappane DSD	690	217	1,249	403	944	194	796	134	578	73	637	79	339	25	89	7	186	10	49	9	16	1,151
Total	**63,264**	**19,707**	**60,786**	**14,076**	**38,998**	**7,038**	**28,907**	**4,377**	**13,483**	**1,668**	**13,959**	**1,458**	**5,619**	**570**	**1,490**	**153**	**3,086**	**293**	**988**	**105**	**230,580**	**49,451**

Farmers and Allottees - 2014

District Name	DSD Name	Farmers			Allottees			Total Farmers		
		Total Farmers	Male	Female	Total	Male	Female	Total Farmers	Male	Female
Kandy	Minipe DSD	11,933	10026	1,907	80	57	23	12,013	10083	1,930
	Udadumbara DSD	5,233	4449	784	19	17	2	5,252	4466	786
	Pathadumbara DSD	7,587	5841	1,746	33	17	16	7,620	5858	1,762
	Akurana DSD	4,781	3794	987	31	10	21	4,812	3804	1,008
Matale	Galewela DSD	13,779	11,235	2,544	38	27	11	13,817	11,262	2,555
	Dambulla DSD	13,537	11,511	2,026	28	26	2	13,565	11,537	2,028
	Naula DSD	6,222	5,356	866	22	18	4	6,244	5,374	870
	Pallepola DSD	5,685	4,742	943	35	29	6	5,720	4,771	949
	Yatawatte DSD	4,750	3,922	828	14	12	2	4,764	3,934	830
	Matale DSD	5,749	4,482	1,267	22	16	6	5,771	4,498	1,273
	Ambanganga Korale DSD	3,656	2,966	690	5	3	2	3,661	2,969	692
	Laggala-Pallegama DSD	3,057	2,763	294	28	19	9	3,085	2,782	303
	Wilgamuwa DSD	7,045	6,049	996	23	20	3	7,068	6,069	999
	Rattota DSD	8,836	7,063	1,773	26	20	6	8,862	7,083	1,779
	UkuwelaDSD	5,590	4,451	1,139	33	21	12	5,623	4,472	1,151
Kurunegala	Giribawa DSD	8,039	6,573	1,466	3	3	0	8,042	6,576	1,466
	Galgamuwa DSD	13,256	10,249	3,007	3	2	1	13,259	10,251	3,008
	Ehetuwewa DSD	6,794	5,618	1,176	6	5	1	6,800	5,623	1,177
	Polpithigama DSD	20,429	16,569	3,860	12	10	2	20,441	16,579	3,862
Anuradhapura	Galenbidunuwawe DSD	11,762	10,066	1,696	47	42	5	11,809	10,108	1,701
	Galnewa DSD	8,238	6,939	1,299	2	1	1	8,240	6,940	1,300
	Ipalogama DSD	7,581	6,273	1,308	8	3	5	7,589	6,276	1,313
	Kahatagasdigiliya DSD	9,390	7,816	1,574	0	0	0	9,390	7,816	1,574
	Kekirawa DSD	11,390	9,458	1,932	68	58	10	11,458	9,516	1,942
	Mihintale DSD	6,312	5,210	1,102	1	0	1	6,313	5,210	1,103

	Nachchadoowa DSD	4,755	3,913	842	68	54	14	4,823	3,967	856
	Nochchiyagama DSD	9,531	7,855	1,676	35	30	5	9,566	7,885	1,681
	Nuwaragam Palatha East DSD	6,268	4,998	1,270	92	64	28	6,360	5,062	1,298
	Palagala DSD	8,566	7,221	1,345	33	28	5	8,599	7,249	1,350
	Palugaswewa DSD	3,746	3,076	670	0	0	0	3,746	3,076	670
	Rajanganaya DSD	7,721	6,290	1,431	32	28	4	7,753	6,318	1,435
	Thalawa DSD	13,390	11,055	2,335	37	31	6	13,427	11,086	2,341
	Thambuttegama DSD	7,831	6,523	1,308	0	0	0	7,831	6,523	1,308
	Thirappane DSD	6,679	5,534	1,145	29	23	6	6,708	5,557	1,151
	Total	**279,118**	**229,886**	**49,232**	**913**	**694**	**219**	**280,031**	**230,580**	**49,451**

		One Land Unit		Two Land Units		Three Land Units		Four Land Units		Five Land Units		Six Land Units		Seven Land Units		Eight Land Units		Nine Land Units		Ten or Above Land Units		Total		
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Total
Kandy	Minipe DSD	3,613	1,229	4,623	559	1,256	92	310	19	90	3	35	1	26	6	36	7	19	0	75	14	10083	1930	12013
	Udadumbara DSD	1,133	280	1,200	240	847	115	501	56	278	31	162	18	105	16	111	14	72	10	57	6	4466	786	5252
	Pathadumbara DSD	3796	1314	1415	339	392	73	130	12	30	4	26	4	14	3	20	9	8	0	27	4	5858	1762	7620
	Akurana DSD	2596	781	816	154	257	48	86	11	31	7	15	4	10	1	8	1	6	1	6	0	3804	1008	4812
Matale	Galewela DSD	4,860	1,505	3,613	614	1,448	229	611	89	297	42	146	17	76	14	62	10	30	8	119	27	11,262	2,555	13,817
	Dambulla DSD	4,602	1,108	3,733	581	1,679	167	629	64	288	20	141	18	69	9	70	6	36	7	290	48	11,537	2,028	13,565
	Naula DSD	1,902	437	1,518	235	886	91	463	39	218	24	120	10	51	5	43	5	25	3	148	21	5,374	870	6,244
	Pallepola DSD	2,018	532	1,261	211	662	95	352	44	160	17	95	14	45	13	38	8	28	2	112	13	4,771	949	5,720

