Making the Eastern Province more resilient to climate change through restoration and enhanced productive landscapes -

Feasibility Study

May 2021

This report has been prepared for IUCN as part of work to prepare the project "Transforming Eastern Province through Adaptation" (TREPA).

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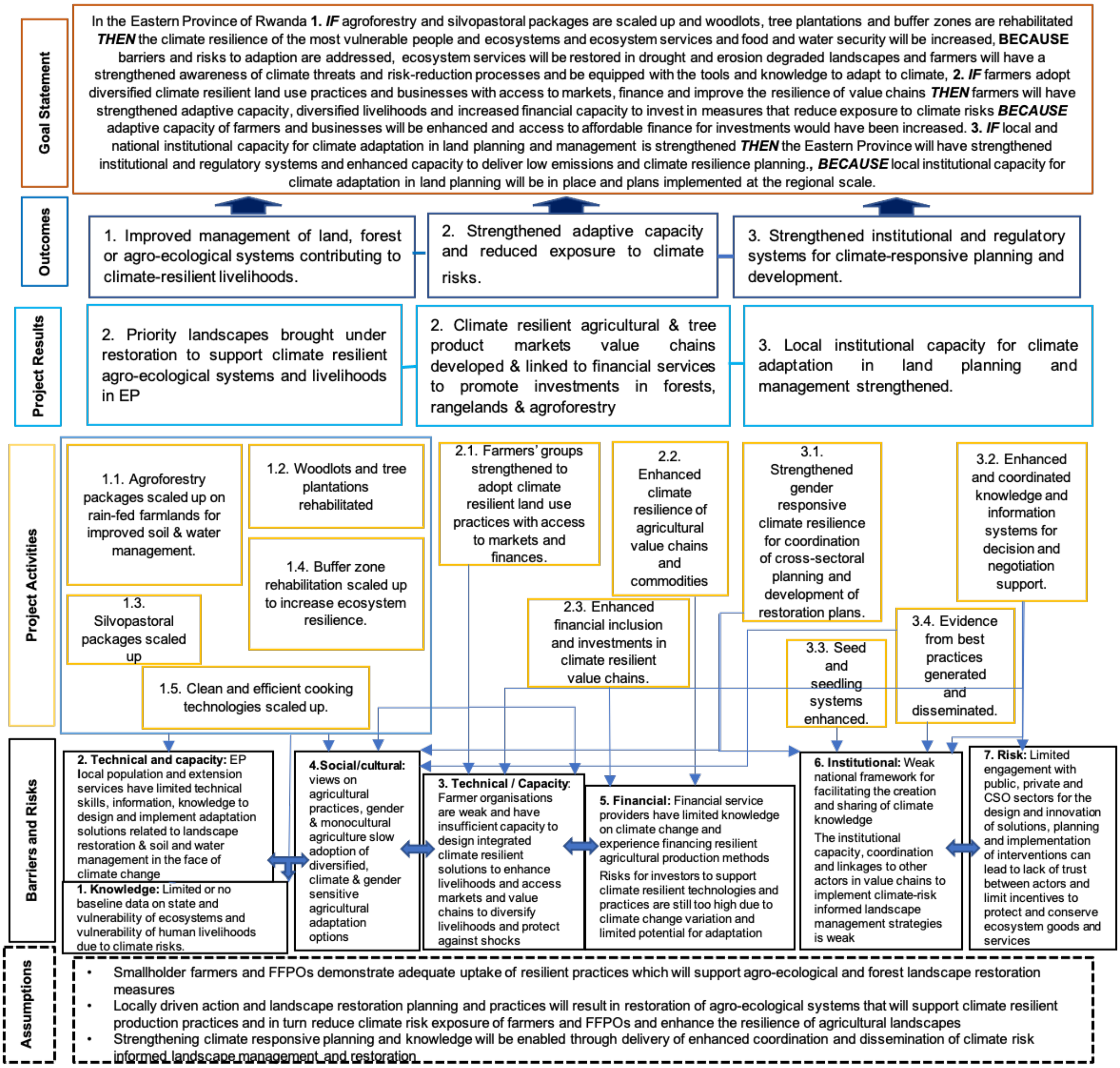
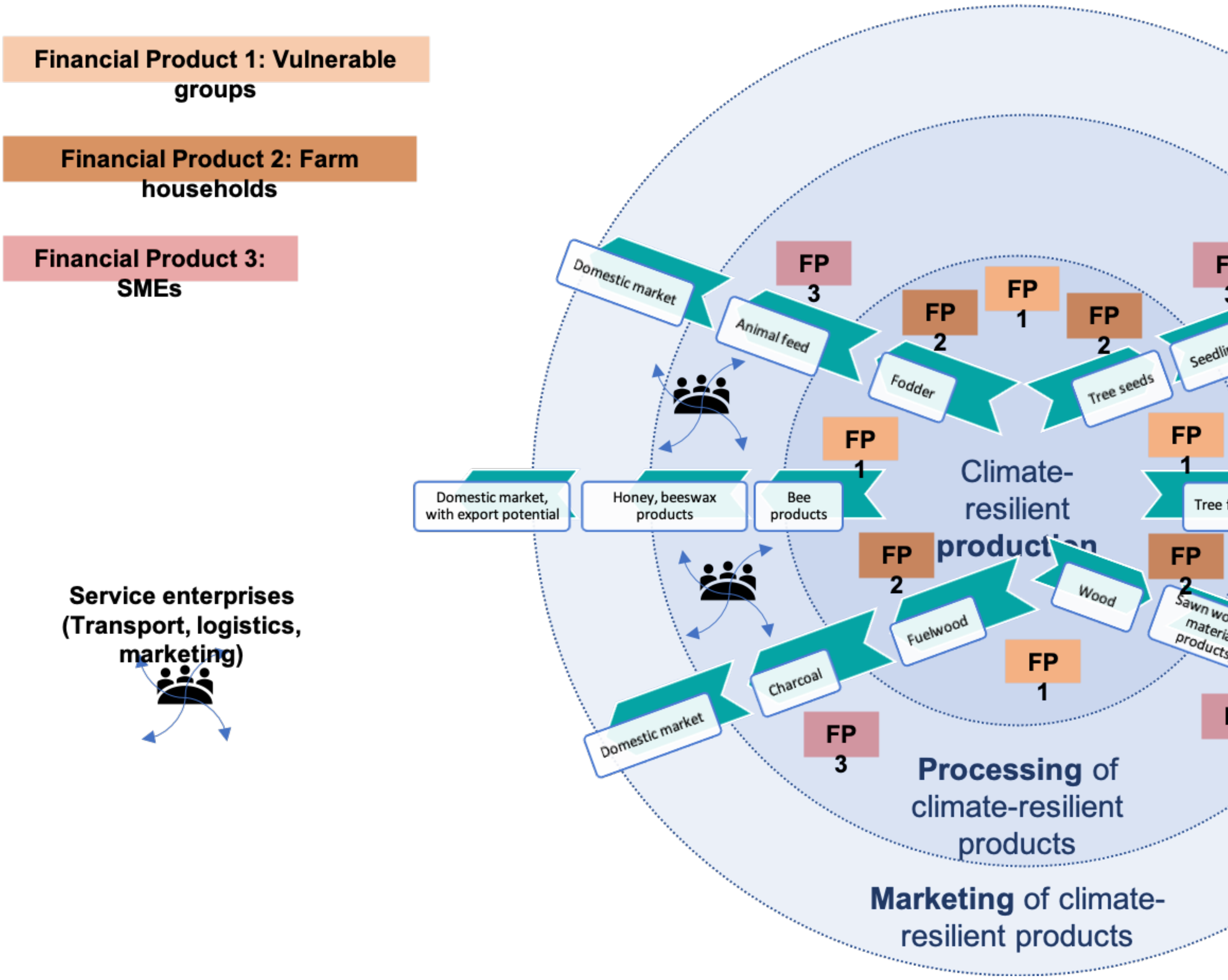
Target group	Baseline	Year 1
Vulnerable rural groups involved in cooking stoves woodlots production	No access to formal finance, very limited informal finance, low financial literacy	Financial literacy, Savings linked to FSPs First group guarantee loans for woodlots, group loans assessed by group coherence tool
Farm households	Limited access to timely and seasonal agri-loans, single commodity loans based on high physical collateral, limited financial literacy. Prevailing commercial interest rates for similar financial products for single crop product interest rates vary above 18%, require collateral and have short tenor of only 6-12 months	Access to agroforestry loan on mixed term conditions (1-5 years) incentivizes engagement in agroforestry practices and reduces collateral needs, financial and climate resilience education.
SMEs processing agroforestry products	No access, no specific products for niche SMEs processing agroforestry products or producing cookstoves. Prevailing interest rates for similar financial products which are only provided in urban areas are around 18% and require significant collateral and tenor of only 6-12 months	Access to prototype loan for investments in machinery and equipment (processing of agroforestry products and cookstove production), credit risk assessment tools developed.
Financial service providers	Limited knowledge and understanding of climate impact on target groups, no tailored financial products limited loan capital, no tools to fair appraise agriculture loans, lack of risk management tools	Assessment based agroforestry and prototype loans for niche SMEs, linking products for savings groups, risk management knowledge on climate impacts improved. Improved or developed tools to assess risk.

Figures


Goal Statement
In the Eastern Province of Rwanda 1. IF agroforestry and silvopastoral packages are scaled up and woodlots, tree plantations and buffer zones are rehabilitated THEN the climate resilience of the most vulnerable people and ecosystems and ecosystem services and food and water security will be increased, BECAUSE barriers and risks to adaption are addressed, ecosystem services will be restored in drought and erosion degraded landscapes and farmers will have a strengthened awareness of climate threats and risk-reduction processes and be equipped with the tools and knowledge to adapt to climate, 2. IF farmers adopt diversified climate resilient land use practices and businesses with access to markets, finance and improve the resilience of value chains THEN farmers will have strengthened adaptive capacity, diversified livelihoods and increased financial capacity to invest in measures that reduce exposure to climate risks BECAUSE adaptive capacity of farmers and businesses will be enhanced and access to affordable finance for investments would have been increased. 3. IF local and national institutional capacity for climate adaptation in land planning and management is strengthened THEN the Eastern Province will have strengthened institutional and regulatory systems and enhanced capacity to deliver low emissions and climate resilience planning., BECAUSE local institutional capacity for climate adaptation in land planning will be in place and plans implemented at the regional scale.
Outcomes
1. Improved management of land, forest or agro-ecological systems contributing to climate-resilient livelihoods.
2. Strengthened adaptive capacity and reduced exposure to climate risks.
3. Strengthened institutional and regulatory systems for climate-responsive planning and development.
Project Results
2. Priority landscapes brought under restoration to support climate resilient agro-ecological systems and livelihoods in EP
2. Climate resilient agricultural & tree product markets value chains developed & linked to financial services to promote investments in forests, rangelands & agroforestry
3. Local institutional capacity for climate adaptation in land planning and management strengthened.
Project Activities
1.1. Agroforestry packages scaled up on rain-fed farmlands for improved soil & water management.
1.2. Woodlots and tree plantations rehabilitated
1.3. Silvopastoral packages scaled up
1.4. Buffer zone rehabilitation scaled up to increase ecosystem resilience.
1.5. Clean and efficient cooking technologies scaled up.
2.1. Farmers' groups strengthened to adopt climate resilient land use practices with access to markets and finances.
2.2. Enhanced climate resilience of agricultural value chains and commodities
2.3. Enhanced financial inclusion and investments in climate resilient value chains.
3.1. Strengthened gender responsive climate resilience for coordination of cross-sectoral planning and development of restoration plans.
3.2. Enhanced and coordinated knowledge and information systems for decision and negotiation support.
3.3. Seed and seedling systems enhanced.
3.4. Evidence from best practices generated and disseminated.
Barriers and Risks
2. Technical and capacity: EP local population and extension services have limited technical skills, information, knowledge to design and implement adaptation solutions related to landscape restoration & soil and water management in the face of climate change
1. Knowledge: Limited or no baseline data on state and vulnerability of ecosystems and vulnerability of human livelihoods due to climate risks.
4.Social/cultural: views on agricultural practices, gender & monocultural agriculture slow adoption of diversified, climate & gender sensitive agricultural adaptation options
3. Technical / Capacity: Farmer organisations are weak and have insufficient capacity to design integrated climate resilient solutions to enhance livelihoods and access markets and value chains to diversify livelihoods and protect against shocks
5. Financial: Financial service providers have limited knowledge on climate change and experience financing resilient agricultural production methods
Risks for investors to support climate resilient technologies and practices are still too high due to climate change variation and limited potential for adaptation
6. Institutional: Weak national framework for facilitating the creation and sharing of climate knowledge
The institutional capacity, coordination and linkages to other actors in value chains to implement climate-risk informed landscape management strategies is weak
7. Risk: Limited engagement with public, private and CSO sectors for the design and innovation of solutions, planning and implementation of interventions can lead to lack of trust between actors and limit incentives to protect and conserve ecosystem goods and services
Assumptions
Smallholder farmers and FFPOs demonstrate adequate uptake of resilient practices which will support agro-ecological and forest landscape restoration measures
Locally driven action and landscape restoration planning and practices will result in restoration of agro-ecological systems that will support climate resilient production practices and in turn reduce climate risk exposure of farmers and FFPOs and enhance the resilience of agricultural landscapes
Strengthening climate responsive planning and knowledge will be enabled through delivery of enhanced coordination and dissemination of climate risk informed landscape management and restoration


Financial Product 1: Vulnerable groups
Financial Product 2: Farm households
Financial Product 3: SMEs
Service enterprises (Transport, logistics, marketing)
Domestic market
Animal feed
Fodder
Tree seeds
Domestic market, with export potential
Honey, beeswax products
Bee products
Climate-resilient production
Fuelwood
Charcoal
Domestic market
Wood
Processing of climate-resilient products
Marketing of climate-resilient products
FP 1
FP 2
FP 3

Abbreviations

CSOs	Civil Society Organizations
EbA	Ecosystem-based Adaptation
EICV	Integrated Housing Living Conditions Survey
FAO	Food and Agriculture Organisation
FEWS NET	Famine Early Warning System Network
FFS	Farmer Field Schools
FLR	Forest Landscape Restoration
FONERWA	National Fund for Environment and Climate Change
FSSP	Forestry Sector Strategic Plan
GCM	General Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Fund
GGCRS	Green Growth and Climate Resilience Strategy
GHG	Greenhouse Gases
GoR	Government of Rwanda
ICS	Improved Cooking Stoves
ICT	Information and Communication Technologies
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel for Climate Change
IUCN	International Union for Conservation of Nature
LAFREC	Landscape Approach to Forest Restoration and Conservation
LVCD	Local Value Chain Development
MIDIMAR	Ministry of Disaster Management and Refugee Affairs
MNR	Ministry of Natural Resources
MINIRENA	Ministry of Natural Resources
MINAGRI	Ministry of Agriculture and Animal Resources
MoU	Memorandum of Understandings
NAPA	National Adaptation Programmes of Action to Climate Change
NGOs	Non-Governmental Organizations
NISR	National Institute for Statistics in Rwanda
NST1	National Strategy for Transformation
NTSS	National Tree Seed Strategy
PET	Potential Evapotranspiration
RLMUA	Rwanda Land Management and Use Authority
RFA	Rwanda Forestry Authority

REMA	Rwanda Environment Management Authority
RDHS	Rwanda Demographic Health Survey
ROAM	Restoration Opportunities Assessment Methodology
SDG	Sustainable Development Goals
SPI	Standardized Precipitation Index
SEDP	Sustainable Energy Development Project
TRI	The Restoration Initiative
TREPA	Transforming Eastern Province through Adaptation
ToT	Training of Trainers
WFP	World Food Program
UNFCCC	United Nations Framework Convention on Climate change

1. Executive Summary

Rwanda is ranked among the first of all African countries in terms of natural resource dependency and thus highly vulnerable to climate change for 2011.[1] The country is already experiencing the impacts of climate change, including increased occurrence and severity of droughts and more frequent floods leading to landslides. The Eastern Province has the most agricultural land (439,000 ha) in Rwanda and is the most exposed to climate-induced prolonged and severe droughts.[2&3] Agriculture is predominantly practiced by smallholder farmers[4] (84% of all farmers) with agricultural production depending almost exclusively on the amount of rainfall during the rainy seasons. Land degradation and soil erosion loss due to unsustainable agricultural practices are major issues in the province which is further exacerbated by erratic rainfall.

In the past two decades, climate change has increased the frequency and intensity of droughts (mainly in Eastern province), floods (mainly in plain overflowed by main rivers) and landslides (mainly in Northern/Western/Southern provinces) affecting two million Rwandans.[5] Droughts are one of the major hazards severely affecting smallholder farmers as they depend on rain-fed agriculture and lack irrigation systems.

Projected impacts will further compound the already-fragile situation in the Eastern Province areas unless major adaptation actions are integrated in the way landscapes are managed and governed. Economic models suggest that Rwanda could lose over 1% of its GDP each year due to climate change related losses by 2030, and an even greater proportion thereafter.[6] Drought scenarios show estimated total monetary losses for the Eastern Province from crop loss and damage (cereals, bananas, beans and cassava) at USD 2 million and USD 7.5 million (RWF 1.9 billion and 6.9 billion) respectively per year.[7]

The main objective of the TREPA project is to lead to a paradigm shift away from degraded and vulnerable land in the Eastern Province unable to sustain livelihoods to a climate resilient landscape providing development opportunities for smallholder farmers. The project builds on Rwanda's national priorities for low-emission and climate-resilient development. The project targets national climate development priorities and has been designed to align with national strategies and policies. The project is deeply aligned with the goals and targets of the recent Rwanda National Forestry Policy 2018 the Forest Sector Strategic Plan 2017-2022 (FSSP) and National Forest Management Plan 2017-2026 (NFMP) all reflecting the government's

[1] Nabalamba, A., Mubila, M., Alexander, P. Climate Change, Gender and Development in Africa. African Development Bank, 2011.