	Yatawatte DSD	1,223	385	1,134	203	688	99	383	55	202	33	108	16	63	11	49	8	34	7	50	13	3,934	830	4,764
	Matale DSD	2,466	836	1,153	280	462	85	192	33	86	14	45	5	40	5	18	8	16	3	20	4	4,498	1,273	5,771
	Ambanganga Korale DSD	1,562	464	769	143	362	57	156	8	58	6	23	3	15	3	12	3	3	2	9	3	2,969	692	3,661
	Laggala-Pallegama DSD	811	138	1,001	93	428	34	238	18	122	10	67	6	43	2	24	0	22	1	26	1	2,782	303	3,085
	Wilgamuwa DSD	2,129	425	3,081	493	579	44	120	15	30	4	15	0	14	3	18	6	14	1	69	8	6,069	999	7,068
	Rattota DSD	3,933	1,159	1,752	373	744	131	307	44	110	19	61	8	30	12	57	16	33	7	56	10	7,083	1,779	8,862
	UkuwelaDSD	2,219	674	1,197	261	520	113	241	43	114	25	55	13	33	4	50	14	24	1	19	3	4,472	1,151	5,623
Kurunegala	Giribawa DSD	1,970	747	2,403	449	1,110	152	548	67	271	30	141	12	63	4	37	3	10		23	2	6576	1466	8042
	Galgamuwa DSD	4,287	1,693	3,565	898	1,376	267	526	81	240	20	121	18	46	10	48	9	10	3	32	9	10251	3006	13259
	Ehetuwewa DSD	1,400	525	2,037	374	1,109	137	490	68	261	40	131	15	82	9	48	3	36	2	29	4	5623	1177	6800
	Polpithigama DSD	6,601	2,013	5,349	1,118	2,239	399	1,177	161	526	73	288	51	148	17	104	14	61	8	86	8	16579	3862	20441
Anuradhapura	Galenbidunuwawe DSD	1,754	536	3,237	600	2,309	300	1,174	119	662	69	373	28	199	23	135	14	66	11	82	12	7,816	1,574	9,390
	Galnewa DSD	2,191	719	3,190	429	981	107	331	28	115	7	51	1	214	17	175	13	102	10	108	9	10,108	1,701	11,809
	Ipalogama DSD	2,088	688	2,513	424	970	129	339	40	146	11	90	8	45	9	43	4	10	1	19	4	5,210	1,103	6,313
	Kahatagasdigiliya DSD	1,233	408	2,139	491	1,890	314	1,096	174	637	88	339	39	14	-	10	-	4	-	7	1	5,062	1,298	6,360
	Kekirawa DSD	2,717	871	3,790	698	1,518	164	633	92	303	42	181	19	20	7	30	2	15	1	11	5	3,967	856	4,823
	Mihintale DSD	1,840	487	1,419	313	1,030	170	484	74	213	34	107	7	49	9	41	7	38	5	24	4	7,885	1,681	9,566

	Nachchadoowa DSD	1,481	515	1,352	222	662	76	246	18	113	8	37	2	18	4	35	5	17	1	16	5	6,318	1,435	7,753
	Nochchiyagama DSD	2,088	689	3,073	630	1,620	234	637	61	221	19	94	23	26	10	61	9	21	2	31	6	6,523	1,308	7,831
	Nuwaragam Palatha East DSD	3,341	1,023	1,077	193	445	60	117	12	32	5	15	4	73	3	94	8	43	3	81	8	11,086	2,341	13,427
	Palagala DSD	2,055	643	2,784	439	1,347	148	570	57	227	20	98	7	99	16	61	9	47	6	62	9	5,557	1,151	6,708
	Palugaswewa DSD	838	259	762	158	499	94	329	53	211	29	149	17	144	23	79	10	51	12	100	11	9,516	1,942	11,458
	Rajanganaya DSD	2,887	939	2,319	370	745	84	204	21	53	3	24	3	84	12	54	12	30	10	120	26	3,076	670	3,746
	Thalawa DSD	3,724	1,193	4,795	886	1,551	174	495	45	158	12	72	9	54	3	36	4	14	4	26	2	6,276	1,313	7,589
	Thambuttegama DSD	2,685	712	2,958	502	530	51	140	10	40	3	31	3	36	1	31	4	6	4	8	-	6,940	1,300	8,240
	Thirappane DSD	1,071	381	1,520	335	1,356	231	774	100	390	45	177	19	39	12	45	9	32	3	52	12	7,249	1,350	8,599
	Total	**85,114**	**26,308**	**78,548**	**14308**	**34,497**	**4,764**	**15,029**	**1,831**	**6,933**	**817**	**3,633**	**422**	**2,087**	**296**	**1,783**	**254**	**983**	**139**	**2,000**	**312**	**230,580**	**49,449**	**280,031**

Number of Farmers at DS Level by Agriculture Practice and Gender - 1

		Paddy			Tea			Rubber			Coconut			Other Field Crops			Seasonal Crops		
		No	M	F	No	M	F	No	M	F	No	M	F	No	M	F	No	M	F
Kandy	Minipe DSD	7494	6754	740	86	77	9	8	7	1	10909	9152	1757	11232	9409	1823	6657	5568	1089
	Udadumbara DSD	2887	2528	359	179	151	28	0	0	0	3597	3058	539	7249	5754	1495	2101	1664	437
	Pathadumbara DSD	1286	1096	190	49	40	9	10	8	2	6626	5077	1549	7244	5560	1684	1062	855	207
	Akurana DSD	441	370	71	578	478	100	7	7	0	3589	2821	768	4554	3596	958	755	623	132
Matale	Galewela DSD	5,967	5,169	798	24	21	3	1	1	0	12,242	9,956	2,286	11,537	9,377	2,160	3,555	3,183	372
	Dambulla DSD	6,771	5,976	795	84	70	14	1	0	1	8,384	7,078	1,306	8,241	6,946	1,295	7,393	6,531	862
	Naula DSD	2,917	2,630	287	8	4	4	0	0	0	4,879	4,215	664	5,447	4,680	767	3,224	2,891	333
	Pallepola DSD	2,111	1,876	235	23	18	5	7	7	0	5,105	4,241	864	5,200	4,319	881	1,358	1,188	170
	Yatawatte DSD	1,995	1,724	271	26	23	3	218	193	25	4,305	3,542	763	4,488	3,710	778	1,392	1,220	172
	Matale DSD	1,010	876	134	23	22	1	51	41	10	4,119	3,186	933	5,267	4,099	1,168	1,139	950	189
	Ambanganga Korale DSD	847	748	99	46	40	6	63	54	9	2,628	2,140	488	3,507	2,845	662	487	418	69
	Laggala-Pallegama DSD	2,155	1,991	164	2	1	1	0	0	0	1,771	1,606	165	1,956	1,753	203	1,016	949	67
	Wilgamuwa DSD	5,360	4,644	716	28	26	2	2	2	0	3,451	2,972	479	4,006	3,428	578	3,211	2,757	454
	Rattota DSD	2,164	1,840	324	822	682	140	188	163	25	6,215	4,990	1,225	8,069	6,455	1,614	1,311	1,067	244
	UkuwelaDSD	1,283	1,099	184	589	462	127	38	26	12	2,668	2,088	580	4,821	3,831	990	791	645	146
Kurunegala	Giribawa DSD	5,169	4,516	653	-	-	-	-	-	-	6,529	5,349	1,180	6,403	5,197	1,206	3,051	2,538	513
	Galgamuwa DSD	6,467	5,452	1,015	5	4	1	1	-	1	9,858	7,599	2,259	10,571	8,178	2,393	6,065	4,710	1,355
	Ehetuwewa DSD	4,366	3,837	529	1	1	-	-	-	-	5,272	4,350	922	5,532	4,558	974	3,048	2,582	466
	Polpithigama DSD	12,305	10,425	1,880	5	4	1	1	1	-	18,970	15,364	3,606	16,953	13,675	3,278	6,896	5,775	1,121
Anuradhapura	Galenbidunuwawe DSD	9,048	7,921	1,127	5	5	-	-	-	-	9,661	8,274	1,387	9,606	8,232	1,374	7,838	6,921	917
	Galnewa DSD	4,420	3,991	429	14	10	4	3	3	-	7,121	6,010	1,111	7,257	6,099	1,158	3,706	3,240	466
	Ipalogama DSD	4,200	3,697	503	9	6	3	3	3	-	6,875	5,684	1,191	6,603	5,439	1,164	2,867	2,474	393
	Kahatagasdigiliya DSD	5,587	4,788	799	5	5	-	-	-	-	6,499	5,358	1,141	6,267	5,201	1,066	6,083	5,229	854
	Kekirawa DSD	6,787	5,928	859	21	20	1	3	2	1	10,452	8,689	1,763	10,526	8,763	1,763	7,554	6,441	1,113

	Mihintale DSD	2,490	2,170	320	3	2	1	-	-	-	5,424	4,507	917	5,576	4,593	983	3,705	3,139	566
	Nachchadoowa DSD	2,292	2,063	229	2	1	1	-	-	-	3,882	3,194	688	4,256	3,478	778	2,299	1,943	356
	Nochchiyagama DSD	4,536	3,951	585	7	4	3	2	2	-	7,720	6,365	1,355	7,971	6,560	1,411	6,381	5,349	1,032
	Nuwaragam Palatha East DSD	1,135	975	160	5	5	-	3	3	-	5,103	4,035	1,068	5,459	4,328	1,131	2,452	1,957	495
	Palagala DSD	5,210	4,635	575	39	35	4	9	7	2	7,629	6,434	1,195	7,756	6,503	1,253	4,045	3,648	397
	Palugaswewa DSD	1,566	1,349	217	10	9	1	-	-	-	3,083	2,526	557	3,332	2,738	594	2,205	1,903	302
	Rajanganaya DSD	3,488	3,048	440	-	-	-	-	-	-	7,087	5,773	1,314	7,022	5,723	1,299	2,376	2,009	367
	Thalawa DSD	7,034	6,157	877	17	15	2	-	-	-	10,785	8,923	1,862	10,856	8,953	1,903	5,786	4,904	882
	Thambuttegama DSD	4,175	3,612	563	9	7	2	3	3	-	7,358	6,122	1,236	7,022	5,840	1,182	1,939	1,725	214
	Thirappane DSD	3,268	2,815	453	11	10	1	-	-	-	5,363	4,438	925	5,208	4,295	913	3,765	3,204	561
	Total	**138,231**	**120,651**	**17,580**	**2,735**	**2,258**	**477**	**622**	**533**	**89**	**225,159**	**185,116**	**40,043**	**236,994**	**194,115**	**42,879**	**117,513**	**100,200**	**17,313**

Number of Farmers at DS Level by Livestock Farming by Gender

		Cattle			Goat			Piggery			Poultry			Other			Aquatic		
		No	M	F	No	M	F	No	M	F	No	M	F	No	M	F	No	M	F
Kandy	Minipe DSD	847	787	60	40	35	5	0	0	0	469	427	42	21	19	2	2	2	0
	Udadumbara DSD	239	210	29	88	83	5	1	1	0	144	122	22	6	5	1	0	0	0
	Pathadumbara DSD	210	185	25	48	43	5	1	1	0	384	298	86	18	12	6	7	6	1
	Akurana DSD	71	61	10	80	73	7	0	0	0	364	302	62	14	12	2	3	3	0
Matale	Galewela DSD	1,045	961	84	138	123	15	220	184	36	1,072	937	135	18	18	0	5	4	1
	Dambulla DSD	632	575	57	35	35	0	26	26	0	456	401	55	3	3	0	2	1	1
	Naula DSD	325	292	33	36	34	2	1	1	0	216	186	30	2	2	0	2	2	0
	Pallepola DSD	403	380	23	68	57	11	0	0	0	372	325	47	5	5	0	1	1	0
	Yatawatte DSD	375	335	40	80	63	17	0	0	0	323	270	53	4	3	1	3	2	1
	Matale DSD	304	255	49	81	68	13	0	0	0	343	262	81	9	8	1	3	3	0
	Ambanganga Korale DSD	147	128	19	98	88	10	0	0	0	338	287	51	0	0	0	0	0	0
	Laggala-Pallegama DSD	194	190	4	0	0	0	0	0	0	82	77	5	0	0	0	1	1	0
	Wilgamuwa DSD	221	207	14	8	8	0	0	0	0	246	223	23	0	0	0	1	1	0
	Rattota DSD	375	337	38	181	153	28	1	1	0	452	376	76	10	9	1	11	9	2
	UkuwelaDSD	145	122	23	63	56	7	0	0	0	177	150	27	4	3	1	5	5	0
Kurunegala	Giribawa DSD	397	366	31	72	69	3	8	8	-	529	470	59	-	-	-	9	8	1
	Galgamuwa DSD	556	504	52	61	58	3	4	4	-	463	384	79	5	3	2	1	1	-
	Ehetuwewa DSD	486	457	29	22	21	1	4	3	1	296	266	30	2	2	-	5	4	1
	Polpithigama DSD	1,684	1,555	129	51	47	4	20	17	3	580	503	77	7	5	2	15	13	2
Anuradhapura	Galenbidunuwawe DSD	649	608	41	10	10	-	5	5	-	511	468	43	1	1	-	1	1	-
	Galnewa DSD	389	360	29	14	13	1	9	9	-	491	427	64	6	5	1	3	1	2
	Ipalogama DSD	412	369	43	39	33	6	23	21	2	635	570	65	3	3	-	7	6	1
	Kahatagasdigiliya DSD	483	439	44	45	42	3	2	2	-	505	446	59	-	-	-	1	1	-
	Kekirawa DSD	697	640	57	81	73	8	6	6	-	816	723	93	5	5	-	1	1	-
	Mihintale DSD	469	422	47	54	47	7	7	5	2	511	449	62	6	6	-	3	3	-

	Nachchadoowa DSD	223	201	22	40	36	4	4	3	1	409	345	64	6	6	-	4	4	-
	Nochchiyagama DSD	476	432	44	35	31	4	6	5	1	718	629	89	7	7	-	2	2	-
	Nuwaragam Palatha East DSD	348	292	56	13	9	4	6	6	-	295	249	46	3	3	-	7	6	1
	Palagala DSD	690	651	39	40	35	5	12	12	-	693	613	80	6	4	2	-	-	-
	Palugaswewa DSD	207	198	9	12	9	3	3	3	-	187	168	19	1	1	-	-	-	-
	Rajanganaya DSD	271	251	20	18	16	2	10	8	2	395	331	64	4	4	-	23	22	1
	Thalawa DSD	581	542	39	32	28	4	6	6	-	528	464	64	9	7	2	19	17	2
	Thambuttegama DSD	340	316	24	30	28	2	9	6	3	475	428	47	6	4	2	15	14	1
	Thirappane DSD	396	363	33	48	45	3	21	19	2	295	266	29	3	3	-	-	-	-
	Total	**15,287**	**13,991**	**1,296**	**1,761**	**1,569**	**192**	**415**	**362**	**53**	**14,770**	**12,842**	**1,928**	**194**	**168**	**26**	**162**	**144**	**18**

Number of Farmers Engaged in Other Economic Activities by Divisional Secretariat - 2014