[2] NISR, The Fifth Integrated Household Living Conditions Survey (EICV5)

[3] MIDIMAR, 2015. The National Risk Atlas of Rwanda

[4] Smallholder farmers in Rwanda have a mean land size of up to 1 ha.

[5] USAID, 2018. Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan.

[6] Rwanda Environment Management Authority and SEI, Economics of Climate Change in Rwanda (2009). http://www.rema.gov.rw/~remagov/fileadmin/templates/Documents/rema_doc/CC%20depart/Economics%20of%20CC%20in%20Rwanda.pdf

[7] MIDIMAR, 2015. The National Risk Atlas of Rwanda

intentions and projects support to address climate change impacts and mitigation targets by improving forest management in collaboration with the private sector.

The TREPA project design is aligned with a number of existing activities and projects in the Eastern Province focused on food security, large scale irrigation and crop resilience to drought. The TREPA project objective in this regard is to lead to a paradigm shift from reliance on degraded and vulnerable land, unable to sustain livelihoods to a climate resilient landscape providing development and diversified climate resilient opportunities for smallholder farmers which complement existing activities in the Eastern Province.

The project will ensure the resilience of the Eastern Province by targeting two layers. First, the degraded and climate sensitive land and forest ecosystems and the prevalent management practices of these systems will be transformed by adaptive agro-forestry, silviopastoral, forestry and water and soil management practices and technologies. Activities and technologies identified through rigorous feasibility in this study have been designed and selected to build resilience in the landscape to sustain agro-ecological systems and livelihoods and increase their capacity to be more adaptive to climate threats and variability, in particular drought. In fact, the restoration activities proposed in this project will increase the resilience of the Eastern Province agriculture sector by ensuring water catchment capacity is maximized. Secondly, these activities, technologies and management practices will be supported and scaled up through setting-up institutional and financing capacity and mechanisms that will help stakeholders such as smallholders or Farmer Forester Producer Organizations (FFPOs) involved in value chains relevant to the Eastern Province to cope with climate variability following the project end.

Investment opportunities coupled with improved land use planning and management will set the scene for transforming the landscape. The project approach is centred on landscape-scale restoration of degraded lands informed by improved climate risk evaluation. Local and national institutions will be strengthened to govern forest and pasture resources at all levels. The project aims at building resilience to the impacts of current and future climate change while advancing equitable social welfare and income generating opportunities. This will be achieved in the following ways:

i) building and strengthening the currently weak institutional capacity and government systems to support rural communities as well as FFPO[8] to adapt to and manage climate risks.

ii) supporting investment opportunities and empower the communities and FFPO to transform their drought-dominated, heavily degraded lands through increased access to finance by means of new pay-for-performance incentives for farmer adoption of restoration and climate-resilient forest and agroforestry practices

[8] Forest-and-farm producer organizations are formal or informal associations of such producers. They are created with the aim of helping their members share knowledge and experience; engage in policy advocacy; secure tenure and access rights to forest, land and other natural resources; improve forest-and-farm management; expand markets; build enterprises; and increase income and well-being. Forest-and-farm producer organizations vary widely in size and institutional form and may focus on forests or combinations of forest- and farm-related activities. They may include indigenous peoples and local community organizations; tree-grower and agroforestry associations; forest owner associations; producer cooperatives and companies; and their umbrella groups and federations

iii) enhance inclusivity and competitiveness of climate resilient commodities market systems and ensure long-term business sustainability through; strengthening business linkages for efficient value chain performance; increase the productivity and profitability of smallholder farmers with the aim of alleviating poverty and reducing the number of those experiencing food insecurity, while increasing the number of those readily accessing markets

iv) strengthening rural communities' and FFPO awareness and understanding of climate change, its impacts and adaptation, and enhancing ownership of adaptation interventions and plans; and

v) facilitating community-based local adaptation planning to deploy resilience building measures and adaptation technologies to strengthen vulnerable food insecure households under conditions of increasing climate-induced droughts.

The project will achieve this through three integrated components (See Section B.3) to deliver a paradigm shift through cross-cutting outputs that bring adaptation results with mitigation co-benefits.

Component 1: Restored landscapes that support climate resilient agro-ecological systems and livelihoods in Eastern Province

Component 2: Climate resilient market development and supply chains incentivize public and private investments in forests, rangelands and agroforestry

Component 3: Strengthening of national and local institutional capacity and cross sectoral coordination to mainstream climate resilience in land management and planning

Government agencies such as Rwanda Forestry Authority (RFA), Rwanda Natural Resources Authority (RNRA), Rwanda Environment Management Authority (REMA) will maintain strong ownership and support activities as aligned with their mandates and the aforementioned plans and strategies.

This feasibility study was carried out on behalf of IUCN as input to a Green Climate Fund (GCF) proposal "**Transforming Eastern Province through Adaptation" (TREPA)** to be submitted by IUCN on behalf of, and in close cooperation with Enabel, ICRAF, World Vision, ICCO. The project focuses on Rwanda's Eastern Province. The study comprises the following information: (1) baseline context for the socio-economic and ecological aspects of Eastern Province; (2) climate vulnerability and risk; (3) policy and institutional frameworks; (4) previous projects and lessons learned; (5) project design and beneficiaries; (6) technical notes on projects interventions and (7) sustainability of the project.

2. Section 1. Introduction

a. 1.1 Structure of the study

This feasibility study was carried out on behalf of the Government of Rwanda and IUCN as input to a Green Climate Fund (GCF) proposal **"Transforming Eastern Province through Adaptation" (TREPA)** to be submitted by IUCN on behalf of, and in close cooperation with the Rwanda Forestry Authority, Enabel, ICRAF, World Vision, ICCO. The project focuses on Rwanda's Eastern Province. The study comprises the following sections:

Section 1 - Introduction to the feasibility study. This section outlines the scope and approach used for the preparation of the study.

Section 2 – Baseline description. This section summarises the socio-economic and ecological context, highlighting key aspects regarding poverty, food security, livelihoods and the state of land degradation and restoration potential.

Section 3 - Climate change and vulnerability assessment. This section describes the historical climate trends and future scenarios, the climate change-related risks and impacts, key factors of vulnerability and the adaptation needs.

Section 4 – Legal and institutional framework. This section provides a summary description of national strategies and plans on development, climate change and natural resource management relevant for the project. It highlights how the project will contribute to national priorities and targets. It further provides a description of the main actors and institutions for the governance of climate change.

Section 5 - Projects on climate change in Rwanda and lessons learned. This section provides a summary of relevant past, current and future projects in Rwanda and key lessons learned. It highlights how the current project will complement, replicate, and will not duplicate the activities of relevant past, current and future projects.

Section 6 - Project design and approach. This section provides an overview of the design of the project, the barriers to adaptation (e.g. technical, institutional, financial, etc.), a characterisation and estimation of the beneficiaries and a description of the Theory of Change underpinning the paradigm shift that the project seeks to achieve.

Section 7 – Technical description of project interventions. This section provides a technical analysis of the interventions under each component at the output, activity and sub-activity level. The projects theory of change will be present how the activities undertaken address the barriers and contribute to a chain of results that lead to the projects intended outcomes given a number of underlying assumptions. Each intervention is further described in technical studies considering the following aspects: (i) Adaptation benefits; (ii) Barriers addressed; (iii) Implementation sites; (iv) Best practices and lessons learned considered; (v) Detailed description of activities.

Section 8 - Overall sustainability of the project. This section presents an overall description of the mechanisms that will be adopted throughout the project components to ensure the sustainability of the proposed interventions.

b.1.2 Approach

The Feasibility Study was carried out in an iterative way in the first half of 2019. It is based on a pre-Feasibility Study (conducted between 2017-2018) outlining an initial scoping of potential activities and a range of technical studies conducted (conducted between 2017-2019). Technical studies were based on site visits conducted to assess the feasibility of these potential interventions, to collect additional data and to detail and narrow the focus of the project. The field visits included stakeholder consultation meetings with the Government of Rwanda, community and and FFPO leaders and beneficiaries, Rwandan organisations, including local government, NGOs, CSOs and other potential partners (see Annex 7 of the Project Proposal Package).

Following the site visit and the stakeholder consultations, the proposed interventions were further refined through discussions with RWFA, IUCN, Enabel, ICRAF, World Vision and ICCO. The activities presented in this Feasibility Study document are the result of this iterative process.

The interventions have been designed to achieve the intended objectives of creating a landscape that is resilient to climate change and can support the smallholder farmers both under current climate threats and in future climate scenarios. The adaptation interventions are grouped into three interrelated Components:

Component 1: Restored landscapes that support climate resilient agro-ecological systems and livelihoods in Eastern Province

Component 2: Climate resilient market development and supply chains incentivize public and private investments in forests, rangelands and agroforestry

Component 3: National and local institutional decision making and cross sectoral coordination mainstream climate resilience in land planning management

The Feasibility Study integrates the gender equality aspect as a cross-cutting issue, highlighting gender disaggregated data in the baseline analysis and indicators, identifying differentiated adaptation needs and capacities for men and women, as well as key considerations for opportunities which have high potential to close the gender gap and foster gender transformative actions in the project location and beyond. Therefore, gender equality is an integral dimension of the project’s design, implementation arrangements, monitoring and evaluation.

3. Section 2. Baseline description

Section 2 summarises the socio-economic and ecological context, highlighting key aspects regarding poverty, food security, livelihoods and the state of land degradation and restoration potential in Rwanda.

a.

b. 2.1 Characteristics of project area

Project interventions will be implemented in the Eastern Province (Figure 1), which was prioritized based on biophysical and social factors, which underpin the high climate vulnerability of Rwanda's economy, the ecosystems and people in the area. The criteria used included: (1) contribution of the region to agricultural production and food security in the country; (2) high social and ecological vulnerability to climate change[9]; (3) very high exposure to climate risks such as droughts[10]; (4) high poverty and malnutrition levels; and (5) high levels of land degradation.

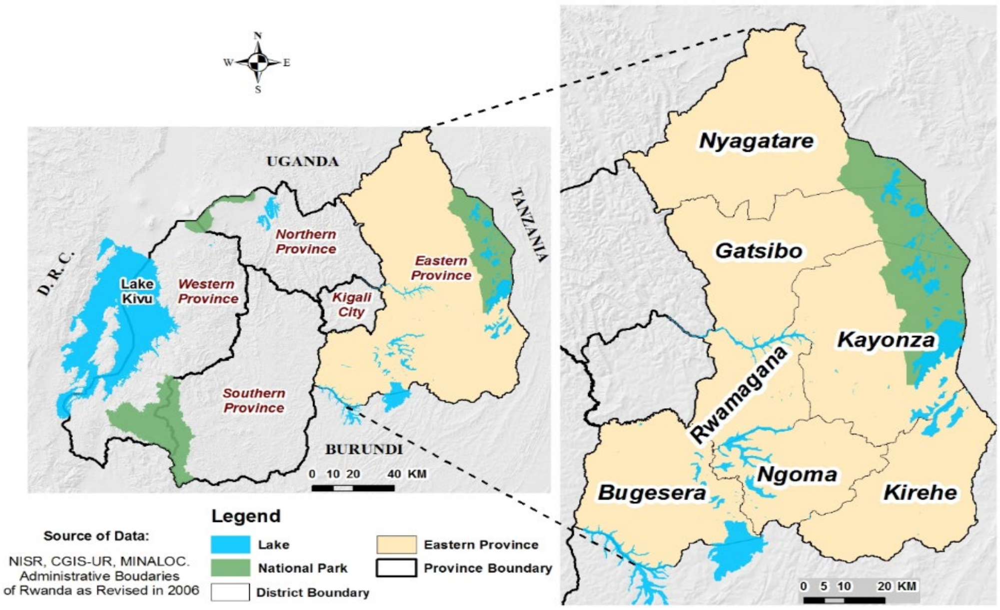


Figure 1. Map of the Eastern Province of Rwanda.

The Eastern Province covers an area of 9,813 km² (20% of country's territory) and includes seven districts: Bugesera, Ngoma, Kirehe, Rwamagana, Kayonza, Gatsibo and Nyagatare (Table 1). The province is characterized by diverse ecosystems including savannah, swamps and montane, moreover the Akagera National Park is located there. The Province is the most populated in Rwanda with an estimated 3,051,454 people (24% of total population est.

[9] REMA, 2015. Baseline Climate Change Vulnerability Index for Rwanda. Rwanda Environment Management Authority, Kigali, 2015

[10] Idem

12,663,116) in 2020.[11] One third of this population lives in poverty (37%) and 15% live in extreme poverty.[12]

Table 1. Description of the Eastern Province in Rwanda by population, density, with description of ecosystems.

Population[13]	Ecosystems
Ngoma *Population:* 396,086 people	Eastern Plateau (1200-1500m of altitude) largely comprises ecosystems where natural vegetation is rare and was gradually replaced by human activities. They include farmlands, some wetlands with a limited number of marshlands used for agriculture and few gallery forests (in Kirehe District) and forest plantations. It rains between 950-1050mm/year. *(Parts of Kayonza and Kihere)*
Gatsibo *Population:* 509,049 people	
Rwamagana *Population:* 368,498 *people*	
Nyagatare *Population:* 547,649 people	Eastern Savannah (below 900m of altitude) are comprised of farmlands, pasturelands, numerous wetlands and semi-arid ecosystems, where the prevalent natural plant species are thorny shrubs and trees, especially Acacia spp and herbaceous characteristic of dry lands. *(Parts of Kayonza and Kihere)*
Kayonza *Population:* 404,584 people	
Kirehe *Population:* 400,130 people	
Bugesera *Population:* 425,459 people	Bugesera (900-1200m of latitude) is an area whose colonization by humans is relatively recent and was largely covered by natural forests. It is characterized with arid and semi-arid areas, numerous lakes and swamps that cover an estimated 10,635 ha.

The province hosts about 25% (Table 2) of the Country's population. The province is comprised of seven districts: Bugesera, Gatsibo, Kayonza, Ngoma, Kirehe, Nyagatare and Rwamagana. The capital city of the Eastern Province is Rwamagana. Table 2 presents a breakdown of Eastern Province by male and female per country province and districts.

Table 2. Rwanda's population size, density, with breakdowns by male and female per country province and districts.[14]

[11] Estimate based on projection based on National Institute of Statistics for Rwanda, 2014 medium projection estimates of a total population in 2020 of 12,663,116 (representing a 20.42% increase). Calculation also includes a rough estimate of urbanisation of 2.86%

[12] National Institute of Statistics of Rwanda, 2017. p. 24

[13] Estimate based on projection based on National Institute of Statistics for Rwanda, 2014 medium projection estimates of a total population in 2020 of 12,663,116 (representing a 20.42% increase). Calculation also includes a rough estimate of urbanisation of 2.86%

[14] National Institute of Statistics of Rwanda, 2017.

Area	Population size (2012)	Population estimate for 2020 (medium projection) [15]	Population density (2012)	Male (2012)	Female (2012)	% share of the total population (2012)
Whole Country	10,515,973	12,663,116	415	5,064,868	5,451,105	100
Eastern Province (Total)	2,595,703	3,051,454	274	1,258,090	1,337,613	24.7
Rwamagana	313,461	368,498	460	153,607	159,854	3
Nyagatare	465,855	547,649	242	228,325	237,530	4.4
Gatsibo	433,020	509,049	274	207,669	225,351	4.1
Kayonza	344,157	404,584	178	166,720	177,437	3.3
Kirehe	340,368	400,130	287	163,790	176,578	3.2
Ngoma	336,928	396,086	388	161,769	175,159	3.2
Bugesera	361,914	425,459	280	176,210	185,704	3.4

Rwanda is considered to be relatively poor, ranking 36 out of 48 Sub-Saharan Africa countries in 2012 in terms of per capita GDP. Real per capita GDP was USD 390 in 2012, compared with the Sub-Saharan Africa average per capita GDP of USD 1,522. About 63% of the population lives on less than USD 1.25 per day and 82% on less than USD 2 per day. Inequality is high: the Gini coefficient is 45.1% (2013) and 43% of the income share is held by 10% of the population.[16] Rural households are more than twice as likely to be in poverty and extreme poverty, than an urban household. Overall 38,2 % of the population lives in poverty conditions and 16% in extreme poverty.[17] In the Eastern Province 37,4% of the population lives in poverty and 15,3% in extreme poverty. Table 3 shows the percentage of population living in poverty and extreme poverty conditions for 2016/2017.

Rwanda’s poverty profile indicates that women are more affected by poverty than their male counterparts, with 47% of female-headed households being poor compared to 44.9% of all households.

Table 3. Poverty and extreme poverty in Rwanda.[18]

Location	Poor [%]	Extreme poor [%]
Nationally		
Country-wide	38,2	16
Area of residence		
Urban	15,8	5,9

[15] Estimate based on projection based on National Institute of Statistics for Rwanda, 2014 medium projection estimates of a total population in 2020 of 12,663,116 (representing a 20.42% increase). Calculation also includes a rough estimate of urbanisation of 2.86%

[16] The World Bank: https://data.worldbank.org/indicator/SI.POV.GINI?locations=RW-BO-FI-DK-NO-SE&start=1997&end=2014

[17] National Institute of Statistics (NISR), 2007. The Fifth Integrated Household Living Conditions Survey (EICV5), 2016/2017.

[18] Idem.