		Number of farmers engaged in other economic activities	%	Number of farmers do not engage in other economic activities	%	Total	%
Kandy	Minipe DSD	6194	7	5819	12	12013	
	Udadumbara DSD	2075	2	3177	6	5252	
	Pathadumbara DSD	5709	6	1911	4	7620	
	Akurana DSD	3920	4	892	2	4812	
Matale	Galewela DSD	8,532	18.6	5,285	16.3	13,817	17.7
	Dambulla DSD	6,977	15.2	6,588	20.4	13,565	17.4
	Naula DSD	3,368	7.4	2,876	8.9	6,244	8
	Pallepola DSD	3,418	7.5	2,302	7.1	5,720	7.3
	Yatawatte DSD	2,955	6.4	1,809	5.6	4,764	6.1
	Matale DSD	4,391	9.6	1,380	4.3	5,771	7.4
	Ambanganga Korale DSD	2,132	4.7	1,529	4.7	3,661	4.7
	Laggala-Pallegama DSD	1,913	4.2	1,172	3.6	3,085	3.9
	Wilgamuwa DSD	1,970	4.3	5,098	15.8	7,068	9
	Rattota DSD	6,409	14	2,453	7.6	8,862	11.3

	UkuwelaDSD	3,756	8.2	1,867	5.8	5,623	7.2
Kurunegala	Giribawa DSD	2,760	1.6	5,282	4.5	8,042	2.8
	Galgamuwa DSD	6,578	3.8	6,681	5.7	13,259	4.6
	Ehetuwewa DSD	2,579	1.5	4,221	3.6	6,800	2.3
	Polpithigama DSD	10,303	5.9	10,138	8.6	20,441	7
Anuradhapura	Galenbidunuwawe DSD	5,411	5.6	6,398	7.5	11,809	6.5
	Galnewa DSD	4,698	4.8	3,542	4.1	8,240	4.5
	Ipalogama DSD	3,956	4.1	3,633	4.2	7,589	4.2
	Kahatagasdigiliya DSD	3,861	4	5,529	6.5	9,390	5.1
	Kekirawa DSD	7,339	7.6	4,119	4.8	11,458	6.3
	Mihintale DSD	4,082	4.2	2,231	2.6	6,313	3.5
	Nachchadoowa DSD	3,095	3.2	1,728	2	4,823	2.6
	Nochchiyagama DSD	4,042	4.2	5,524	6.5	9,566	5.2
	Nuwaragam Palatha East DSD	5,320	5.5	1,040	1.2	6,360	3.5
	Palagala DSD	3,704	3.8	4,895	5.7	8,599	4.7
	Palugaswewa DSD	2,258	2.3	1,488	1.7	3,746	2
	Rajanganaya DSD	3,700	3.8	4,053	4.7	7,753	4.2
	Thalawa DSD	5,505	5.7	7,922	9.3	13,427	7.3
	Thambuttegama DSD	2,905	3	4,926	5.8	7,831	4.3
	Thirappane DSD	3,772	3.9	2,936	3.4	6,708	3.7
	Total	**149,587**		**130,444**		**280,031**	

Number of Farmers Employed in Other Jobs by Gender and Divisional Secretariat - 2014

		Government			Semi Government			Private			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Kandy	Minipe DSD	744	82	826	178	12	190	1777	168	1945	2699	262	2961
	Udadumbara DSD	423	52	475	58	7	65	408	57	465	889	116	1005
	Pathadumbara DSD	702	190	811	182	14	196	1368	190	1558	2252	313	2565
	Akurana DSD	316	43	359	74	6	80	1287	197	1484	1677	246	1923
Matale	Galewela DSD	1,104	179	1,283	90	14	104	1,554	234	1,788	2,748	427	3,175
	Dambulla DSD	987	132	1,119	187	12	199	1,055	169	1,224	2,229	313	2,542
	Naula DSD	574	45	619	64	3	67	600	63	663	1,238	111	1,349
	Pallepola DSD	590	52	642	86	8	94	740	57	797	1,416	117	1,533
	Yatawatte DSD	442	50	492	77	9	86	613	90	703	1,132	149	1,281
	Matale DSD	737	124	861	75	13	88	810	142	952	1,622	279	1,901
	Ambanganga Korale DSD	249	35	284	23	5	28	781	116	897	1,053	156	1,209
	Laggala-Pallegama DSD	242	22	264	74	4	78	194	18	212	510	44	554
	Wilgamuwa DSD	335	31	366	29	2	31	407	32	439	771	65	836
	Rattota DSD	952	138	1,090	216	36	252	1,650	170	1,820	2,818	344	3,162
	UkuwelaDSD	588	104	692	92	7	99	814	121	935	1,494	232	1,726
Kurunegala	Giribawa DSD	661	98	759	34	11	45	418	61	479	1,113	170	1,283
	Galgamuwa DSD	1,205	231	1,436	66	17	83	905	170	1,075	2,176	418	2,594
	Ehetuwewa DSD	632	46	678	36	7	43	334	47	381	1,002	100	1,102
	Polpithigama DSD	1,702	176	1,878	159	27	186	2,612	395	3,007	4,473	598	5,071
Anuradhapura	Galenbidunuwawe DSD	1,619	174	1,793	73	4	77	655	76	731	2,347	254	2,601
	Galnewa DSD	770	136	906	49	12	61	528	76	604	1,347	224	1,571
	Ipalogama DSD	1,028	167	1,195	67	17	84	856	148	1,004	1,951	332	2,283
	Kahatagasdigiliya DSD	1,611	130	1,741	131	10	141	342	43	385	2,084	183	2,267
	Kekirawa DSD	1,418	209	1,627	125	13	138	1,535	245	1,780	3,078	467	3,545
	Mihintale DSD	1,059	83	1,142	120	17	137	518	61	579	1,697	161	1,858
	Nachchadoowa DSD	535	52	587	54	8	62	925	106	1,031	1,514	166	1,680

	Nochchiyagama DSD	1,280	119	1,399	159	5	164	793	111	904	2,232	235	2,467
	Nuwaragam Palatha East DSD	1,013	128	1,141	94	12	106	632	90	722	1,739	230	1,969
	Palagala DSD	749	106	855	37	7	44	734	139	873	1,520	252	1,772
	Palugaswewa DSD	366	51	417	37	5	42	488	79	567	891	135	1,026
	Rajanganaya DSD	597	55	652	26	6	32	656	110	766	1,279	171	1,450
	Thalawa DSD	1,230	139	1,369	183	14	197	922	116	1,038	2,335	269	2,604
	Thambuttegama DSD	562	60	622	69	11	80	320	37	357	951	108	1,059
	Thirappane DSD	816	75	891	43	-	43	435	71	506	1,294	146	1,440
	Total	**27,838**	**3,514**	**31,271**	**3,067**	**355**	**3,422**	**28,666**	**4,005**	**32,671**	**59,571**	**7,793**	**67,364**

Number of Farmers Engaged in Own Enterprise or Self Employment

		Agricultural			Non-Agricultural			Total		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
Kandy	Minipe DSD	336	63	399	1,399	138	1537	1735	201	1936
	Udadumbara DSD	315	46	361	280	49	329	595	95	690
	Pathadumbara DSD	220	94	314	866	113	979	1086	207	1293
	Akurana DSD	150	49	199	669	66	735	819	115	934
Matale	Galewela DSD	1,044	212	1,256	1,302	257	1,559	2,346	469	2,815
	Dambulla DSD	1,128	199	1,327	479	55	534	1,607	254	1,861
	Naula DSD	481	77	558	419	47	466	900	124	1,024
	Pallepola DSD	253	43	296	413	32	445	666	75	741
	Yatawatte DSD	189	28	217	437	69	506	626	97	723
	Matale DSD	151	26	177	623	109	732	774	135	909
	Ambanganga Korale DSD	65	21	86	496	82	578	561	103	664
	Laggala-Pallegama DSD	237	32	269	733	83	816	970	115	1,085
	Wilgamuwa DSD	278	39	317	259	23	282	537	62	599
	Rattota DSD	482	110	592	782	135	917	1,264	245	1,509

	UkuwelaDSD	378	96	474	395	42	437	773	138	911
Kurunegala	Giribawa DSD	198	34	232	397	52	449	595	86	681
	Galgamuwa DSD	637	190	827	948	143	1,091	1,585	333	1,918
	Ehetuwewa DSD	83	17	100	684	53	737	767	70	837
	Polpithigama DSD	770	154	924	1,607	195	1,802	2,377	349	2,726
Anuradhapura	Kahatagasdigiliya DSD	582	160	742	226	24	250	808	184	992
	Galenbidunuwawe DSD	687	94	781	682	72	754	1,369	166	1,535
	Mihintale DSD	176	27	203	737	102	839	913	129	1,042
	Nuwaragam Palatha East DSD	717	180	897	817	170	987	1,534	350	1,884
	Nachchadoowa DSD	177	14	191	492	57	549	669	71	740
	Nochchiyagama DSD	204	60	264	255	28	283	459	88	547
	Rajanganaya DSD	173	32	205	403	39	442	576	71	647
	Thambuttegama DSD	210	33	243	396	58	454	606	91	697
	Thalawa DSD	584	109	693	532	45	577	1,116	154	1,270
	Thirappane DSD	465	82	547	555	56	611	1,020	138	1,158
	Kekirawa DSD	310	51	361	946	98	1,044	1,256	149	1,405
	Palugaswewa DSD	78	5	83	210	35	245	288	40	328
	Ipalogama DSD	261	38	299	422	50	472	683	88	771
	Galnewa DSD	670	89	759	877	97	974	1,547	186	1,733
	Palagala DSD	214	25	239	430	33	463	644	58	702
	Total	**12,903**	**2,529**	**15,432**	**21,168**	**2,707**	**23,875**	**34,071**	**5,236**	**39,307**

Project Components and Approaches

Outputs, Activities and Inputs at Project/Program level						
Expected Result	**Indicator**	**Means of Verification (MoV)**	**Baseline**	**Target**		**Assumptions**
				Mid-term (if applicable)	Final	
Project/program outputs	**Outputs that contribute to outcomes**					
1.1 Improved land and water management in upstream catchment areas to safeguard production of environmental goods and services	Erosion prevalence across upstream catchment Sedimentation rates and capacity of reservoirs within the upstream catchment No of ha of upstream catchments protected by soil and water conservation measures.	Erosion prevalence metrics from satellite image analysis for project area, represented in online dashboard. Periodic measurements of sediment flow rates and reservoir capacity made by MDA Intervention area metrics on online project information portal	Weighted area estimate required from Tor's analysis to be inserted here for the new upstream boundaries. Current average loss of capacity per annum to be inserted here Project charts interventions made by the project so baseline is 0	Mid-term would be 25% of target because implementation comes on stream only after design and planning that takes 12-18 months 10,391 ha	Erosion prevalence across catchment reduced by 50% Sedimentation of reservoirs reduced to a negligible level (<0.1 % loss of capacity per annum) 41,564 ha[53]	Sufficient buy in from Divisional Secretariats (DS) and willingness to work across DS boundaries to address integrated action for hydrological units. PES scheme sustains funding for maintenance of soil and water conservation measures across the upstream target area.

[53] This is 25% of the upstream catchment area, interventions are spatially targeted so that this coverage provides effective whole catchment protection

1.2 Sustainable climate-resilient primary production in upstream catchment areas and downstream irrigated agricultural area	No of farm households benefiting from water management and climate-adapted agricultural practices (including estate workers) Average cropping intensity for irrigated rice	Annual reports, web-based dashboards at sub-basin scales, Divisional Secretariat records of participating households, documented changes in livelihood outcomes from survey results. Cropping intensity from Dept. of Agrarian Dev. Records.	11,500 Current cropping intensity <0.8 in target area	23,919 >1.2	61,174[54] >1.75	Sufficient buy in of farmers, communities and plantation companies to achieve adoption targets for water management and climate-adapted agricultural practice. Value chain upgrading (in 3 below) is successful in increasing value capture by farmers and plantations enabling them to continue to invest in sustainable upstream land use.
2.1 Upgraded and more efficient green value chains and penetration of new markets	No of households benefiting from value chain upgrading options (certification, quality assurance, processing and collective marketing). Number of people employed in green growth business start ups[55]	Annual reports and Divisional Secretariat records.	The project will track household uptake due to project activity The project will track business start-ups associated with project activity	2,500 625	10,000[56] 2,500[57]	Sufficient buy in from producers and other value chain actors to effect value addition. Sufficient buy in from people prepared to operate as green growth entrepreneurs, take risks and grow businesses. Continued growth prospects nationally and globally for green products and services

[54] Need update with aggregate figures across the different upstream land uses
[55] Note that farming households and plantations are also beneficiaries of new green growth businesses that buy and add value to locally produced goods and services
[56] Need to update with rationale based on projection of value chain upgrading potential
[57] Need to update with rationale based on projection of green growth potential