Rural	43,1	18,1
Province		
Kigali city	13,9	4,2
Northern Province	42,3	17,4
Southern Province	41,4	16,9
Eastern Province	37,4	15,3
Western province	47,1	21,6

The past three Rwanda Demographic Health Survey (RDHS) (2005, 2010, 2015) reported a persistently high prevalence of stunting for children between 6-59 months and elevated levels of anaemia among women of reproductive age. Stunting prevalence trended downward and is 38% in 2015, but masks significant district level disparities, with prevalence in 14 of 30 districts still above the WHO critical level of 40%. In 2015, anaemia was documented among 36.5% children between 6-59 months and 19% of among women of reproductive age at 19%.[19]

c. 2.2 Agricultural sector

In Rwanda, the agriculture sector accounted for more than 30% of GDP for 2014[20] and 80% of the population is engaged in the sector. While agriculture created less than 15% of new jobs in 2001 and 2011, its share increased to 50% between 2011 and 2017 and to 60% between 2017 and 2019. Reliance on farm wage work rose by a third in rural areas, and in particularly in the Eastern Province. About 50.6% of Rwanda's land area is agricultural and 98% of it is rain-fed. The Eastern Province has the most agricultural land (439,000 ha) in Rwanda.[21] Agriculture is predominantly practiced by smallholder farmers[22] (84% of all farmers) with agricultural production depending almost exclusively on the amount of rainfall during the rainy seasons (mid-September – December and mid-January – mid-May). There are four seasons, in which the long rainy (March-April-May) and short rainy (September-October-November) seasons alternate with long dry (June-July-August) and short dry seasons (Mid-December-January-February) throughout the year.

Based on these seasons, Rwanda has two distinct agricultural seasons, with a third minor season related to households that cultivate in marshland areas during the drier season (Figure 2).

- Agricultural Season A: starts in September and ends in February of the following calendar year, with the main harvest in December to February
- Agricultural Season B: starts in March and ends in July of the same calendar year with main harvest in June-July

[19] World Food Program, 2019.
[20] World Bank, 2019. Rwanda Systematic Country Diagnostic.
[21] NISR, 2017. The Fifth Integrated Household Living Conditions Survey (EICV5)
[22] Smallholder farmers in Rwanda have a mean land size of up to 1 ha.

- Agricultural Season C starts in August and ends in September of the same calendar year with the harvest taking place in September

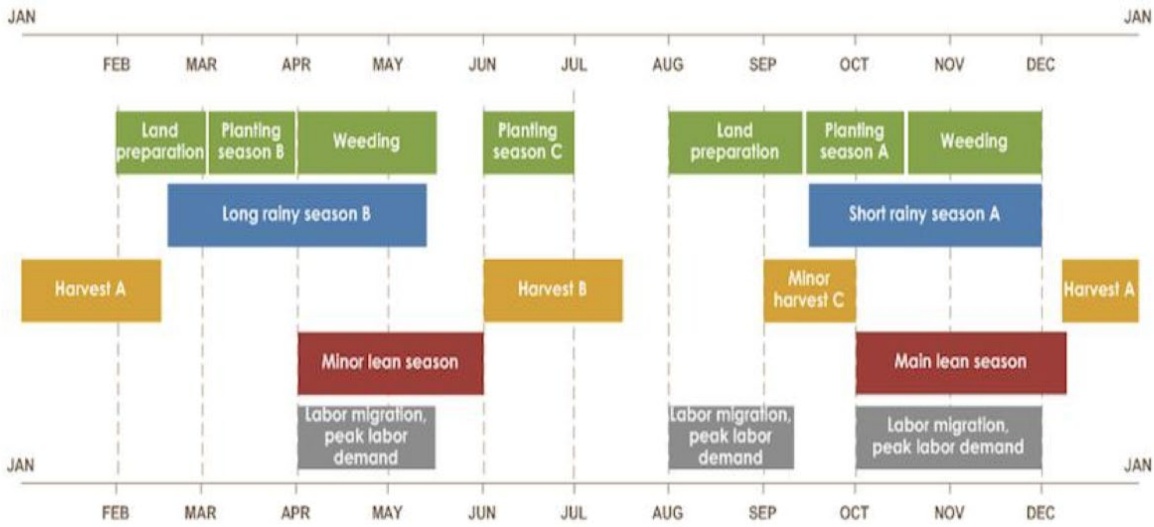
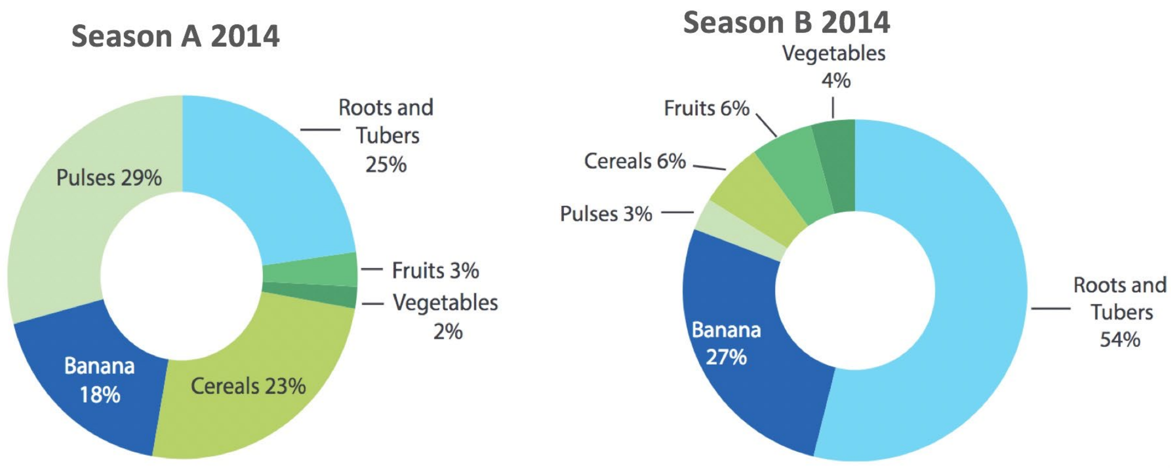


Figure 2. Agricultural seasonal calendar for Rwanda.[23]

Major crops include beans, cassava, maize and banana, other fruits and vegetables. About 68% of all households in Rwanda have livestock, most commonly: goats, cattle, and chicken. Livestock is currently the fastest growing sub-sector of the economy with an average growth of 8.3% per annum between 2010 and 2016.[24] Although cattle farming is widely spread across the country, the highest concentrations of cattle are in the Eastern Province accounting for about 31% of the total cattle population in 2015.[25] Figure 3 shows the country-wide, on average, share of land area per major crop for the two seasons are as follows as of 2014.



[23] FEWS NET, 2012. Rwanda Livelihood Zones and Description: https://fews.net/sites/default/files/documents/reports/RW_livelihood%20descriptions%202012%20final.pdf

[24] National Institute of Statistics of Rwanda (NISR), Ministry of Finance and Economic Planning (MINECOFIN), 2014. *2012 Fourth Rwanda Population and Housing Census. Final Results: Main indicators report.*

[25] IFAD, 2016. Rwanda Dairy Development Project: Detailed design report. Republic of Rwanda. Report No: 4167-RW.

Figure 3. Share of land (in %) by category of crops cultivated in 2014 -Season A and B.

Smallholder farmers in poverty conditions are particularly vulnerable to a range of shocks. According to the World Food Programme (2015) the most commonly reported shocks in the country include drought, irregular rains, and prolonged dry spells (41.1%), followed by serious illness or accident of household member (19.7%), loss or reduced employment, income for a household member (8.9%), and unusually high level of crop pests and diseases (7.8%).[26]

In addition to crops, livestock is another important source of income and food for agricultural households in the country. Currently, livestock contributes 3% to Rwandan GDP and 9.9% to agricultural, forestry and fishing GDP. It contributes to growth rate of 0.3% compared to 0.4% growth rate of Agriculture to GDP.[27] However, livestock is expected to rise to close to 50% over the next 20 years. Current cattle population in Rwanda is estimated at 1,335,000 heads where Nyagatare district accounts for 9.4% of total cattle in the country and 29.9% of total cattle of eastern province, which has the highest number of cattle in the country.

About 68% of all households in Rwanda and 70% in the Eastern Province raise some type of livestock. Goats, cattle and chicken are the most commonly raised types of livestock. According to the Integrated Housing Living Conditions Survey (EICV5), the Eastern Province has the largest overall number of households that raise goats (

Table 4).

Table 4. Percentage of HH raising livestock by type.[28]

	% of HHs raising livestock, by type						
	Cattle	Sheep	Goats	Pigs	Rabbits	Chicken	Others
All Rwanda	47.3	15.7	53.0	24.1	22.9	45.5	10.2
Kigali City	41.2	5.4	46.2	4.5	17.2	53.4	4.9
Southern Province	47.1	7.2	56.4	37.6	29.7	45.6	10.8
Western Province	42.5	19.9	50.4	25.1	23.2	36.5	15.5
Northern Province	57.8	35.8	39.3	20.3	25.9	39.7	10.6
Eastern Province	44.6	6.2	64.5	15.8	14.1	57.3	5.1

Success of intensive dairy in East African region has been attributed to high biomass fodder species, especially the Napier grass (*Pennisetum purpureum*). Napier grass has enabled farmers to raise the bulk of the roughage feeds from small land (< 0.5 ha) to maintain at least one lactating cow. However, this grass is adapted only to cut and carry of forage system, which is the system of majority of farmers in the country. The Girinka programme has created another type of intensive cattle keepers who have less land than they need to grow food, fodder and cash crops on the same land holding. Available information suggests that land limitation for fodder production is an eminent constraint for majority of farmers in Rwanda.

[26] WFP, 2015. Comprehensive Food Security Analysis.

[27] NISR, 2017. The Fifth Integrated Household Living Conditions Survey (EICV5).

[28] NISR, 2017.

A study of the intensive dairy systems around Kigali showed that increasing the number of animals on limited land reduces yields. However, farmers who were able to outsource crop residues and agro-industrial products were able to sustain high levels of milk yield per cow.

However, improved dairy cows, cannot reach their potential productivity if they are exclusively fed on Napier grass without additional intake of proteins. The current situation is that there is limited forage production and lack of diversity in the type of forage available.

The most important threats are related to the grazing land degradation due to over-carrying (high size of cattle herd compare to the real capacity of the land) and to the increased reduction in land access and the subsequent consequences on animal nutrition, and the still insufficient consideration to the impacts of herd growth on GHG emission.

However, in an improved situation, the occurrence and the importance of the deficit between milk demand and supply will be delayed if effective interventions are implemented to improve yield per animal rather than increasing the number of animals producing milk. The dairy sector is susceptible to climate change both on the production and marketing sides, as water and land become more limited for fodder production and as temperatures increase and longer erratic dry season requiring changes to forage feeding systems. This makes the fodder production and transport and safe storage of milk in the supply chain to consumers more complex with and requirements for more energy use. Without major unit cost-reducing developments in feed/forage production, milk supply and marketing chain, many of the short-term gains and improvements made in the livelihoods of smallholder farmers from investments in the dairy sector will be reduced due to increasing climatic risks and higher energy costs. On the other hand, dairy farming is also a contributor to climate change as increases in dairy production may contribute to anthropogenic greenhouse gas (GHG) emissions, biophysical degradation and potential loss of biodiversity if extensification occurs and green strategies are not promoted along with good dairy management practices. For these reasons, increases in dairy production need to be realized through a well-managed intensification, rather than extensification approach, and must incorporate climate-smart measures and technologies to mitigate against adverse environmental impact.

In the last decade, due to the pressure on land and increasing conflict of interest with agriculture and the support of the government to established better managed and profitable husbandry systems, out-grazing of cross breed animals with temporary housing on fenced farms (ranch established on degraded schrubland/savannah) is replacing the free grazing. The following example demonstrates this transformation: 1 dairy farmer in Nyagatatre District had between 150 and 200 local breeds in 2008 and was raising on between 120 and 130 hectares (1,4 cows per ha per year) which would give him about 40 litres of milk per day. Now, the same farmer has about 30 cross-breed cows and gets about 100 litres of milk per day – from 10 lactating cows among them –, which he keeps on a 20-hectare-pasture (0.5 cows per ha per year). Current annual lactation yield of local cow (67%) is estimated around 494 l/cow/year, while crosses (28%) reach 1868 l/cow/year and exotic (4%) are delivering 2995 l/cow/year in average.

Within the Eastern Province, farmers are experiencing severe animal feed shortages during the dry season (June–September) that reduces milk production and increases cattle mortalities. In this cluster, cattle are raised under open and deteriorated range areas due to lack of appropriate grazing management and observance of the proper land carrying capacity leading to overgrazing and inadequate dry matter intake. Lack of conservation technologies, low availability of dry season feed, and insufficient quality commercial feeds also contribute to poor nutrition.

One of the main challenges in the Eastern Province is the shortages of feeds and water, which are somehow linked. Most of the time the size of herds is higher than the carrying capacity of the grazed schrubland, leading to over-exploitation of grasses and thus to land degradation. Due to the lack of water, herd have to run long distance to find water (lake/rive), which is using energy (and thus decreasing productivity) while leading to additional land degradation effect. These land degradation lead to to loss of soil fertility and finally to loss of water retention capacity and to a continuous decrease of the land carrying capacity, increasing the pernicious circle. This over-charging and this related shortage of feed has a direct consequence on the low milk production.

d.2.3 Land use and degradation

High density population zones in Rwanda are characterized by land overexploitation and severe alteration of vegetation cover. A recent study by the Economics of Land Degradation Initiative found a positive and statistically significant relationship between the rate of poverty gap (period 2002-2004) and soil nutrient depletion from cereal croplands in Africa. Agricultural land is mainly located at slopes (up to 55% inclination), which are highly prone to soil erosion due to a fragile soil and a high average rainfall intensity of 1156 mm annually that concentrates in the wet season. The rainfall erosivity has a high impact on soil erosion and contributes to about 80% of soil loss. Variability of rainfall occurrence and intensity will considerably increase soil erosion.[29] Soil loss for Rwanda is estimated at 15 million metric tons per year, which is equivalent to losing the capacity of the land to feed 40,000 people annually.[30] According to the IUCN Restoration Opportunities Assessment Methodology (ROAM) analysis in 2015, approximately 37% (374,130 ha) of the territory of the Eastern Province is degraded (Table 1).[31] The Eastern Province alone is responsible for approximately 21% of the soil erosion in the country.[32]

Land degradation is a result of a complex chain of direct and indirect drivers. In Rwanda key drivers for land degradation include:

- High population density and growth rate, combined with scarcity of land for food production and supply of wood energy for cooking;
- Drought exposing friable soil to land degradation, especially on sloppy areas;

[29] Karamage et al. 2016. Extend of cropland and related soil erosion risk in Rwanda. *Sustainability* **2016**, *8*, 609

[30] GoR, 2004. *National Land Policy*. MINITERE.Kigali.

[31] IUCN, 2015. Restoration Opportunities Assessment Methodology.

[32] Karamage, et. al. 2016. Extent of Cropland and Related Soil Erosion Risk in Rwanda. *Sustainability* **2016**, *8*, 609; doi:10.3390/su8070609

- Large gap between supply and demand in wood for cooking, leading to over-exploitation and degradation of trees/shrub resources (both in forest and crop/agroforestry lands) with consecutive exposure of soils to erosion;
- Over-exploitation of crop residues for energy or animal feed, without ensuring required return of biomass to soil for fertility;
- Reduced soil water retention capacity with negative impact on ground water level and the soil microclimate;
- The reasons above lead to loss of soil productivity (both for food and wood), loss of profitability and business opportunities, degradation of socio-economic conditions, an increase of food insecurity and lack of access to wood for cooking, especially for the most vulnerable population.

Observed climate change not only exacerbates many of the ongoing land degradation processes of managed ecosystems (such as croplands and pastures) but will become dominant pressure that introduces new degradation pathways in natural and seminatural ecosystems.[33] Variation of the timing of rainfall events may have significant impacts on processes of soil erosion, while soil moisture content is affected by changes in evapotranspiration and evaporation which may influence the creating of surface runoff.

Restoration Opportunities Assessment Methodology (ROAM) analysis in 2015, approximately 37% (374,130 ha) of the territory of the Eastern Province is degraded (Table 5).[34] The Eastern Province alone is responsible for approximately 21% of the soil erosion in the country.[35]

Table 5. Proportions of most degraded lands in the Eastern Province in Rwanda.[36]

Districts of the Eastern Province	Most Affected Land (Ha)	% of District territory
Bugesera	61,317	48
Gatsibo	50,218	32
Kayonza	75,477	39
Kirehe	47,324	40
Ngoma	20,976	24
Nyagatare	103,850	54
Rwamagana	14,968	22
TOTAL (ha)	**374,130**	37

[33] IPCC, 2019. Special Report on Climate Change and Land.
[34] IUCN, 2015. Restoration Opportunities Assessment Methodology.
[35] Karamage, et. al. 2016. Extent of Cropland and Related Soil Erosion Risk in Rwanda. *Sustainability* **2016**, *8*, 609; doi:10.3390/su8070609
[36] IUCN, 2015. Restoration Opportunities Assessment Methodology.