2.2 Payment for ecosystem services (PES) mechanism	Quantity of funds flowing from government revenue on water use to upstream catchment protection.	MMDE records of revenue and payments.	Baseline is at 0 since there is no scheme in operation in the target area at the outset	250 K USD per annum	1 M USD per annum	Successful implementation of catchment protection measures in 2 above. Government commitment to developing PES modalities is maintained. Water users (principally micro-hydro power generators) continue to use water and pay the levy for PES
3.1 Governance mechanism for sustainable land management and productivity enhancement in the upstream catchment area	Existence of integrated (across admin / hydrological boundaries) sub-basin implantation teams, sub-basin land use plans and information dashboards showing the extent of their implementation.	Annual reports and online information portal	There are no such integrated governance structures in the area at the outset	Five sub-basin governance units operating	Five sub-basin governance units operating	Sufficient buy in at DS level to co-operate in relation to coherent catchment boundaries.
3.2 Integrated rural advisory capacity responsive to developing knowledge base, real time weather and market information	No of farm households in receipt of customised advice	Records of use rates of smartphone Apps providing advice	Tailored advice not currently available	76,467	305,868	Sufficient buy in at GN level to operate local innovation platforms Sufficient buy in by farmers and communities to access advice provided
Activities	**Description**		**Inputs**		**Description**	
1.1.1: Streamside protection and drainage management along roads	These are conservation measures focused on the linear stream and road networks supporting action at both community and individual household level. Priority areas for intervention will be determined on the basis of sub-basin planning process in 3.1.1 using information derived from the information portal in 3.1.2 and funded where appropriate via the PES mechanism in 2.2.1. Initial funding will be provided as sunk costs directly from project funds to initiate catchment protection and improved water supply for		Vegetation management to control run-off and enhance infiltration (this will have benefits for reducing reservoir spills (dam safety) and sedimentation and therefore downstream irrigation supply); and soil health management (soil C, water retention, biotic function) and focus on streamside management.		There are 2,373 km of stream and canals within the upper catchment of the project area to be selected for project interventions The streamside interventions will be implemented by the Department of Agrarian Development in the Ministry of Agriculture There is 1,766 km of all types of roads in the upper catchment to be selected for project interventions	

	upstream households and farms while the PES is gradually phased in to maintain best practice over the life of the project, so at the end of the project a sustainable mechanism is in place to maintain appropriate water flow and quality and control across the sub-basin implementation areas.	Drainage management along roads and in relation to other soil disrupting construction activity (to prevent run-off and increase groundwater recharge, take water off rather than allowing it to accumulate down the hill) with community management to maintain dykes and clear silt	The drainage management along roads will be implemented by the Road Development Authority in the Ministry of Highways and the Provincial Roads Authority in the Provincial Councils.
1.1.2: Rehabilitation and establishment of village tanks, ponds and irrigation networks	This will involve rehabilitation and development of village level ponds and irrigation channels (including both direct rainwater harvesting and tapping stream networks) based on thematic mapping of priority areas for intervention. water flow and quality, stream erosion and ground water re-charge monitoring at GN level	Action will focus on: Thematic mapping of areas suitable for practicing various rainwater harvesting options such as village tanks and farm ponds. Construction and rehabilitation of farm and village ponds and the irrigation networks connecting them to field agriculture (including links to channeling water from roads in 1.1.1). water flow and quality, stream erosion and ground water re-charge monitoring at GN level	32 abandoned village tanks and 121 functional ponds and tanks within the upper catchment area Implemented by the Department of Agrarian Development in the Ministry of Agriculture
1.1.3: Restoration of forest mosaic landscapes	This activity focuses on restoring degraded forests within protected areas and forest fragments, re-growing forests in priority areas for the supply of ecosystem services, especially watershed protection, and the planting of trees outside forests for improved sustainability and livelihoods. The project will employ a Forest Landscape Restoration (FLR) approach in the forest mosaic landscape areas adjoining protected areas.	Key actions will include: Assisted natural regeneration and planting of diverse tree assemblages to restore degraded forests, Enhancing the ecosystem service provisioning of existing timber plantations through understorey rehabilitation and under-planting with species more suited to the local environment and people's needs than the pines and	41,911 ha dense forest 21,905 ha open forest 62,204 scrub (degraded grassland) Implementation will involve Forestry and Central Environmental Authority, Knuckles Environmental Protection Agency, Ministry of Mahaweli Development and Environment; Department of Agrarian Development, Ministry of Primary Industries; Wildlife Department, Ministry of Sustainable Development; Land Reform Commission, Ministry of Lands with technical backstopping from ICRAF.

		eucalypts that were planted previously Restoration of degraded grassland areas, which have thus far defied restoration attempts. Ensuring forest resilience through use of climate proofing in selection of species and genetic compositions of any plantings	
1.2.1: Increasing cropping intensity of irrigated rice in both upstream and downstream areas	This activity focusses on development of smart farming techniques to grow appropriate climate adapted varieties and make efficient use of irrigation water and fertilizer (maximizing use of organic inputs and recycling) as well as employing integrated pest control based on real time weather and pest incidence data (connected to the information system developed in 3.1.2.) Traditional irrigation methods like furrow irrigation (FI) and continuous flooding irrigation (CI) result in high water loss. Water saving irrigation methods improve water use efficiency (WUE). The System of Rice Intensification (SRI) that the project will promote is a climate-smart, yield-increasing system that is being utilized by more than 10 million smallholder farmers in over 55 countries. The innovation combines a number of agronomic practices to boost yields while reducing the use of purchased inputs and water. The project will also provide customized advice for enhancing rice productivity through use of appropriate varieties for each context, storage and processing to maintain quality as well as supporting enhanced production of	There are five key intervention areas: *i) Make better use of irrigation water (higher WUE) through better irrigation management and variety choice* *ii) Achieve cropping intensity greater than or equal to 2, with enhanced productivity.* iii) *Store, process (including drying) and assure quality to achieve reasonable prices* *iv) Dietary diversity (though enhancement of what is available across landscapes) and addressing wind issues* *v) Establish network of automatic weather stations to collect real time precipitation, temperature and wind data to parameterize crop models and understand fine scale variation in climatic conditions across the project area.*	122,150 ha downstream paddy 8,793 ha upstream paddy Implemented by the Department of Agrarian Development in the Ministry of Agriculture with ICRAF backstopping data collection and crop modelling.

	associated crops for increased dietary diversity.		
1.2.2: Intensification of Sustainable smallholder production	This will focus on options for sustainable intensification of homegardens, analog forests, spice gardens and annual horticultural crops in the upstream catchment. Interventions include climate proofing of tree species choice, pruning to control distribution of light in mutlisrata systems and improve timber quality and agronomic management. Annual horticultural systems focus on annual crop production: kidney beans, beets, chillies, big onions, green gram, cabbages, bitter gourd, pumpkin, tomato, okra, eggplant, luffa, and long beans. These crops are produced for both household consumption and market sales. Individual farms cultivate a diversity of crops under low input and rainfed conditions. While focused on annual horticultural crops, these systems also contain tree components that provide both service and production roles. The diversity of tree species is similar to homegardens and spice gardens. Analog forests model the process of natural forest development and forest service functions in (re)establishing a sustainable ecosystem characterized by a high biodiversity to biomass ratio. Analog forests are designed through a synthesis of traditional and scientific knowledge, to optimize the production and service potential of the system rather than to maximize the productivity of a single species component. While focused on ecosystem restoration, analog forests are also designed to provide economic benefits. Annual species are also components of analog forests.	Key intervention areas are: • Enhancing species diversity to reduce climate, biophysical and market vulnerability; • Strengthening farmers' access to the best-available quality germplasm of priority climate-resilient species, varieties and cultivars that match local biophysical and soil conditions; • Developing individual and group tree nurseries to empower farmers to independently produce high quality seedlings of priority species; • Promoting thinning to achieve recommended spacing, remove unproductive trees, remove low value species, and increase the vigor and productivity of the remnant stand; • Promoting pruning to remove unproductive branches, improve tree vigor and productivity, and increase light levels for understory intercrops; • Promoting intercropping with annual crops to improve overall system productivity; • Promoting the production and use of organic mulch and fertilizers to rehabilitate soils, improve water recharge, and produce products for the green economy; • Exploring the feasibility of drip irrigation for high-value tree crops to improve water use	There are 28,457 ha of homegardens in the upper catchment (upstream) to be considered in the project area