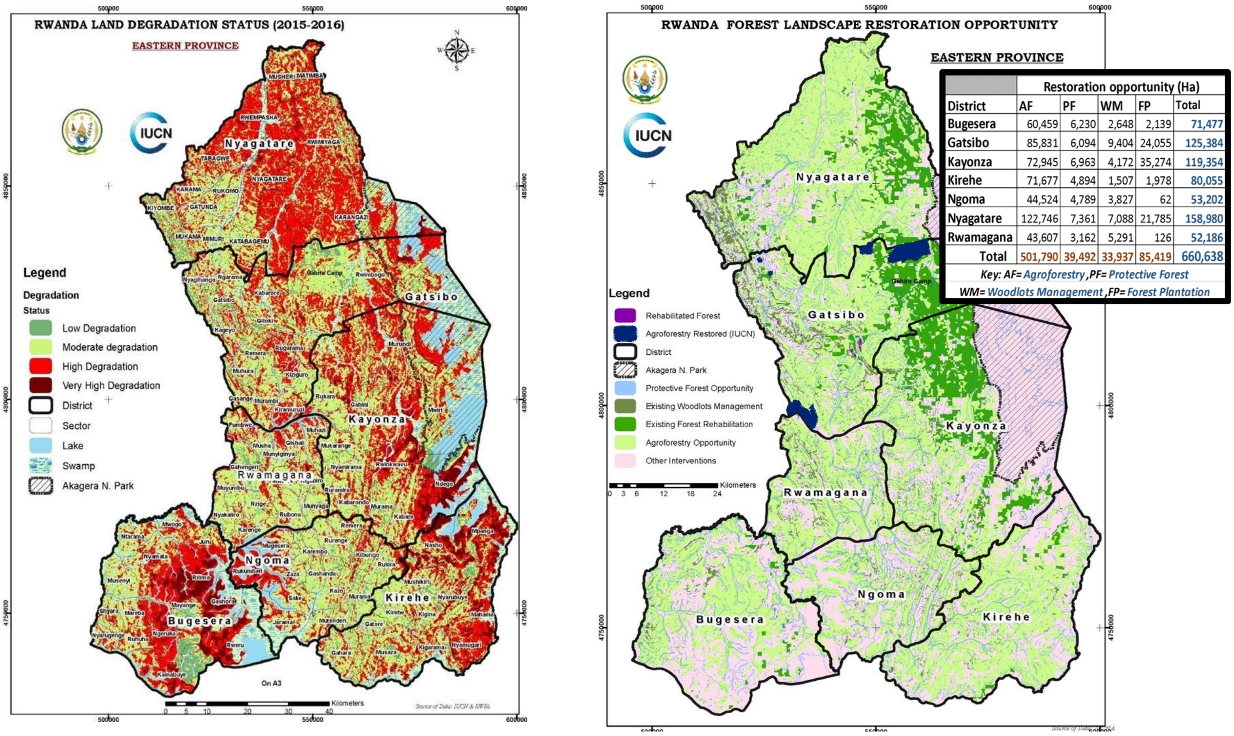


Figure 4. Map of land degradation status
identified restoration opportunities in the Eastern Province of Rwanda.[37]

i.

In 2014, the Government of Rwanda published the National Restoration Opportunities Assessment. This initial appraisal identified agroforestry as the single most significant restoration opportunity with a total potential area of 1.1 million ha for Rwanda, with around half (502.000 ha) in the Eastern Province (Table 6).[38]

Table 6. Degraded land available for restoration to improve climate resilience in the Eastern Province of Rwanda.[39]

Intervention	Land Available for Restoration in Eastern Province		National Total
	Eastern Province	**% of Rwanda Potential**	
Improve management of existing woodlots	32,816 ha	13%	255,930 ha
New agroforestry on steep slopes	272,723 ha	39%	705,162 ha
New agroforestry on flat and gentle slopes	231,855 ha	57%	405.314 ha

[37] MNR et al, 2015.
[38] MINIRENA, 2014. Forest Landscape Restoration Opportunity Assessment for Rwanda.
[39] Idem.

e.

f. 2.4 Current forest status and management in the Eastern Province

Historically, the forest cover in Eastern Province was dominated by shrub-lands and wooded savannah and only few man-made tree plantations were established, explaining their low coverage. In recent decades, in order to compensate the high degradation of these shrub-land/savannah areas, the government (central and district level) started to increase the afforestation efforts.

Tree plantations are far below the optimal productivity (around 4.5 instead of 9 m3/ha/year) and stocking (around 36 instead of possible 60-80 m3/ha) due to poor management and over-exploitation. Woodlots (with area>0.25 ha) and non-protected tree plantations cover around 47,000 ha, representing only 5.6 % of total land area[40] of the Eastern Province and 6.9 % of the total forest landscape (675,000 ha) constituted by these non-protected (productive) tree plantations. Crop/agroforestry lands constituted 488,000 ha and shrub-lands 140,000 ha estimate based on 2009 forest cover (C-GIS 2012) corrected by National Forest Inventory Results (NFI 2016). Table 7 summarises the current status of forestry in the Eastern Province.

Table 7. Current status of forestry in the Eastern Province (estimate compilation based on 2009 forest cover (C-GIS 2012), on National Forest Inventory Results (NFI 2016) and on District Forest Inventory results (DFI 2016) of Kirehe, Ngoma and Bugesera.

District	Total Area (ha) 2009	Total Area (ha) 2017	Average Stock 2017 (m3/ha)	Annual Growth 2017 (m3/ha/year)	Total Stock 2017 (m3)	Annual Growth 2017 (m3/year)
BUGESERA	3.535	3.900	21,86	3,71	85.273	14.458
GATSIBO	9.780	7.559	55,87	5,69	422.324	43.010
KAYONZA	4.479	3.619	30,16	4,37	109.140	15.806
KIREHE	1.594	4.681	48,07	5,53	225.013	25.877
NGOMA	3.931	10.500	25,36	3,90	266.269	40.961
NYAGATARE	8.202	10.830	29,45	4,22	318.940	45.695
RWAMAGANA	5.340	5.740	21,01	3,74	120.579	21.463
TOTAL EP	36.861	46.828	33,05	4,43	1.547.538	207.271
Ideal standard EP			60-80	9,00	2.809.705	421.456
Total Rwanda	285.183	285.183	32,92	5,65	9.387.124	1.610.234

The severe over-exploitation of tree plantation is directly linked to high pressure on woody resource for cooking energy: the total theoretical[41] demand of wood in Eastern Province is estimated at 1.65 M m3/year while the current sustainable supply capacity of overall

[40] Excluding lakes

[41] Theoretical demand of wood (if wood resource is available and affordable), calculated based on LEAP software customized for Rwanda (MININFRA, LEAP database, 2018)

forest/schrub land and agroforestry tree resources is only around 0.55 M m3/year[42], meaning that the gap is compensated by over-exploitation of current stocks (especially in District owned and small-holder private plantations) and/or by over-use of crops residues and small dry grasses (not returning anymore to soil for fertility).

Consequently, the estimated sustainable supply capacity (annual growth) of the Eastern Province tree plantation is only around 207,000 m3/year (with a stock of 1.5 M m3) whilst it should produce 421,000 m3/ha/year (with a stock of around 2.8 M m3) under an optimal sustainable production system (considering the same area with an optimal average stock of 60 m3/ha and an optimal average productivity of 9 m3/ha/year).[43]

Crop and agroforestry lands are the basis for agriculture and forestry activities and represent the main source of income for rural populations, food security and wood for cooking energy. Compared to the overall rain fed crop land of the EP which requires agroforestry practices (around 495.916 ha), the areas currently managed as well integrated agroforestry system with a tree/shrub density of 120-200 stump per ha remain very limited (may be around 2-4%).

In reality tree and shrubs are scattered in the landscape on contour lines of progressive/radical terraces, on parcel borders, on road/river side, in the home garden, scattered in crop land or in intercropping lines and in small woodlot (less than 0.25 ha). The overall tree/shrub density in crop land is still very low (21 tree/ha) and many farmers, even if they recognise their importance, are still seeing the trees as a competitor to their conventional crops instead of looking at it as a complementary crop from which many benefits can be derived. Figure 5 presents the main dominant tree species in crops / agroforestry lands in present in the Eastern Province.

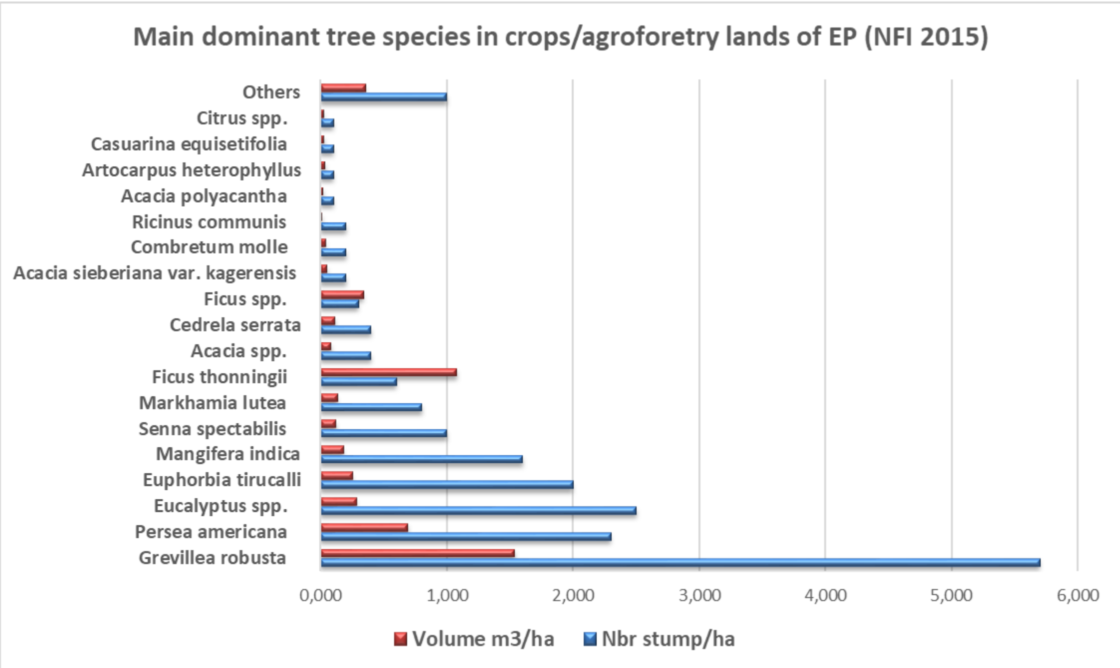


Figure 5. The main dominant tree species in volume (m3/ha).

42 See detail estimate calculation in Excel table Output 1.5 – Sheet "EP Wood Growth BAU"

43 Average standard set for Eastern Province according DFMP database in process of establishment in RFA, with the support of FMBE project.

Eucalyptus spp (third dominant), which is not really an agroforestry species, is essentially dedicated to small woodlot, while Grevillea (dominant and most appreciated) and other agroforestry species are scattered within parcels or on borderlines. Fruit species (avocado, mango, citrus) are more often located in home gardens where they can be better protected and managed. The presence of species such as Ficus, Combretum, Acacia, etc. indicate that an important part of these agroforestry areas is established on former degraded shrubland.

Currently these agroforestry trees have a sustainable supply capacity of around 238 m3/year of woody biomass[44], contributing to 43% of the overall supply capacity of forest resources of the Eastern Province. In ideal standard situation, considering an overall average tree density of 64 trees/ha (3 times more), these crops/agroforestry areas should have a sustainable supply capacity of around 700 m3/ha of woody biomass per year, contributing to 54% of the overall supply capacity of the Eastern Province. [45]

According to the survey RFA/FMBE, (FFS survey 2019) conducted in 2017/18 of 600 farmers households of the Eastern Province (Rwamagana), only 5.9% of their total crops/woodlot area (totalising in average 0.94 ha /household) is dedicated to wood/fruit tree production, while beans, tubers (manioc), corn and banana are the dominant crops sharing the essential land and income. It has to be noted that fruit trees appear as more profitable (400 Euros/ha/year) than wood product (160 euros/ha/year). This is due to the fact that conventional tree/woodlot are more often located in marginal land with poor soil, while being overcut (harvest every 2-3 years) due to high pressure for cooking fuel, not allowing trees to reach their optimal age of productivity (5-15 years). The fruit trees which have high potential and importance for both incomes and nutrition are still planted in very few numbers with limited variety of species including avocado, mango, citrus and macadamia. Thus, this niche represents a high potential of development to increase income generation and food security.

With regards to forest ownership, there are three categories: (i) District owned forests; (ii) State owned forests; (iii) Smallholder forests. Table 8 and Table 9 summarise the key characteristics of each ownership case.

Table 8. Characteristics of forest ownership categories in Eastern Province.

Ownership category	% of total forest cover	Characteristics
District owned forests	3.8	District forests are under-stocked (around 34 m3/ha[46] with a yield estimated to 3.8 m3/ha/year) while the average standard for district forests dominated by coppicing regime should be between 60-80 m3/ha with a yield of 9 m3/ha/year.

[44] See detail calculation and estimate in Excel sheet Output 1.1 – Data 2015, based on DFI, 2016; NFI, 2016; Forest Cover Map 2009, DFMPs of Ngoma, Kirehe and Bugesera 2015, DFMP of Gatsibo 2017, DFMP of Rwamagana 2018

[45] See detail calculation and estimate in Excel sheet Output 1.1 – Data 2015.

[46] According to DFMPs inventories carried out in 2016-2018 in Rwamagana, Bugesera, Ngoma, Kirehe and Gasabo

State owned forests	42	State forests have average size of 5-10 ha. They are better stocked (around 54 m3/ha[47] with a yield of around 5.89 m3/ha/year) than in district/small-holder plantation, but still far below the ideal standard of plantation under high forest regime[48] (80-100 m3/ha with a yield of 11-12 m3/ha/year).
Small-holder forests	54	Small-holder private plantations have average size 0.25 - 2 ha. They are very under-stocked (around 16 m3/ha[49]) while the average standard for the small private plantation are dominated by a coppicing regime that should be around 50-70 m3/ha. Small holders individually don't have investment capacity and don't have access to micro-finance facilities, which is explaining why plantations are not renewed and are becoming on average older and more unproductive.

Table 9. Forest ownership status for the Eastern Province and Rwanda. (data compilation based on DFI, 2016; NFI, 2016; Forest Cover Map 2009, DFMPs of Ngoma, Kirehe and Bugesera 2015, DFMP of Gatsibo 2017, DFMP of Rwamagana 2018).

	State Forests			Districts Forests			Private Forests		
District	Total Area State 2017	Average Stock (m3/ha) DFI 2016-2018	Annual growth 2017 (m3/ha/year)	Total Area District 2017	Average Stock (m3/ha) DFI 2016-2018	Annual growth 2017 (m3/ha/year)	Total Area private 2017	Average Stock (m3/ha) DFI 2016	Annual growth 2017 (m3/ha/year)
BUGESERA	1.220	40,65	4,80	88	29,02	3,50	2.592	12,78	3,20
GATSIBO	5.610	65,00	6,30	565	58,00	5,00	1.384	18,00	3,50
KAYONZA	1.300	50,00	5,90	200	30,00	3,60	2.119	18,00	3,50
KIREHE	3.768	53,75	6,00	147	39,28	4,00	766	21,79	3,50
NGOMA	2.653	54,64	6,00	335	9,39	3,00	7.512	15,73	3,20
NYAGATARE	3.800	50,00	5,55	200	30,00	3,50	6.830	18,00	3,50
RWAMAGANA	1.310	46,90	5,60	246	15,90	3,00	4.184	13,20	3,20
TOTAL Eastern	19.661	54,84	5,89	1.781	33,78	3,87	25.386	16,12	3,33
Total Rwanda	74.147	127,00	8,00	11.407	26,00	4,00	199.628	17,00	3,50

g. 2.5 Current status of pasture systems in the Eastern Province

In Rwanda the predominant livestock production system is a smallholder crop-livestock mixed farming system with average land holding of 0.76 ha for the majority of farmers.[50] Smallholder

[47] Idem.

[48] For State Forests, the High Forest regime is recommended everywhere possible, to secure the production at national level of timber/poles/service wood, while optimising the profitability per ha and using wood residue as biomass fuel (FSSP 2018-2022).

[49] According to DFMPs inventories carried out in 2015 in Bugesera, Ngoma, and Kirehe, and according to National Forest Inventory of 2015.

[50] Mutimura, M., Lussa, A. B., Mutabazi, J., Myambi, C. B., Cyamweshi, R. A., and Ebong, C. 2013. Status of animal feed resources in Rwanda. Tropical Grasslands - Forrajes Tropicales. 1:109. doi: 10.17138/TGFT(1)109-110

farmers keep one to three cows. In Rwanda, there are three types of dairy cattle management systems based on feeding methods.

- **Open-grazing** – Animals freely graze on individual or communal grazing lands. This type of system is dominant in lowland Eastern Province, where 40% of the national cattle population is found and the relative availability of grazing land is superior to other areas. Diminishing grazing land, however, is forcing people to gradually shift from open grazing to semi-grazing and zero-grazing, which is most common in the highland areas.
- **Semi-grazing** – The semi-grazing system is a hybrid between open-grazing and zero-grazing. It is characterized by a shortage of land that results in a farmer needing to keep his few cows in stalls. Such farmers, however, do not always have sufficient money and/or knowledge to feed their cows properly and so they may allow their herd to graze on nearby land part of the time. This is a transitory state from open-grazing system to zero-grazing.
- **Zero-grazing** – The zero-grazing system is characterized by keeping animals in a shed and feeding by cutting and carrying forage and crop residues to the cows. This production system is increasing in proportion due to the shrinkage of grazing land, which has been widely turned over to crop cultivation in response to increasing population.

At the current level of productivity and considering the insufficient adaptation of production system to climate change, the country will not be able to meet the rapidly growing domestic demand for milk and sustain the upward trend in cross-border exports to the DRC and Burundi markets. Within the Eastern Province, farmers are experiencing severe animal feed shortages during the dry season (June–September) that reduces milk production and increases cattle mortalities. In this cluster, cattle are raised under open and deteriorated range areas due to lack of appropriate grazing management and observance of the proper land carrying capacity leading to overgrazing and inadequate dry matter intake.

Lack of conservation technologies, low availability of dry season feed, and insufficient quality commercial feeds also contribute to poor nutrition. For grazed degraded shrublands and fenced ranches, urgent and important measures have to be taken to avoid the quick wood stock degradation which will lead to hardly reversible soil/land degradation, loss of water retention capacity and important loss of production opportunity (wood, milk and meat) on around 100.000 ha (20% of total land area of the Eastern Province).

Despite the remarkable progress in the development of the dairy sector in the country, significant challenges still remain. Key among them are: (i) the inexistence of integrated silvo-agro-pastoral plan where location and size of herd are adapted to land forage capacity and to water accessibility (ii) low milk productivity attributed to the still low number of improved dairy cattle and compounded by inadequate forage base, animal feeding practices and seasonal fluctuations in water availability; (iii) limited support services (AI, vet, extension, inputs) and an inadequate knowledge to manage dairy cattle; (iv) limited organization of farmers for effective collective action in marketing of milk and access to inputs/services; (vi) inadequate development and management of milk collection, processing and marketing infrastructure for supply of good quality milk to the domestic and regional markets; (vii) limited access to finance for dairy value chain actors, especially women and youth; and (viii) a nascent policy and institutional framework, with the need for specific laws, regulations and capacity development of key institutions to encourage the growth of the industry.