	Homegardens, spice gardens, annual horticultural systems, and analog forests can be viewed as a continuum of smallholder systems. From horticultural systems focused on annual crops, to homegardens and spice gardens representing perennial (tree) farming systems, to analog forests being a forest management and restoration approach. All include both annual and perennial species and are concerned with sustainable management. A difference being that homegardens, spice gardens and annual horticultural systems focus on enhancing smallholder livelihoods in an environmentally sustainable manner; and analog forests focus on ecosystem restoration with livelihoods as the secondary objective.	efficiency and increase tree vigor and productivity.	
1.2.3: Restoration and intensification of sustainable plantations	This will include tea, coconut, rubber, timber and large-scale cultivation of spices and include development of landscape planning at estate level and the development of food forests to address food security of estate worker families, some of whom have entered contract farming arrangements with estate companies. Timber plantations in or near natural forest areas will be included in 1.1.3 while those in predominantly agricultural landscapes will be covered here.	• Landscape planning of estates to allocate land appropriately to intensive cultivation of export crops, subsistence production of nutritionally rich diets for estate workers and their families and soil and water conservation, including the establishment of exemplar landscapes. • Species suitability mapping to reduce climate, biophysical and market vulnerability; • Best-available quality germplasm of priority climate-resilient species, varieties and cultivars that match local biophysical and soil conditions; • Promoting thinning to achieve recommended spacing, remove unproductive trees, remove low value species, and increase the vigor and productivity of the remnant stand;	4106 ha tea 2713 ha coconut 2251 ha rubber 2090 ha timber 1076 ha pepper 102 ha cinnamon

		• Promoting pruning to remove unproductive branches, improve tree vigor and productivity, and increase light levels for understory intercrops; • Promoting intercropping with annual crops to improve overall system productivity; • Promoting the production and use of organic mulch and fertilizers to rehabilitate soils, improve water recharge, and produce products for the green economy; • Exploring the feasibility of drip irrigation for high-value tree crops to improve water use efficiency and increase tree vigor and productivity.	
2.1.1Conduct Domestic value chain mapping and green market assessments for products especially from small holder and subsistence farmers	This involves the detailed geo-referenced mapping of existing agricultural value chains (cash crops, spices, herbs and fruits) to capture their current lengths (vertical upstream to downstream) and breadths (horizontal links to input and service sectors as well as the national system of innovation (NSI)) as well as the identification of respective intra-governance structures.	Establishment of modes of regular market analyses and trade regimes conducive to green production and processing methods as well as products Identification of Sri Lanka's agricultural value chains in national, regional and global markets Scoping opportunities of rent appropriation and comparative advantage with respect to agricultural value chains.	This will result in a detailed overview of actors, especially weaker actors (women, smallholder and subsistence farmers) their relationship to each other through business models, their physical location in biophysical and socioeconomic systems as well as their placement in the intra-chain governance regime and in the political and macroeconomic systems of governance.
2.1.2Provide technical support for Enterprise and institutional development to exploit green growth opportunities for small	This involves the development of capacity to operate farms and collective groups as business enterprises. It involves support to actors to set up soft institutions where needed (based on Activity 2.1.1)		Bottlenecks and inefficiencies will be identified along and across value chains, to foster co-innovation of new green technologies and to stimulate the development of new businesses and business relationships to exploit green growth opportunities for

holder farmers in the uplands			smallholders and subsistence farmers adopting sustainable practices.
2.1.3: Identification and implementation of value chain upgrading options for smallholder and subsistence farmers engaged in climate smart agriculture	This involves the joint analysis (linked to Activities 1.2.1-3) and pursuit of meeting buyers' critical success factors and of value chain upgrading options with respect to products, processes, functions, inter-sectoral relationships, institutions (link to Activity 2.1.2) and new (green) technologies to achieve greater value chain efficiencies and market penetration of existing value chains, the participation in new value chains and/or the exiting from unprofitable or environmentally unsustainable value chains.	Development of new products and services Targeted branding of existing products and establishment of a Green Sri Lanka national brand that benefits climate smart agriculture. Obtaining appropriate third-party certification and quality assurance Improvement of production, harvesting, post-harvest management, storage and transport technologies.	These inputs facilitate the co-innovation of new technologies along green value chain principles involving the creation of new markets for novel products such as sweet dwarf mangos, superfoods and Ayurveda products, which will be offered especially to smallholder and subsistence farmers to help them to 'climate proof' their livelihoods.
2.2.1: Developing a portfolio of business cases for negotiating performance-based financial transfer mechanisms	This will involve a robust socioeconomic and ecological baseline and supporting information that will become the core for the evidence of the provision of the ecosystem service (output-based payments) and address additionality concerns to reduce the cost of policy implementation. This comprises the basic appraisal of ecosystem services (ES) that are economically valuable and ES providers practicing environmentally protective best practices in the upstream catchment, including their livelihood options and local conservation knowledge.	Information on ecosystem services and solutions for ES provisions will be linked to spatially explicit assessment and interventions of land degradation (Activity 3.1.2), and locations of prioritized PES scheme will be determined based on the integrated land use plan at sub-basin scale (Activities 3.1.1). Potential smallholders as PES participants will be selected by considering their opportunity costs, farming systems and other socioeconomic profiles by applying behavioral economic methods such as reverse auctions.	Payment modalities will be discussed and consulted to both providers and beneficiaries. Options and values of revenue from ES beneficiaries, such as hydropower companies and large-scale water users, are determined based on a watershed valuation process, negotiation and policy analysis of possible revenue collections when engaging public entities. An incentive-based scheme, such as PES, synergized with relevant development programs (linked to Output 2.1) will become an alternative sustainable finance for activities 1.1.1, 1.1.2 and 1.1.3 (as a key element of the exit strategy)
2.2.2: Setting up a PES intermediary body as a part	The intermediary body will be a committee within the nested-multi-stakeholder platform	Intensive facilitation to ensure the committee members understand	The roles of PES intermediary body include information exchange, program design, upscaling and replication, networking,