The silvo-pastoralism[51] system, mixing animal husbandry and management of silvopastoral trees/shrub is one of the recommended particular agroforestry systems. In the last decade, due to the pressure on land and increasing conflict of interest with agriculture and the support of the government to established better managed and profitable husbandry systems, out-grazing of cross breed animals with temporary housing on fenced farms (ranch established on degraded schrubland/savannah, with grazing rotation and reducing the number of cows per ha) is replacing the free grazing (Eugene, 2017).

As a sign of high national priority, the National Strategy for Agroforestry (2019-2028) has been recently developed with the support of FAO. Its aim is to set the frame enabling good collaboration between MoE/RFA (agency in charge of forestry and tree resources management) and MINAGRI/RAB (agency in charge of agriculture system extension) to support the right dissemination of high productive agroforestry systems. Tree/shrub species such as Acacia spp, *Terminal superba*, *maesopsis eminii* and *Pterygota sp*, or *Faiderbia albida*, *Calliandra calothyrsus* are kept/planted in fenced and managed pastoral area to get their several positive impact such as additional shading and forage for cattle (especially in dry season), soil erosion control, improvement of soil fertility through nitrate fixation, increase of water retention capacity, etc.).

Silvo-pastoralism further aims to align with the Sustainable Development Goals (SDGs) related to poverty (1), hunger and food security (2), responsible consumption and production (12), climate change (13) and ecosystem sustainability (15).

i.

[51] In the context of the Rwanda and its EP, silvo-pastoralism has to be understood as a livestock production system established on fenced grazing areas mixing forage grasses production and shrub/trees management which are providing additional important nutritional complementation, shade, water retention capacity increase, soil nitrate fixation, etc.

4. Section 3. Climate change profile – risks and vulnerability

Section 3 provides an overview of the climate risk and vulnerability context in Rwanda and the Eastern Province in particular. It describes the historical climate trends and future scenarios, climate change-related risks and impacts, key factors of vulnerability and adaptation needs for the population and the ecosystems.

a.

b. 3.1 Historical trends of climate change and variability

i. 3.1.1 Climate zones and seasons

The climate in Rwanda varies significantly across the country and between seasons. The country has four main climatic regions – the eastern plains, the central plateau, the highlands, and the regions around Lake Kivu. The eastern plains receive an annual rainfall of between 700 mm and 1,100 mm (in 57 to 100 days), with a mean annual temperature between 20 °C and 22 °C. The central plateau receives rainfall of between 1,100 mm and 1,300 mm (in 90 to 150 days), with an annual mean temperature between 18 °C and 20 °C. The highlands, including the Congo-Nile Ridge and the volcanic chains of Birunga, receive annual rainfall of between 1,300 mm and 1,600 mm (in 140 to 210 days), with an annual mean temperature between 10 °C and 18 °C. Regions around the Lake Kivu and Bugarama plains get annual rainfall of between 1,200 mm and 1,500 mm (in 150 to 210 days) and have an annual mean temperature between 18°C and 22°C.[52]

ii. 3.1.2 Climate historical trends

Rwanda has high interannual climate variability. Further compounding climate vulnerability is a lack of historical records which makes climate trends difficult to analyse. Although Rwanda's Meteorological Agency has established a climate data portal that brings together numerous data sources, there is limited available and downscaled climate analysis. According

[52] Republic of Rwanda, 2018. Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

to Rwanda's Third National Communication on Climate Change, the following general climate trends were observed for the period 1961-2016:[53]

- **Temperature:** Recent data analysis indicate that there is an increasing trend in mean temperatures with the increase varying between 1.4°C and 2.56°C. Average temperature is significantly increasing at a rate of 0.29°C per decade from 1985 to 2015, with increased interannual variability in recent decades (e.g., 0.79°C average increase from 2012 to 2014).[54]
- **Rainfall:** It is evident that the variability of seasonal rainfall during the most recent decade (2001-2016) has increased when compared to the previous decade (1961-2000). In particular there is a decline in the frequency of rainfall of between 35-45 days and a reduction of 250 mm in mean rainfall in the eastern region.
- **Change in seasonality:** Rainy seasons have become shorter and more intense, leading to a reduction in agricultural production with occurrences of more frequent drought and flood conditions.

In recent years, higher temperatures, prolonged droughts, and elevated rates of evapotranspiration have resulted in disturbances in the hydrologic cycle and altered river flows.[55] While Rwanda has not yet experienced serious water scarcity problems, in the long-term, climate-related changes such as fluctuations in rainfall and temperature, and increases in floods and droughts, will impact water availability.[56]

Rwanda is already experiencing the impacts of climate change, including increased and longer droughts and more frequent and severe floods leading to landslides. In recent years, extreme weather events in Rwanda increased in frequency and magnitude, leading to significant losses including human lives. Extreme events have also intensified in terms of their impacts.[57] These events include droughts in the eastern and southern regions that have resulted in a series of severe famines, and heavy rainfall in northern and western regions has led to erosion, flooding, and landslides.

The Eastern Province receives an annual rainfall of between 700 mm and 1,100 mm (in 57 to 100 days), with a mean annual temperature between 20 °C and 22°C. Changes in and variability of the climate has already been observed in the province with some of the highest observed shifts in the period 1961-2016[58]:

- **Temperature:** The highest annual mean temperature increase of 2.58°C was observed in the region for the period between 1971 and 2016.
- **Rainfall:** Eastern regions have experienced serious rainfall deficits over several years over previous decades, alternated with rainfall excesses in other years.

[53] Republic of Rwanda, 2018. Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

[54] USAID, 2019. Climate Change Risk Profile Rwanda.

[55] Idem.

[56] Netherlands Commission for Environmental Assessment, 2015. Climate Change Profile: Rwanda.

[57] Republic of Rwanda (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

[58] Republic of Rwanda (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

- **Moisture index:** The reduction in the aridity index implies a continuous warming up of the mentioned areas. Occurrence of dry years has increased in the years between 1992-2008.

Existing climate change variability already significantly affects Rwanda's economy with recurrent floods, seasonal variation in rainfall and droughts among others. The climate impacts have already affected people's livelihoods and all major sectors - from agriculture, land, and water resources to human settlements, transport, and infrastructure. According to a study by Didace Musoni (Rwanda Meteorological Center quoted in Rwanda Focus, 2010), heat waves have become more severe and the highest maximum recorded temperature between 2001 and 2010 was as high as 35.4°C compared to 32.8°C in the preceding decade.

iii. 3.1.3 Changes in extreme events

1. 3.1.3.1 Droughts

Droughts are one of the major hazards severely affecting Rwandan farmers as they depend on rain-fed agriculture and lack irrigation systems. The most exposed districts to rainfall deficit in Rwanda are in the Eastern Province - Bugesera, Nyagatare, Gatsibo, Kayonza, Ngoma and Kirehe in the Eastern Province. These districts are characterized by high frequency of rainfall deficit, late rainfall onsets, and a significant number of dry spells, making them prone to drought.

Climate analysis shows that in season B, the districts of Gatsibo, Kayonza, and Kirehe from the Eastern Province have very high susceptibility to being affected by severe drought compared to other districts and provinces.[59]

Between 1990 and 2016, six major agricultural droughts[60] occurred in the country, leading to crop failure, food shortages and famine. Almost all drought events occurred in the Eastern Province. A drought in 2006 affected over 1 million people.[61] Around 73% of the Rwandan population is working in the agricultural sector and agricultural droughts are a severe challenge the majority of the population.[62] In 2016, drought affected Rwanda's Eastern Province, especially Kayonza, Kirehe, and Nyagatare districts, leaving 44,000 poor households (some 225,000 people) food insecure.[63]

[59] MIDIMAR, 2015. The National Risk Atlas of Rwanda.

[60] Definition from National Risk Atlas of Rwanda: Agricultural drought focuses on differences between actual and potential evapotranspiration and soil- water deficits. They are crop-specific and heavily dependent on the timing of rain and dry periods related to crop-cycles. Agricultural droughts can therefore occur in the absence of meteorological drought, and vice versa.

[61] MIDIMAR, 2015. The National Risk Atlas of Rwanda.

[62] NISR, 2014. Fourth Population and Housing Census, Rwanda Thematic report Labor force participation, Kigali City: NISR.

[63] Government of Rwanda: Drought Assessment, 31st May to 3rd June 2016.

The frequency of drought occurrence and severity has increased in East Africa in the last two decades (1981 – 2014).[64] Figure 6 illustrates the pattern of recurring drought referring to the countries of the Lake Victoria (including the Eastern Province of Rwanda). By comparing the Standardized Precipitation Index (SPI) values it is visible the increased frequency of severe droughts (SPI>-1.5), which is followed by a short-lived recovery periods or sometimes back-to-back with extreme flooding, such as the 2006, 2009, and 2015 El Niño events, allows insufficient periods for recovery, especially for pastoralists, who require 3–5 years of good rainfall to restock.

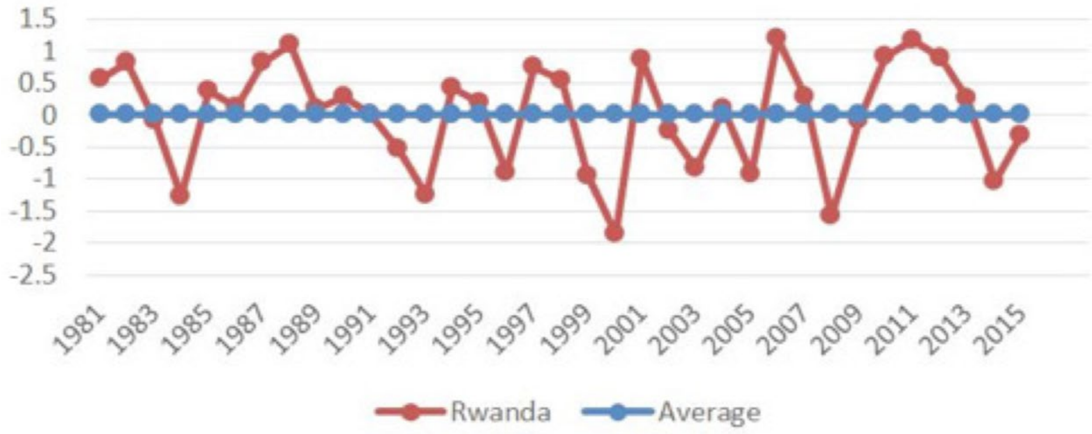


Figure 6. Standardized Precipitation Index which describes the drought pattern in Rwanda compared to an average for the period 1981 - 2015.[65]

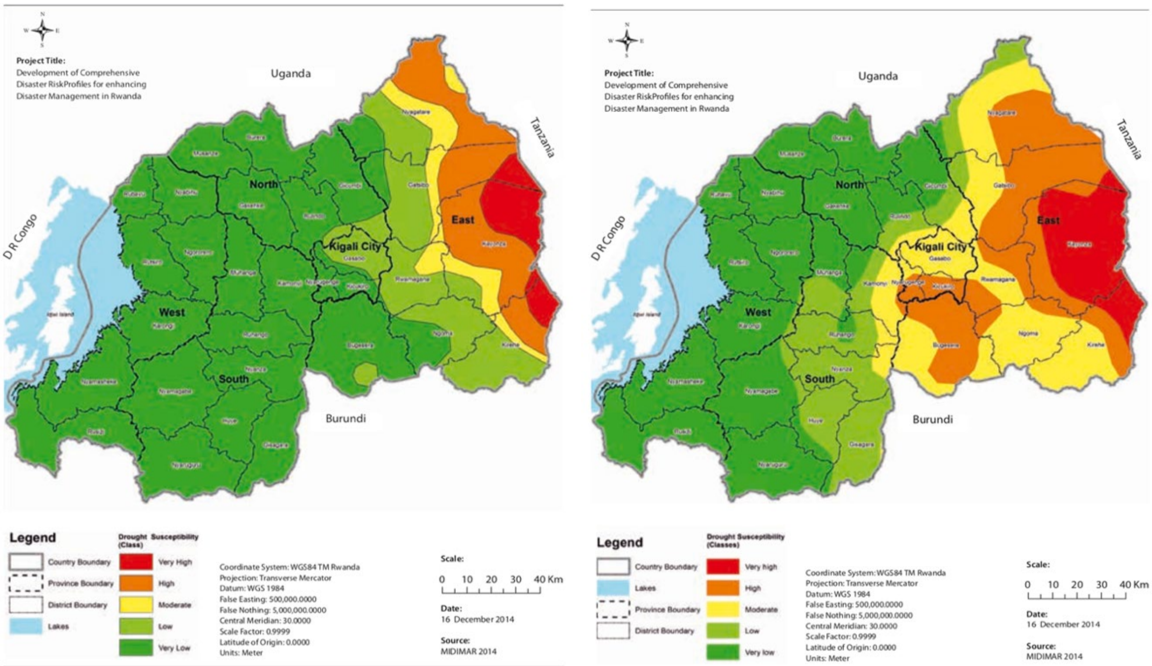
In Rwanda, analysis from the National Risk Atlas (2015) shows that the number of people vulnerable to severe drought are 28,582 and 157,786 for Seasons A and B respectively for the seven districts of the Eastern Province. In particular:

- For Season A scenario: The districts of Gatsibo, Kayonza, and Kirehe are highly susceptible to being affected by severe drought compared to other districts in the country. Kayonza district has **26% of its territory exposed to severe drought** with high probability. Additionally, the districts of Kayonza, Kirehe, Nyagatare and Gatsibo have more than 80% of the total population vulnerable (at 31%, 22%, 18%, and 12% respectively).
- For Season B scenario: The districts of Kayonza, Kirehe, Gatsibo have **75% of their territory exposed to severe drought** and have the highest number of vulnerable populations with 15%, 10%, and 9% respectively of the total population at risk countrywide.

A total of 62,033 tons and 157,786 tons of major crops (cassava, banana, beans) are exposed to drought.[66] Such agricultural losses are equivalent to estimated USD 9.5 million (RWF 8.8

[64] USAID, 2018. Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan.
[65] USAID, 2018. Lake Victoria Basin Climate Change Adaptation Strategy and Action Plan.
[66] MIDIMAR, 2015. The National Risk Atlas of Rwanda.

billion for Seasons A and B.[67] Figure 10 shows a drought hazard map highlighting in orange and red the high level of susceptibility to drought in the Eastern Province.



Drought hazard map of Rwanda for the agricultural seasons (A) and (B).[68]

2. 3.1.3.2 Floods and landslides

Rwanda is also highly susceptible to landslides and 42% of the country's area is classified with moderate to very high susceptibility.[69] The lack of vegetation cover and increased rainfall intensity are the major factors for the high susceptibility to landslides in the country. Due to limited land availability in Rwanda, agriculture and infrastructure are often established at slopes with high potential risk of landslides. From 2011 to 2013, landslides caused 74 deaths, 22 injuries, 573 houses destroyed or damaged, and 656 ha of affected land.[70]

Due to its dense river network and large wetlands, the country is threatened mainly by riverine floods. Major flood events have doubled in the last two decades, from 13 flood events in the period 1980 – 2000 to 30 flood events in the period 2000 – 2020.[71] Floods between 2011 and 2013 resulted in 38 casualties, 40 injured, 878 houses destroyed or damaged and 746 ha of

[67] Idem.
[68] MIDIMAR, 2015. The National Risk Atlas of Rwanda.
[69] Idem.
[70] Idem.
[71] CRED/EM-DAT, n.d. emdat.be. [Online] Available at: http://www.emdat.be/disaster_list/index. html [Accessed April 2020].

affected land.[72] However, Rwanda lacks most of the hydrological and hydraulic data needed for flood hazard analysis. In addition, there is little existing flood literature that could serve as reference.

While there is little data and literature for analysis of flooding and landslide events, documented cases of flood damage to agriculture and impacts on food security are increasing in occurrence and severity according to RMEA.[73] Furthermore, interpretation of climate data indicates the severity and intensity of drought, flooding and landslide events and their impacts on agriculture and livestock as well as food security will increase.

Among expected climate changes described for the EP, the hazardous increase of total rainfall but also the rain intensity during the rainy season is highlighted.

These stronger rains are exposing lands on sloppy areas not covered by vegetation to a higher soil erosion and degradation risk. The low vegetation cover and the soil degradation will limit the water retention capacity in upstream areas of water catchment, increasing the water and sediment runoff to the downstream rivers and plains. The impact on upstream will be the soil degradation, the reduction of water retention capacity, and consequently a higher exposure to drought during the dry season. On downstream of the water catchment, in the extreme rainy season, this additional water run-off from upstream could cause some flooding with a reduced access to this fertile soil, disturbing the crop areas under irrigation and damaging already established crops.

However, the slope and rain intensity are not sufficiently high to generate a serious risk of landslide in the Eastern Province (these risks are observed only in Northern/Western/Southern Provinces of Rwanda, cfr “Landslide Susceptibility Assessment Using” by Jean Baptiste Nsengiyumva and all, 2017).

Considering the topography and their limited size, the areas potentially impacted by floods in sub-catchments of the EP are very limited: only flooding plains areas which are subject to the additional overflowing from major rivers Nyabarongo-Akagera are concerned by a significant risk and represent around only 1% of the overall EP areas (National Risk Atlas of Rwanda, 2015).

c. 3.2 Climate projections

i. 3.2.1 Projected climate trends for temperature and rainfall

Climate change in Rwanda is expected to result in increased temperatures, intensified rainfall, and prolonged dry seasons.[74] Each region in Rwanda will experience these challenges differently: increased soil erosion will affect the mountainous west region, parts of the central

[72] CRED/EM-DAT, n.d. emdat.be. [Online] Available at: http://www.emdat.be/disaster_list/index. html [Accessed 30 September 2019].

[73] Idem

[74] Republic of Rwanda (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

north and south will suffer floods, and the east and southeast will experience droughts and desertification.

The Third National Communication on Climate Change used the new version of the stochastic weather generator-LARS-WG incorporating predictions from 15 General Circulation Model (GCMs) used in the IPCC AR4 and was used to project precipitation and temperature data for 2050 (with baseline 1961-1990):

- **Temperature:** Projections show a rise of up to 2.5°C by mid-century, up from the 1970 average.[75] It is expected that the number of hot days will continue to rise.[76] In addition, increases in average maximum and minimum monthly temperatures ranging from 1.5-2.7°C and 1.7-2.8°C, respectively, are expected.[77]
- **Rainfall:** Rains are likely to be less uniformly distributed in the future, Average annual rainfall may increase by up to 5-10% by the 2030s from 1970. The mean rainfall is predicted to increase by between 0.1 and 1.24 mm and 0.1 and 0.82 mm per year in the north-east and the south-west regions of the country respectively except during the short rainy season (Mid-September-October-November-Mid-December), showing a marked decline of between 0.412 and 1.65 mm per year in the north-east region of the country.

Additionally, scenarios show[78] that the number of hot days and hot nights is projected to increase between 17 - 31% (hot days) and 47-64% (hot nights).[79]

In the Eastern Province, climate projections show increase in temperatures for longer periods and decrease in rainfall during the short rainy season, which exposes the province to more frequent and prolonged **dry spells** than before. Dry spells with increase in duration with a range of 0 to +7 days by 2050.[80,81] The province already receives a low amount of rainfall and such changes rainfall and temperature are bound to cause potential **water deficit** in the province in the coming years.

Due to climate change, the negative impacts seen from today's climate variability are likely to become worse. This includes an increase in extreme events including severe droughts and floods. Seasonal droughts are expected to be prolonged, which will impact especially the east and south- east areas in the country.[82] While there is an expected decrease in rainfall during the short rainy season, **rainfall will be unevenly distributed**. Projections show **an increase in heavy rainfall event frequenc**y (7–40 percent) **and intensity** (2–11 percent) by 2050.[83]

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[75] Idem.

[76] Future Climate for Africa, 2016. Rwanda Climate Fact Sheet. Africa's climate: Helping decision-makers make sense of climate information

[77] Republic of Rwanda, 2015. Intended Nationally Determined Contribution (INDC) for the Republic of Rwanda.

[78] For each scenario projections from the CMIP5 dataset (basis of the 5th IPCC report), bias-corrected projections of global models and finally projections of regional models have been analyzed together. These results are estimated on the basis of a high emission scenario (RCP8.5 (IPCC-AR5)). The baseline is 1961-1990.

[79] Climate Service Centre, 2016. Factsheet Climate Rwanda.

[80] USAID, 2019. Climate change risk profile Rwanda. URL: https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID-ATLAS-Rwanda-Climate-Risk-Profile.pdf

[81] Netherlands Commission for Environmental Assessment, 2015. Climate Change Profile: Rwanda

[82] Netherlands Commission for Environmental Assessment, 2015. Climate Change Profile: Rwanda

[83] Idem.

After prolonged dry season, events of extreme rainfall will likely lead to more **floods** .[84] These can lead to greater human mortality, contamination of water sources, loss of crops, and damage and destruction to homes and critical infrastructure.

Models suggest that Rwanda could lose over 1% of its GDP each year due to climate change related losses by 2030, and an even greater proportion thereafter.[85]

The Eastern Province is exposed to experience increased temperature for longer periods and increased frequency of dry spells.[86] Climate scenarios indicate even greater unevenness in rainfall distribution, and more extremes in rainfall volumes and seasonality. The province already receives a low amount of rainfall and further decline in rainfall is bound to experience potential water deficit in coming years.

ii.

iii. 3.2.2 Projected trends the moisture index

Cumulative effects of projected climate change are assessed through the downscaled analysis of the Moisture Index in the Eastern Province. The Moisture Index is the same as the Aridity Index and will be further referred to in this study as Moisture Index, that considers the increasing values in the index correspond to more humid conditions. This index shows how droughts affect agricultural and forest productivity. Total volumes of precipitation (P) and Potential Evapotranspiration (PET) were obtained for the project area after reprojection the relevant geospatial layers to the equal-area Mollweide projection via the raster: project Raster function. For full details of the methodology used in the models for the estimation of soil moisture index, see Annex 2. The models estimate that the Soil Moisture Index decreases under climate change scenario in the Eastern Province. In the baseline, the total P and PET were 42,772 mm and 56,367 mm respectively, resulting in a moisture index of 0.7588. In the future climate, total P and PET were 32,753 mm and 59,852 mm respectively, resulting in a moisture index of 0.5472. The difference in moisture index is presented in Figure 7.

[84] Republic of Rwanda, 2018. Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

[85] Rwanda Environment Management Authority and SEI, Economics of Climate Change in Rwanda (2009).

[86] Republic of Rwanda (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

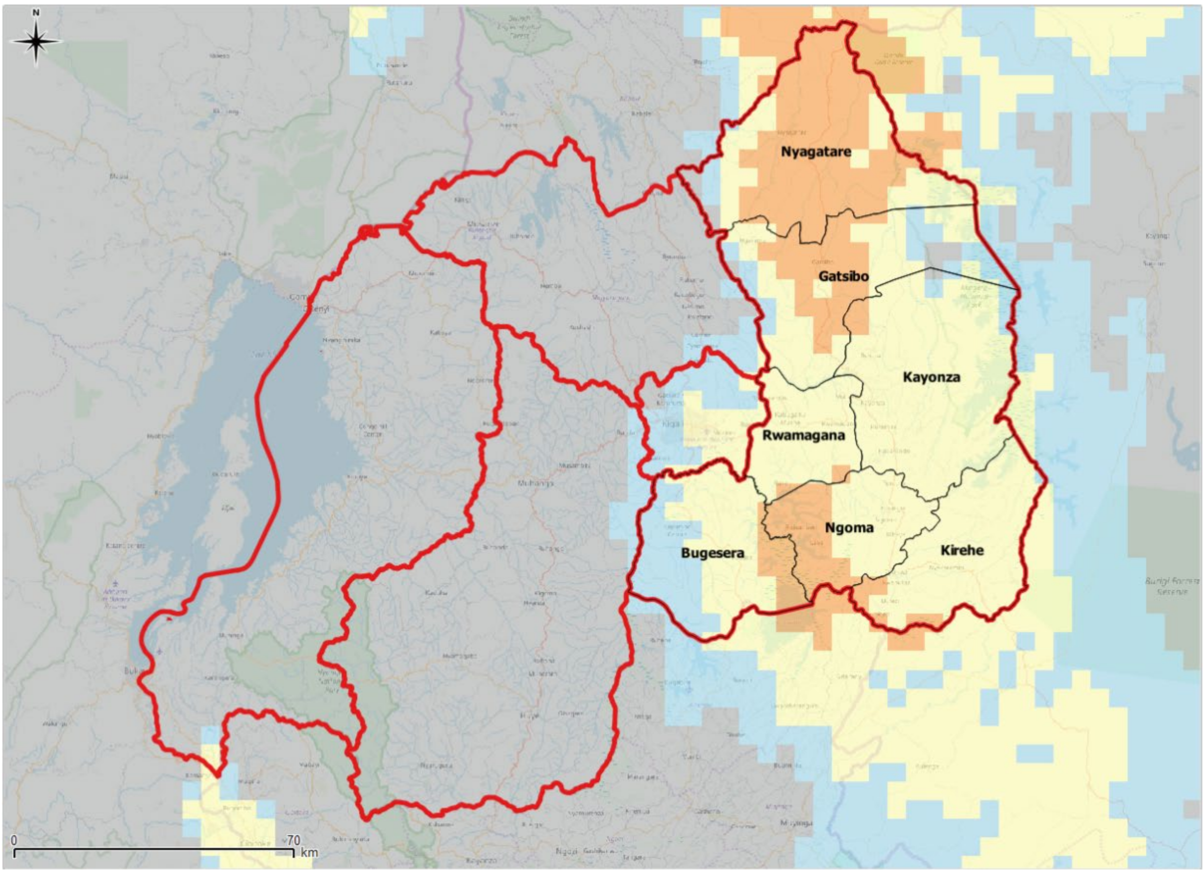
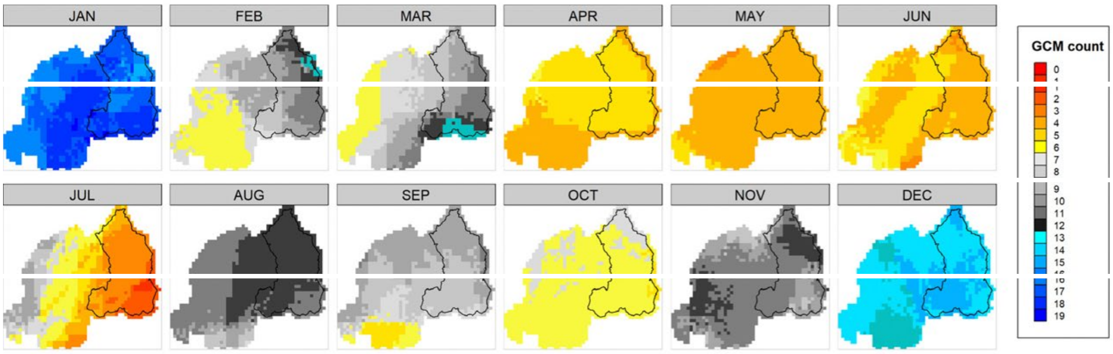


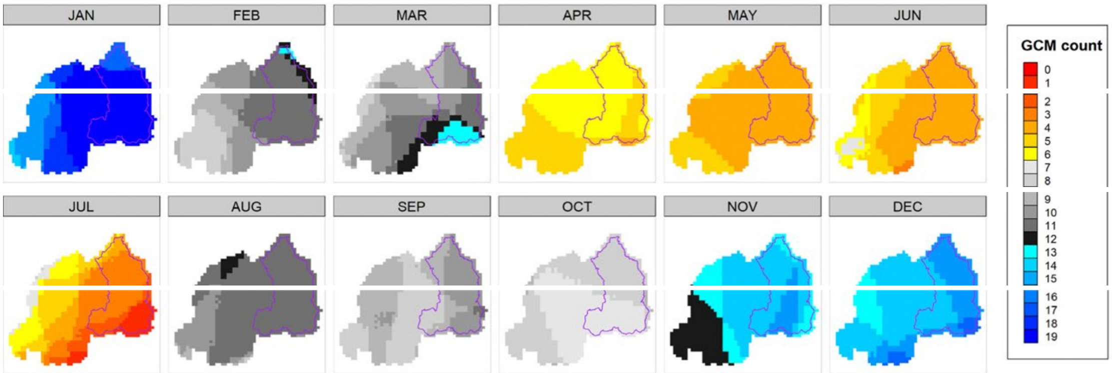
Figure 7. Differences in moisture index. Orange: 0.5-0.55; yellow: 0.55-0.6; blue: 0.6-0.65; grey: > 0.65. Note that orange, yellow and blue zones are classified as dry sub-humid by UNCCD drylands criteria (moisture index 0.50-0.65).

Figure 8 shows that it is likely that the moisture index will decrease in the Eastern Province for the months of April to May, which are important months for crop sowing. The decrease in moisture index in these months is a combined effect of decrease in precipitation and increase in PET. This will have immediate impacts on the agricultural systems and crop production. For most of the project area, excluding the northern part, the moisture index is likely to decrease in October, which is a month of crop sowing, as a result of increases in PET. The moisture index is likely to increase in the project area in December and January, which are the months mainly for crop harvesting. In these months, the increase in precipitation is larger than the increase in PET. In November, the increase in precipitation is balanced by the increase in PET, resulting in no likely change in the moisture index. See Annex I and II for a detailed description of the model results.

(a) Moisture Index



(b) Precipitation



(c) Potential evapotranspiration

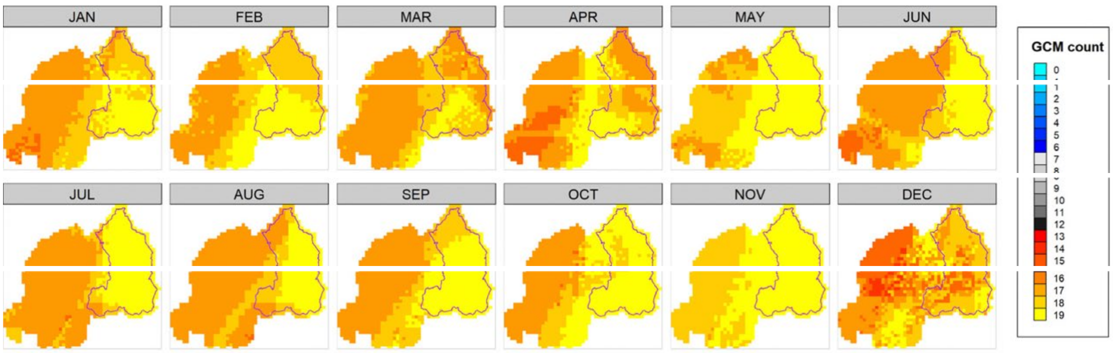


Figure 8. Counts of General Circulation Models

Figure 8 shows counts of General Circulation Models that project monthly increases for Rwanda 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 polygon outlines Eastern Province (shapefile from GADM 3.6).

d.3.3 Vulnerability to climate change

Rwanda is highly vulnerable (0.555) to climate change and ranks 114 out of 181 countries at risk according to the ND- GAIN index (2017).[87] In particular the rural population and agricultural capacity are scored with highest vulnerability among the other vulnerability factors. Although, Rwanda is on its road to respond effectively, the adaptation needs and urgency to act are greater.

As weather-related events become more frequent, intense, and variable in nature, the coping capacities of households, communities, FFPOs, and national systems erode. In most cases, pre-existing coping strategies are already limited due to the seasonality of livelihoods, as well as prevailing levels of poverty, food insecurity, malnutrition, and environmental degradation. If these factors are not addressed along with the drivers of climate change, wellbeing across the country will deteriorate as climate shocks continue occurring. In 2011 Rwanda was ranked among the top of all African countries in terms of natural resource dependency and thus is highly vulnerable to climate change.[88] Since 2011 social vulnerability has reduced steadily through socio-economic development. Poverty levels have dropped from 44% of the population in 2011 to 39% in 2014, while inequality has decreased from 0.49 in 2011 to 0.45 in 2014 as measured by the Gini coefficient.[89]

The Eastern Province presents the highest levels of vulnerability in the country (0.48) based on high exposure; medium adaptive capacity; and high sensitivity.[90] The vulnerability baseline analysis for the Eastern Province shows that the high sensitivity is due to unstable family income source, undiversified livelihood sources, high dependence on rain-fed agriculture and change in the state of natural resources. It is considered that the adaptive capacity is medium due to access to information and awareness to change agricultural practices.

Existing power imbalances between men and women cause women to bear most negative effects of climate change-induced disasters. Moreover, the fact that women are primarily responsible for households' water availability and food security suggests their burdens will increase disproportionately due to climate change.[91] Estimations show that more female-headed households live in poverty than those headed by males (47% compared to 44%, respectively). Women's literacy rates are lower than men's (60% compared to 70%, respectively), which further constrains already limited opportunities in terms of accessing

[87] See ND-GAIN 2017 rankings https://gain.nd.edu/our-work/country-index/rankings/ [accessed 06/09/2019]. The ND-GAIN framework 'breaks the measure of vulnerability into exposure, sensitivity and adaptive capacity, and the measure of readiness into economic, governance and social components.' For more information and data also see https://gain.nd.edu/our-work/country-index/

[88] Nabalamba, A., Mubila, M., Alexander, P. Climate Change, Gender and Development in Africa. African Development Bank, 2011.

[89] World Bank, Rwanda – Overview (last viewed June 2017). http://www.worldbank.org/en/country/rwanda/overview

[90] REMA, 2015. Baseline Climate Change Vulnerability Index for Rwanda. Rwanda Environment Management Authority, Kigali, 2015

[91] NEPAD, 2012. African Gender, Climate Change and Agriculture Support Program (GCCASP) – Rwanda.

resources, information and participating in the overall decision-making processes in the households. In rural areas, the primary source of economic vulnerability for women can be women's access to assets (i.e. land ownership, livestock, non-farm business assets).

Because of its geographical features and climatic profile, Rwanda is prone to various hazards but especially droughts, localized floods and landslides.[92] Figure 9 shows the vulnerability of provinces to climate variability and change as a combination of sensitivity, exposure and adaptive capacity. The Eastern Province is most exposed to the effects of changes in temperature (heat waves or episode) and rainfall (shifts in amount of rain and seasonality).