of the multi-stakeholder platform, and its governance system established	(Activity 3.3.1) and involve establishing an adaptive rural advisory services (RAS) facility to support adoption of catchment protection practices (including implementing regulations from 3.1.1 as well as prioritized promotion of best fit practice matched to local context).	their roles, have sufficient capacity, and are able to monitor, evaluate, upscale and replicate PES	representation and mediation, administration and coordination of PES programs, including payment collection, financing, distribution, performance monitoring and evaluation.
2.2.3: Establish a monitoring system for PES schemes in the upstream catchment area	This involves establishing a monitoring system for PES schemes comprising both socioeconomic and ecological criteria and indicators. The monitoring system will determine the performance of ES providers in accessing ES rewards, financially and non-financially	Scoping of watershed, problems, criteria and indicators. Capacity strengthening activities for local stakeholders on how to monitor, evaluate and develop criteria and indicators.	The criteria and indicators are developed by considering SDG and other national commitments such as the Sri Lanka Nationally Determined Contributions (NDC) and National Adaptation Plan (NAP)
3.1.1: Develop an integrated land use policy and planning mechanism at sub-basin scale	To carry out this activity and ensure long term sustainability, five new governance structures (implementation teams) will be developed that will be put in place to integrate across non-congruent administrative (Divisional Secretariat - DS) and hydrological (sub-catchment) boundaries as follows: 1. The five sub-catchments on the east of the target catchment area (Amban Ganga, Puwakpitiya Oya, Thelgamu Oya, Kalu Ganga and Knuckles Ellewana Kanda Eastern Slope). These are well connected to one another and embrace the large DSs of Lagalla Pallegama and Wilgamuwa and the larger eastern part of the Naula DS (the rest is part of 3 below). Much of the area is less degraded than other parts of the overall catchment so the density of intervention is anticipated to be lighter than in other sub-basin units. 2. The upland part of the Sudu Ganga sub-catchment including the Rattota and Ambanganga Korale DSs.	Five sub-basin SHARED stakeholder engagement processes	The SHARED stakeholder engagement process will involve multi-stakeholder workshops that bring together the relevant sectors and stakeholders, including District Secretariat, representatives of key local agencies, private sector, plantations and farmers organizations. This will include stakeholder network, causal and outcome mapping, review of existing decision making cycles and structures and the formulation of desired outputs. The workshops will be used to co-design information systems and define capacity, governance and information needs for each sub-basin implementation unit. The workshops will provide effective formats for land use planning, regulatory and incentive measures and capacity development to enhance integrated, evidence-based land use planning and policy development.

	3. The lower part of the Sudu Ganga sub-catchment including the Ukuwela, Matale and parts of Akurana and Naula DSs 4. The Nalanda Oya sub-catchment embracing Pallepola and Yatawatta. 5. The Heen Ganga and Hasalaka Oya sub-catchments in the south, comprising Udadumbara DS and part of Minipe DS.		
3.1.2 Develop the SHARED information system to support land use planning, climate adaptation, market information and monitoring of the performance of intervention options	The information system will involve developing spatially explicit assessments of land degradation that are critical for the development of effective adaptation options and targeting interventions, while also providing a framework for monitoring of progress over time. Both socioeconomic and biophysical information will be integrated.	Five LDSF baseline surveys with associated satellite image analysis Implementation of five sub-basin information portals and dashboards Development of an interface to connect sub-basins to an integrated upstream catchment portal	By providing a robust indicator framework, advanced analytics and diagnostics (models), the information system will be key to the development of spatially explicit interventions to protect and restore ecosystem function and adaptation. Land degradation hotspots (e.g. soil erosion and compaction) and soil health variables (e.g. soil organic carbon) will be mapped at high spatial resolution (10 to 30m), by combining data collected from the LDSF sites with data from the global database.
3.1.3: Development and refinement of SLM framework	This Activity will synthesize information to support land use planning, climate adaptation, market information and monitoring developed under Activity 3.1.2. with the nested-scale multi-stakeholder innovation platforms for facilitating participatory engagement at the GN level established under Activity 3.3.1. It will produce an organized set of intervention options for land and water management tailored to the range of local contexts occurring in the project area.	Collation of local and expert knowledge to characterize variation in contextual factors conditioning suitability of recommended practices (listed in 1.1 and 1.2) across the project area Production of six initial option by context matrices for activities 1.1.1-3 and 1.2.1-3 and a gap analysis identifying information needs. Design of scaling so that planned comparisons embedded in the roll out of interventions use co-learning to fill information needs	This involves an iterative process of co-design and participatory evaluation following the ‘core 4 framework’ set out in the program description in Section C3.

		and efficiently adapt options to local context.	
3.2.1: Establishment of nested-scale multi-stakeholder innovation platforms from sub-basin to GN scale	A key element of resilience enhancement of communities and ecosystems includes the engagement of relevant and diverse stakeholders across scales in adaptation planning, This is aided through the utilization of online dashboards and structured engagement to facilitate stakeholder interaction and interrogation with evidence. Understanding how various stakeholders interact with each other, as well as obtain, share and utilize information/evidence in prioritizing practices that minimize potential negative environmental impacts is key to developing context-appropriate innovation platforms.	Root-cause analysis of key constraints (barriers) to adoption of best practices. Mapping stakeholder networks and their connectivity to inform upscaling activities. Prioritization of options by women, men and young people. Trade-off analyses between environmental impact and increased agricultural production.	Specific interactive exercises will guide stakeholders to conceptualize key themes, group them into appropriate modules based on decision making hierarchies and processes with a commensurate process for prioritizing data, indicators and visualization options. Based on priorities of the location, terms of reference will be established for innovation platforms. Each will have a different composition according to the relevant government, civil society and private sector actors at the location. Platforms will be linked across sub-basins to share information and learning down to the GN level.
3.2.2: Develop local capacity for adaptive and sustainable land management	This activity addresses key capacity development required across government to connect bottom up methods that ensure that feasible options are developed and top down rural advisory service RAS mechanisms that are required to make them widely available. This requires developing capacity to be able to operate a responsive and evidence-based rural advisory service that can incorporate developing knowledge and real time information about changing conditions in the short term (such as weather or pest outbreaks) and long term (such as suitability of tree species in the context of climate change).	Training of: 1. Project managers who need to understand the concepts and approaches being used. This will be by one day face-to-face training events provided by ICRAF staff (three per year, pooled across sub-basins). 2. Field officers who are responsible for implementing field activities. These will primarily be training-of-trainer events, requiring face-to-face training (by managers for field officers) with distance-learning backup (five three-day events per year and access to distance learning materials developed in 3.2.3.) 3. Farmers and others who will adopt new practices. These training events are conducted by	The purpose of **training** is to ensure all involved are able to use the framework and tools (see 3.3.3). The training will involve the executing partners implementing 1.1.1-3 and 1.2.1-3 as listed above.

		the trainers attending the events in 2 above.	
3.2.3: Development and production of simple to use guidelines, manuals and tools for matching options to context and implementing SLM, sustainable intensification and value chain upgrading options	The adaptive and responsive options by context framework employed in the project requires simple guidelines and tools that make it easy for it to be taken up and used at grass roots level. These are developed: - using the data compiled from external sources or generated in previous stages - analysing and interpreting the data - making decisions on options to promote in particular circumstances	A series of guides, checklists, frameworks, SmartPhone Apps, videos and distance learning materials tailored to capacity needs defined in 3.2.2	Where appropriate, tools will be developed as interactive smartphone Apps capable of suggesting likely options for particular situations utilising georeferencing in the smartphone with information held in the information system developed in 3.1.2, that may include real time weather and market information in addition to advice based on performance evaluation of options across the contexts they have been tried out in the project area.