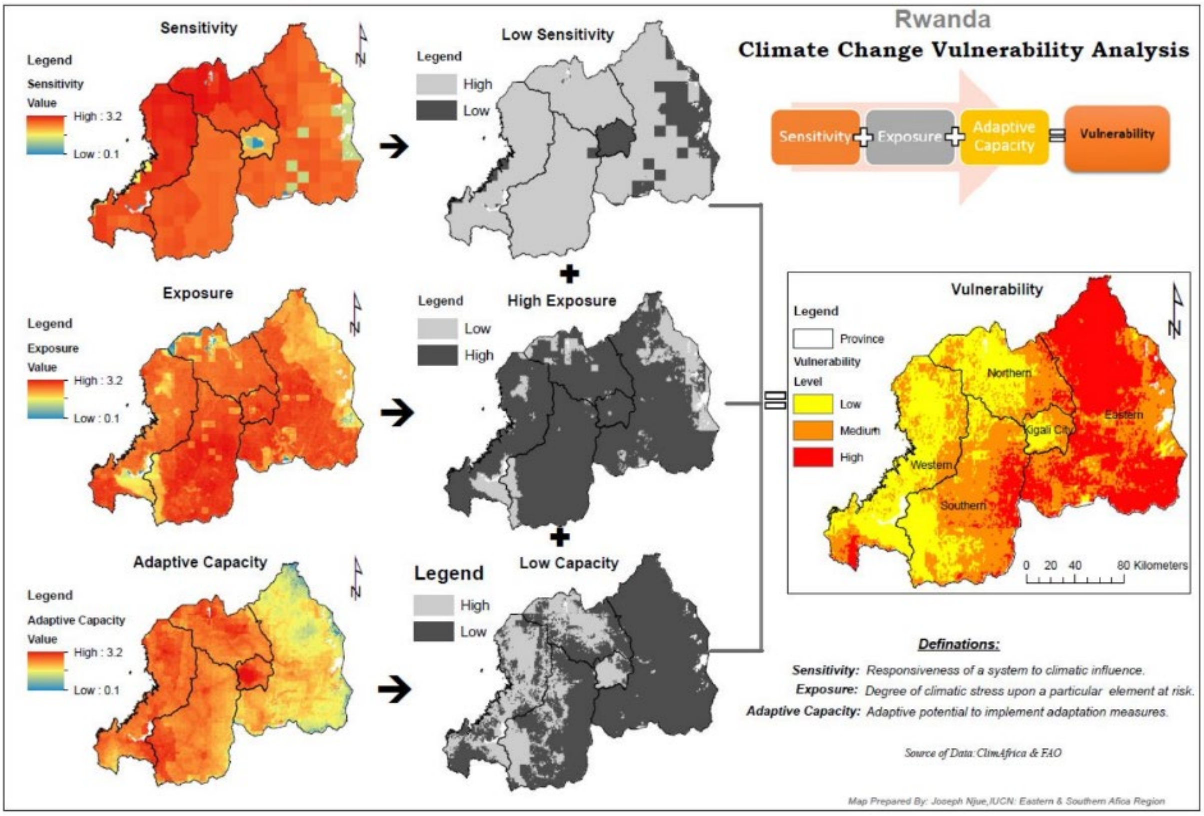


Figure 9. Map presenting the vulnerability index per Province in Rwanda.[93]

A steady depletion of Rwanda's forest and water resources has heightened the country's sensitivity to climate change. Between 1990 and 2015, the area of cropland encroached substantially on woodland and sparse forest.[94] This is particularly true for steeply sloping areas in the east and west. Overall, the share of land covered by vegetation dropped from 25 percent in 1960 to less than 10 percent in 2010. Vegetation density as measured by the Normalized Difference Vegetation Index (NDVI) decreased by more than 1.5 percent between 2000 and 2016. Between 2010 and 2015 alone, sparse forest areas shrank by about 305,000 hectares (about 12 percent of the country's total surface area), and annual crops increased

[92] Douglas et al, I. A. K. M. M. M. Y. M. L. &. C. J., 2008. Unjust waters: climate change, flooding and the urban poor in Africa Environment and Urbanization.
[93] REMA, 2015. Baseline Climate Change Vulnerability Index for Rwanda. Rwanda Environment Management Authority, Kigali, 2015
[94] Rwanda Land Accounts, 2018.

by about 207,000 ha (about 8 percent). Demand for biomass for energy use is a major driver of deforestation and forest degradation. More than 95% of the rural population depends on wood for fuel, and the national dependency level is over 85%. There is a severe and increasing gap between wood supply and demand, which is more than twice the sustainable supply. public forests and private forests are often seriously overcut.

e. 3.4 Climate risks and impacts

i. 3.4.1 Impacts in the agricultural sector

Rwandan agriculture is predominantly rain-fed and therefore highly sensitive to variations in climate conditions and exposed to weather-related risks such as severe, frequent, and prolonged dry spells occurring during the cropping seasons.[95] Approximately 80% of the country relies on agriculture for their livelihood and more than 30% of the GDP comes from the sector.[96] Hence, factors which underpin the vulnerability of agriculture such as climate change directly affect Rwanda's vulnerability.

Farmers practice small-scale, subsistence, rain-fed farming, using traditional technologies and practices that are no longer adequate for the challenges posed by climate change and variability. Agricultural production is exposed to risks such as weather- related shocks as well as pest and disease outbreaks. The prolonged droughts in the eastern and southern regions and unpredictable rains and floods in the northern and western regions are also having negative impacts on agricultural production. Agricultural production is further hampered by deforestation and soil erosion. Added to this, rising temperatures influence crop and livestock productivity through crop failure and increased diseases and pests. Droughts, particularly in the east and parts of the south, resulting in reduced water and feed availability, will affect the livestock sector. These losses will, in turn, affect the dairy value chain. Although subsistence farmers are most affected, the vulnerability to climate variability and change extends to all aspects of the agricultural value chain.

Recent events provide clear evidence of the significant impacts of extreme events on agricultural production. For instance, erratic rainfall in 2008 caused maize yield losses of 37% in the eastern provinces and 26% in the southern provinces. Milk production losses were estimated at 60% in times of drought.[97] Moreover, pests and diseases have greatly affected

[95] Republic of Rwanda, 2015. Intended Nationally Determined Contribution (INDC) for the Republic of Rwanda.

[96] Government of Rwanda. Green Growth and Climate Resilience: National Strategy for Climate Change and Low Carbon Development. Kigali: Government of Rwanda, November 2011. https://cdkn.org/wp-content/uploads/2010/12/Rwanda-Green-Growth-Strategy-FINAL1.pdf

[97] Kagabo DM; Ndayisaba PC. 2015. Enriching soils through soil erosion control structures (bench terraces), fodder production, manure management and efficient fertilizer use in the Kagera basin, Rwanda: Report. Kigali: Rwanda Agriculture Board (RAB).

agricultural production throughout the country, resulting in losses in yields and income, but also an increased use of agro-chemicals.[98]

Farmers expanding their agricultural lands into more fragile environments such as steeper hill slopes and wetlands, is a response to increased food demand. Agricultural activities at steeper hills is highly risky and has triggered land fragmentation and reduction of farm size, over-exploitation of soil resources, habitat loss, soil erosion and degradation, thus making the land more sensitive and exposed to climate-induced hazards. As discussed in Section 2, Rwanda is among the countries most affected by land degradation which is mostly defined as a reduction in productivity of the land or soil caused by human activity, exacerbated by natural processes, and often magnified by and closely intertwined with climate change and biodiversity loss. To cope with the demographic pressure, the Government of Rwanda launched a large-scale national cropland conversion campaign that aimed to expand the irrigated cropland by 100,000 ha by 2020, among which 35,000 ha will be hillside irrigation, and 90% of the cropland is located on slopes of 5%–55%. With a hilly and mountainous relief, a fragile soil and a high average rainfall intensity of 1156 mm that concentrates in the wet season, the lands of Rwanda are highly susceptible to soil erosion. According to a global assessment, Rwanda was among the 22 countries most seriously affected by soil degradation. Previous studies suggested that severe soil erosion in Rwanda, like in other East African countries, could be associated with unsustainable agricultural land management increased by high population densities. The rainfall erosivity will have a high impact on soil erosion, which is likely to contribute to about 80% of soil loss. Table 10 presents potential impacts from climate change on agriculture and livestock under climate change scenarios.

Table 10. Scenario analysis of potential climate change impacts on agriculture and livestock sector[99]

Climate change trends	Potential impacts on agriculture and livestock
Increasing trend in mean temperatures (projected annual mean temperature increase between 0.10°C and 0.30°C)	• Decrease in tea and coffee production • Leads to significant reduction of crop yields of cereals • Heat stress affects physiological processes health and mortality of livestock • Higher disease pressure on livestock, through change of the thermal optimum for pathogens, hosts, vectors and epidemiology, together with a number of indirect effects
Decreasing trend in mean rainfall and number of rainy days coupled with more days with extreme	• Late harvests, delay of sowing in the next season, seasonal crop failures and low yield • Famines and food insecurity

98 World Bank; CIAT. 2015. Climate-Smart Agriculture in Rwanda. CSA Country Profiles for Africa, Asia, and Latin America and the Caribbean Series. Washington D.C.: The world Bank Group.
99 Republic of Rwanda (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

rainfall intensities particularly in the Eastern and parts of Southern regions	● Limited grazing and feed resources during long dry spells significantly reduce milk productivity and thus affect food security of cattle farmers ● Increased use of swamps for agricultural purposes will soon or later also have implications for overall water balance in the country and its availability for agriculture
Increase in rainfall intensities in North-west highlands and South-western regions	● Increase soil loss and nutrient leaching from soil, thus challenging agricultural productivity growth. ● Increased runoff during heavy storms destroy existing soil conservation facilities, increase sedimentation of lakes and ponds thus altering fish habitats.
More frequent violent storms (strong winds, hailstones, thunders, torrential rains)	● Crop damage or total crop destruction and thus yield reduction; ● Increased flooding and land erosion /sedimentation destroying crops cultivated on vulnerable/fragile areas such as valleys and steep slopes.

*For detailed implications of climate risks for targeted value chains see Annex 3.

Scenarios show that a total of 62,033 tons and 157,786 tons of major crops (cassava, banana, beans) are vulnerable to severe drought in Season A from September until the end of December and Season B from March and ends in May.[100] Banana and cassava are the most vulnerable crops with loss of approximately 149,190 tons and 64,111 tons respectively for both Season A and Season B.[101] The estimated economic costs from damaged crops produced during the two seasons could reach USD 2 million (equivalent to 1.9 billion RWF) for Season A and USD 7.5 million (equivalent to 6.9 billion RWF) for Season B.[102] These losses were estimated for the seven major crops (banana, beans, cassava, sorghum, rice and maize) considered in the exposure and vulnerability analysis in the preceding chapters.

The World Food Program (2018) estimated the drought impacts for each province for the agricultural seasons A and B for the period 2016 – 2018. The models analysed the vegetation development through Normalized Difference Vegetation Index (NDVI) anomaly linked with rainfall temporal profiles to visualize the impact of drought or irregular rainfalls along the agricultural seasons.[103] For this period, vegetation development was below the 20-years average in Kirehe, Kayonza, and Nyagatare districts, the City of Kigali, and some parts of the Western Province. For Kirehe and Ngoma, vegetation index might be a direct consequence of

[100] Republic of Rwanda (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

[101] MIDIMAR, 2015. The National Risk Atlas of Rwanda.

[102] Idem.

[103] World Food Programme, Vulnerability Analysis and Mapping (VAM (2018) Comprehensive Food Security & Vulnerability Analysis. United Nations World Food Programme Headquarters: Via C.G. Viola 68, Parco dei Medici, 00148, Rome, Italy

rain deficit compared to rainfall long-term average. As can be seen in Figure 10, Figure 11, and Figure 12, the NDVI anomaly in 2018 was particularly marked.[104]

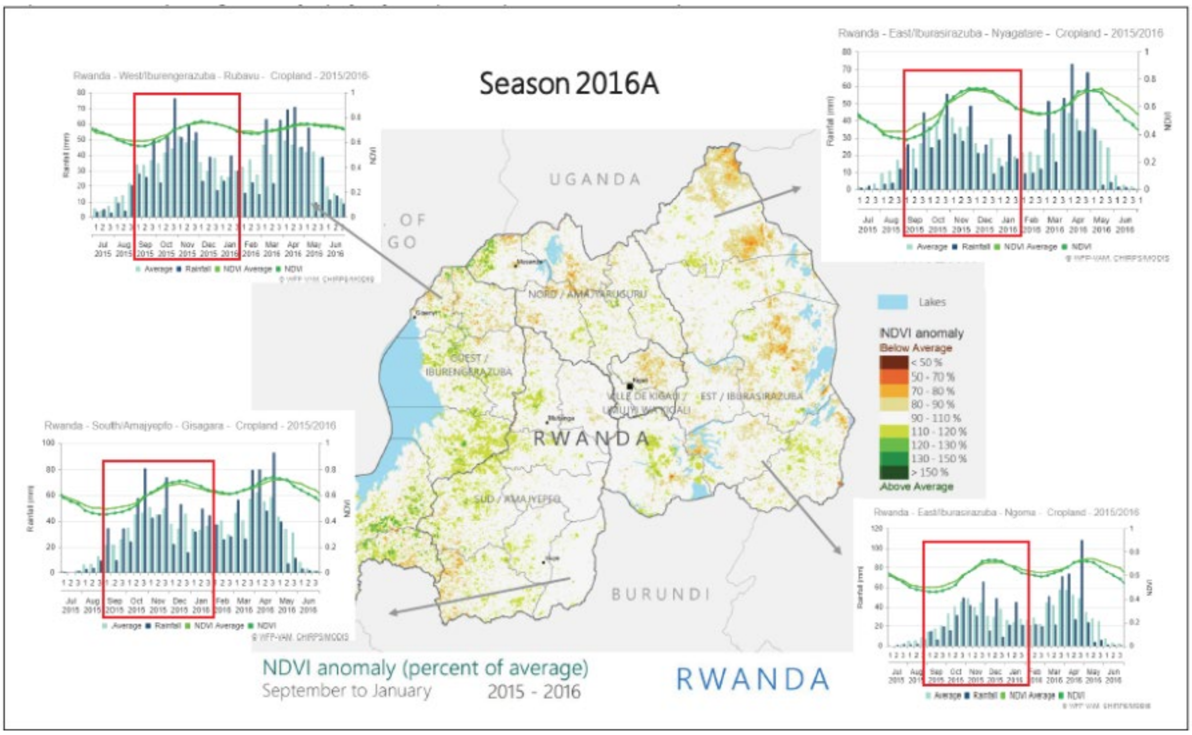
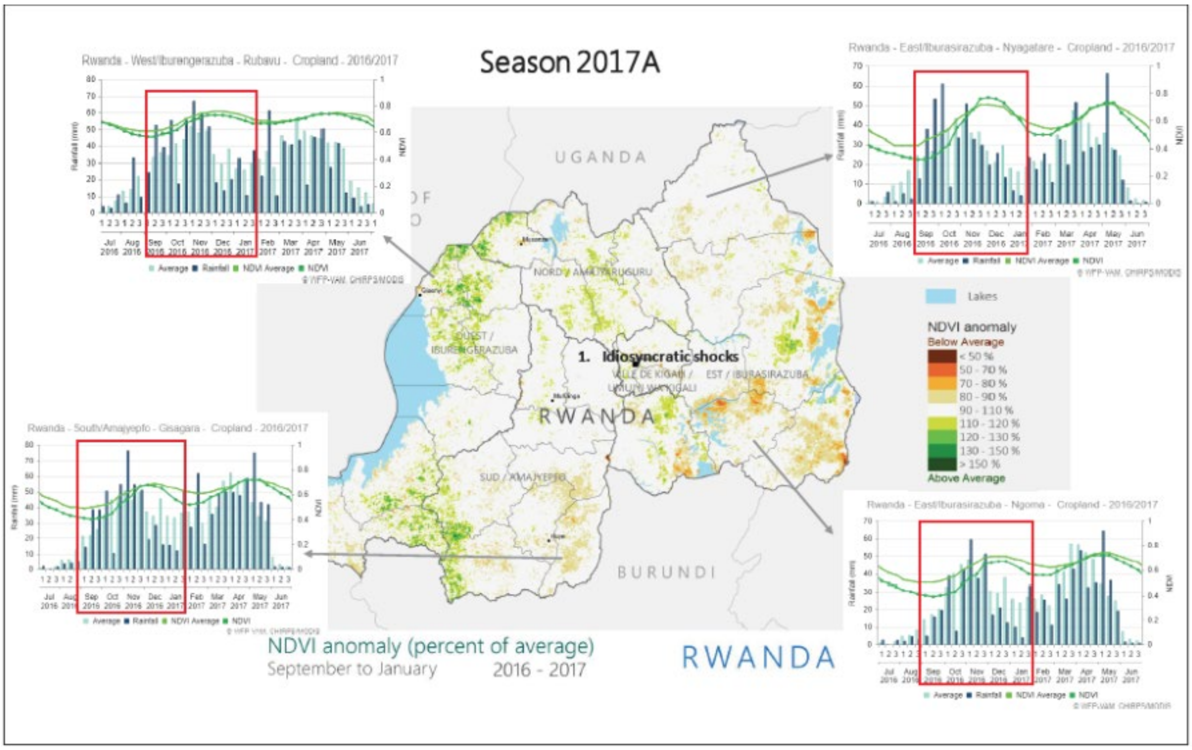


Figure 10. NDVI anomaly average and rainfall for the period September 2015 to January 2016.



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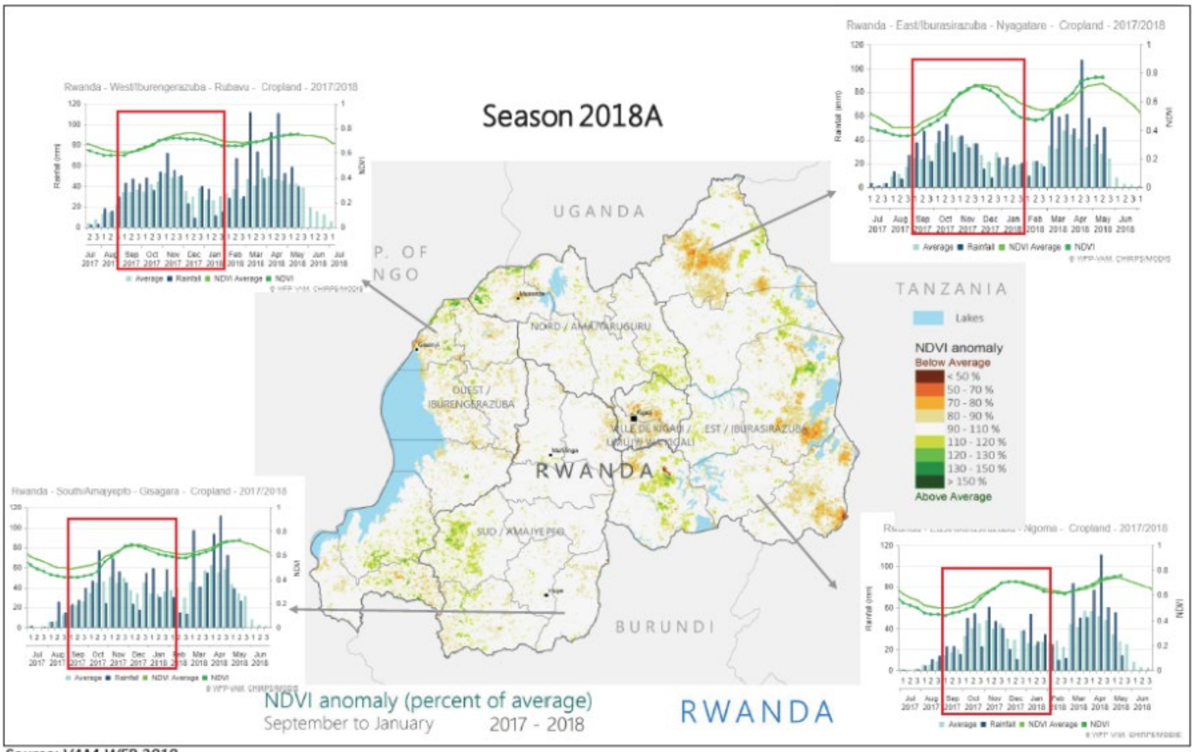
104 World Food Programme, Vulnerability Analysis and Mapping (VAM (2018) Comprehensive Food Security & Vulnerability Analysis. United Nations World Food Programme Headquarters: Via C.G. Viola 68, Parco dei Medici, 00148, Rome, Italy

Figure 11. NDVI anomaly average and rainfall for the period September 2016 to January 2017.



Source: VAM-WFP 2018

Figure 12. NDVI anomaly average and rainfall for the period September 2017 to January 2018.

The Eastern Province is characterized by high frequency of rainfall deficit, late rainfall onsets, and a significant number of dry spells. Intensifying these characteristics, landscapes and forest ecosystems services which support the provinces eight major crops are already degraded and many unable to sustain livelihoods making the province **highly prone to drought**[105]**:**

- Season A: **In total, 11,900 hectares of land area cultivated with the eight major crops are exposed to high drought in Season A** with a total of 6,400 hectares of this in Kayonza District, 3,260 hectares in Kirehe District, and 2,200 hectares is located in Gatsibo District. **The total volume of crop production exposed is 86,600 tons.**
- Season B: **A total of 21,400 hectares of land area cultivated with the eight major crops are exposed to drought.** Notably, compared to Season A, the total cultivated area exposed has increased for Season B. Specifically, Kayonza District has more cultivated areas exposed numbering to 15,050 hectares comprising of 6,100 ha of banana, 3,440 ha of ordinary beans, 1,930 ha of sorghum, 1,080 ha of maize, 870 ha of cassava, 260 ha of climbing beans, and 70 ha of rice. Kirehe District have approximately 6,300 hectares of land area cultivated with various major crops

[105] MIDIMAR, 2015, The National Risk Atlas of Rwanda.

produced in Season B are exposed to very high drought. **The total volume of crop production exposed is to very high susceptibility around 189,650 tons.**

Drought scenarios i.e. Season A and Season B, show estimated monetary losses for the Eastern Province from crop damage and loss at USD 2 million and 7.5 million (RWF 1.9 billion and 6.9 billion) respectively (Table 11). These losses were estimated for eight major crops. For Season A, the highest losses could be experienced by Kayonza, Kirehe and Gatsibo districts. The highest losses could occur on banana, cassava and cereals (i.e. maize, rice and sorghum) and beans.[106]

Table 11. Estimated monetary losses from crops due to drought in Season A per year.[107]

District	Estimated Losses (in Rwf)					
	Cereals[38]	Beans [39]	Irish Potatoes	Banana	Cassava	Total
Gatsibo	116,310,037	21,205,576	29,579,367	198,115,338	100,863,654	466,073,972
Kayonza	89,210,472	22,286,135	73,432,128	435,078,530	186,363,003	806,370,269
Kirehe	128,414,390	24,373,664	55,784,262	236,127,640	195,156,237	639,856,193
Ngoma	50,136	12,497	29,110	158,888	143,597	394,228
Nyagatare	5,757,888	1,864,120	911,586	7,478,720	7,797,807	23,810,122
Rwamagana	2,775,823	443,836	2,125,674	7,446,301	4,798,485	17,590,119
Total	**342,518,747**	**70,185,829**	**161,862,128**	**884,405,417**	**495,122,782**	**1,954,094,903**

The cost for cereals comprised the average of the costs for maize (195/kg or 445,000/ton); rice (750/kg or 750,000/ton); and Sorghum (390/kg or 390,000/ton)[38] Cereals include maize, rice and sorghums[39] Beans is comprised of long beans and ordinary beans

For Season B, the highest estimated losses is also expected in Kayonza, Kirehe and Gatsibo (Table 12). These are the districts which have large areas cultivated with these major crops and with high exposure and vulnerability at the same time.

Table 12. Estimated monetary losses from damaged crops due to drought in Season B per year.[108]

[106] MIDIMAR, 2015, The National Risk Atlas of Rwanda.

[107] Idem.

[108] Idem.

District	Estimated Losses (in Rwf)					
	Cereals	Beans	Banana	Irish Potatoes	Cassava	Total
Bugesera	96,899,566	26,342,696	79,229,155	22,322,772	294,750,708	519,544,896
Gatsibo	250,328,142	45,639,677	426,393,506	63,662,158	217,083,682	1,003,107,166
Gicumbi	10,058,188	8,247,612	13,286,763	7,168,493	15,662,801	54,423,857
Gisagara	640,260	155,288	401,932	143,328	1,861,864	3,202,672
Kayonza	179,650,818	44,879,512	876,155,138	147,876,607	375,295,243	1,623,857,318
Kamonyi	29,032,346	5,881,666	19,082,591	7,372,713	171,400,542	232,769,858
Kigali	32,910,131	8,586,108	40,526,092	16,800,427	92,919,783	191,742,541
Kirehe	250,056,789	47,461,972	459,802,984	108,626,715	380,020,823	1,245,969,283
Ngoma	63,328,047	15,785,032	200,693,723	36,769,244	181,380,073	497,956,120
Nyagatare	130,544,049	42,263,723	169,559,113	20,667,675	176,793,502	539,828,061
Nyanza	6,549,401	1,596,075	2,906,061	1,663,065	15,498,891	28,213,493
Ruhango	3,578,539	1,107,158	2,115,330	695,388	41,839,083	49,335,498
Rulindo	5,784,656	3,270,828	7,065,326	2,275,676	11,445,422	29,841,908
Rwamagana	143,289,547	22,911,053	384,382,262	109,728,500	247,700,482	908,011,844
Total	**1,202,650,479**	**274,128,400**	**2,681,599,975**	**545,772,761**	**2,223,652,901**	**6,927,804,516**

Special note: A number of projects to address drought and other climate vulnerabilities of Eastern Province crop systems, including large scale irrigation projects, have been established by government entities such as the Ministry of Agriculture (MINAGRI) and development partners such as IADB and the World Bank (refer to Section 5. Projects on climate change in Rwanda and lessons learned). In this regard, the TREPA project's is complimentary to these programs. The projects objective is to lead to a paradigm shift from reliance on degraded and vulnerable land, unable to sustain livelihoods to a climate resilient landscape providing development and diversified climate resilient opportunities for smallholder farmers which compliment these existing activities in the Eastern Province.

ii. 3.4.2 Impacts in the forestry sector

It is difficult to distinguish the impacts of climate change on forest resources from other non-climate change factors such as agriculture, infrastructure development, urbanization, among others. However, it is recognized that the socio-economic and political drivers will likely be exacerbated by future climate change with projected increase in temperature, decreased rainfall in many parts of the country and occurrence of extreme events such as drought, flooding and landslides. The potential climate change impacts are summarized in Table 13.

Table 13. Scenario analysis of potential climate change impacts on the forestry sector[109]

Climate change scenarios	Potential impacts on Forestry
Increasing trend in mean temperatures (projected annual mean temperature increase between 0.10°C and 0.30°C)	• Increasing temperature will create a favourable environment for more forest pests and diseases. This will reduce the productivity of forests and may increase risks of deforestation and forest degradation.

109 Republic of Rwanda (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali

Decreasing trend in mean rainfall and number of rainy days	• Decrease in rainfall will likely increase water stress of trees particularly in semi-arid areas in Eastern and Southern regions, reducing their productivity and leading to dieback; • More frequent droughts will upsurge anthropogenic stress and increase deforestation and forest degradation, frequent and severe forest fires and reduce the capacity of water catchment;
Increase in rainfall intensities coupled with strong winds, hailstones, thunders, torrential rains in North-west highlands and South-western regions	• Increased forest productivity due to increased rainfall availability; however, subsequently increased extreme weather events such as strong winds, violent storms, violent floods will negatively affect forest resources particularly in fragile areas such as on steep slopes and valleys.

iii. 3.4.3 Impacts in the water sector

Although Rwanda is considered to have sufficient water resources, it is highly vulnerable to current climatic variability through flood and drought episodes. As rainfall variability is related to overall impacts on hydrological flow, water storage and availability, climate-related impacts on water resources lead to more floods and dry spells, while groundwater recharge diminishes. The possibility of more extreme climatic events, such as prolonged drought, raises concerns for water access, even in areas known to be water secure. With reduced and increasingly unreliable rainfall, agriculture - the biggest water user - is expected to rely more on irrigation. This will undoubtedly increase the pressure on water resources. Therefore, in the near future, Rwanda's main water resource management challenge will be meeting increasing multiple water demand, as it balances declining water availability, ecosystem degradation, pollution and climate change. Moreover, because of increasing population pressure and declining water quality and quantity, access to clean water will become more of a predominant problem.

5. Section 4. Legal and institutional framework

Section 4 provides a summary description of national strategies and plans on development, climate change and natural resource management relevant for the project. It highlights how the project will contribute to national priorities and targets. It further provides a description of the main actors and institutions for the governance of climate change.

a.

b. 4.1 Legal and political framework

Rwanda ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and the Kyoto protocol in 2003. Rwanda submitted its first National Adaptation Program of Action (NAPA) in 2006. In 2009, the Climate Change and International Obligations Unit (CCIOU) was established within the Rwanda Environmental Management Authority (REMA). Subsequently, in 2010, the Government established its National Implementing Entity (NIE) under the Ministry of Natural Resources (MINIRENA), to facilitate access to financial resources from the UNFCCC Adaptation Fund (AF). Over the last decade, the government of Rwanda has intensively embarked on investments in CSA practices such as land husbandry, water harvesting and hillside irrigation to increase resilience to climate change, reduce water erosion and soil loss, halt land degradation, and increase land productivity. Programs that mitigate emissions such as one cow per poor family, zero grazing and the use of droppings for household biogas production in intensive livestock systems have been implemented. Agroforestry was promoted in the country and recently, the government of Rwanda pledged in AFR100 to restore 2 millions of hectares of land mainly through agroforestry (http://www.bonnchallenge.org/content/rwanda). Government's initiatives mainly involved the development of Rwanda National Strategy on Climate Change and Low Carbon in 2011 and the establishment of a green fund (FONERWA) with the purpose to be the engine for the next 50 years of green growth in Rwanda while serving as touchstone for Africa and the rest of the world.

The national strategies and plans outline the priority sectors for the government of Rwanda are (i) agriculture and food security, (ii) hydroelectric and wood energy, (iii) human settlements and Infrastructure, (iv) fresh water and land Ecosystems, (v) health and (vi) industry. The priority adaptation actions are presented in the National Adaptation Programmes of Action to Climate Change (NAPA) (MINIRENA, 2006) and more elaborated in the Intended Nationally Determined Contribution (INDC) (GoR, 2015).

The Green Growth and Climate Resilience Strategy (GGCRS) provides the country's roadmap for becoming a climate resilient, low carbon economy by 2050. The GGCRS developed in 2011 is central in directing the achievement of Rwanda's development targets through low carbon and climate resilient pathways and has high- level commitment from GoR. GGCRS' strategic objectives include the achievement of sustainable land use and water resource management and reduced vulnerability to climate change. The strategy contains 14 Programmes of Action towards its achievement, including Sustainable Land Use Management and Planning and Sustainable forestry, agroforestry and biomass energy. The GoR has successfully mainstreamed climate change into its national strategies and many of its sectoral strategies. Environment and climate change issues are also included in the Budget Call Circular (BCC). However, limited capacity to tackling climate change issues particularly in productive sectors such as agriculture reduces national capacity to adopt and implement the GGCRS.

Through the climate change project under REMA, Rwanda formulated its Initial National Communication in 2005, the second National Communication in 2011 and the third National Communication in 2017.

The major national strategies for development, climate change and environment include:

1) National Strategy for Transformation 2017 – 2024

In the medium-term, the National Strategy for Transformation, NST-1/Seven Years Government Program (2017-2024) sets the priority for a Green Economy approach in its Economic Transformation Pillar that promote “Sustainable Management of Natural Resources and Environment to Transition Rwanda towards a Green Economy”. Moreover, Environment and Climate Change were highlighted in NST1 as cross-cutting areas of policy concern which can be positively impacted by a range of development activities with priority given to agriculture, urbanization, industries and energy.

2) Vision 2020 Development Programme (2000)

The VISION 2020 seeks to fundamentally transform Rwanda into a middle-income country by the year 2020. This will require achieving annual per capita income of US$ 900 (US$ 290 today), a poverty rate of 30% (64% today) and an average life expectance of 55 years. The six pillars of Vision 2020 are interwoven with three cross-cutting issues including protection of environment and sustainable natural resource management.

3) National Adaptation Programme of Action (NAPA) (2004)

The NAPA articulates Rwanda’s strategy to reduce vulnerability to climate change particularly from the main climatic hazards including intense rainfall, flash flooding, landslides, drought and low flows, extreme temperatures and heat waves. The six NAPA priorities are: 1) Integrated Water Resource Management; 2) Setting up information systems to early warning of hydro-agro meteorological system and rapid intervention mechanisms; 3) Promotion of non-agricultural income generating activities; 4) Promotion of intensive agro-pastoral activities; 5) Introduction of species resisting to environmental conditions; and 6) Development of firewood alternative sources of energy.

4) National Strategy for Climate Change and Low-Carbon Development “Green Growth and Climate Resilience” (2011)

This Strategy was developed in 2011 and aims to guide the process of mainstreaming climate resilience and low carbon development into key sectors of the economy. It provides a strategic framework which includes a vision for 2050, guiding principles, strategic objectives, 14 programmes of action (1. Sustainable intensification of small-scale farming; 2.Agricultural diversity of markets; 3.Sustainable land use management; 4.Integrated water resource management; 5.Low carbon energy grid; 6.Small scale energy access in rural areas; 7. Disaster management; 8. Green Industry and private sector development; 9. Climate compatible mining; 10. Resilient transport systems;11. Low carbon urban system; 12. Ecotourism, conservation and payment of ecosystem services; 13. Sustainable forestry, agroforestry and biomass; and 14. Climate predictions), enabling pillars and a roadmap for implementation.

5) Intended Nationally Determined Contribution (INDC)

Rwanda's Intended Nationally Determined Contribution (INDC) puts a strong emphasis on sustainable forestry, agroforestry and biomass energy as one of the programmes under which specific actions are implemented to achieve direct and indirect mitigation benefits. In conformity of INDC, Rwanda aims to reach 100% of farms implementing agroforestry by 2030, and making a larger use of soil conservation techniques and crop intensification practices through agroforestry. Agroforestry has high potential to fulfil NDC commitments by reducing emissions from agriculture and making it resilient through appropriate investments and innovations. Additional measures emphasises in the document include agroecology techniques, improving soil conservation and land husbandry (terraces and agroforestry); increasing irrigation and water management including rainwater harvesting; afforestation through enhanced germplasm and technical practices in planting and post-planting processes; Improved Forest Management for degraded forest resources; and sustainable use of biomass fuels through the increased uptake of improved cookstoves and biogas.

5) National Strategy for Agroforestry

In 2010, the Government of Rwanda committed to restoring the ecological health of two million hectares of land, which essentially represents the whole country. This commitment was the first in Africa, and a foundational commitment to the Bonn Challenge, a global target to restore 150 million ha of degraded land by 2020. Subsequent developments following Rwanda's inspirational lead, have led to other African countries pledging to restore 86 million ha of land within the frameworks of both the Bonn Challenge and the Africa Forest Restoration Initiative (AFR100). Among the 2 M ha committed for Rwanda, 502.000 ha is constituted by the rain-fed crop/agroforestry lands of the Eastern Province.

As a sign of high national priority, the National Strategy for Agroforestry (2019-2028) has been recently developed with the support of FAO. Its aim is to set the frame enabling good collaboration between MoE/RFA (agency in charge of forestry and tree resources management) and MINAGRI/RAB (agency in charge of agriculture system extension) to support the right dissemination of highly productive agroforestry systems.

One of the most important recommendations of the National Strategy for Agroforestry is

to use the existing extension system (Twigire Muhinzi[110]/Farmer Promoters and Farmer Field School groups - FFS group) in order to ensure adequate and quick dissemination of agroforestry systems, taking advantage of their current organization, skill and interest in implementation of improved techniques.

In 2018 the Cabinet approved a new National Tree Seed Strategy (NTSS) focusing on the development of the national capacity to supply agroforestry Tree Reproductive Material that can support increase of productivity while being more climate resilient. The strategy further aims to align with the Sustainable Development Goals (SDGs) related to poverty (1), hunger and food security (2), responsible consumption and production (12), climate change (13) and ecosystem sustainability (15).

6) Rwanda's National Forest Policy (2018) and Forestry Sector Strategic Plan (FSSP 2018-2022)

The National Forest Policy highlights the dissemination of productive and resilient agroforestry systems (tree density target of 50 tree/ha in 2022) as a key pillar of the strategy. The aim is to increase forest and trees cover and stock to mitigate climate change and assist in climate regulation.

TREPA project is designed in line with the abovementioned development climate change, natural resources management policies and strategies and aims to contribute to achieving their targets (Table 14). The project considers Rwanda's land use and ownership policies as well.

Table 14. List of key climate change and development policies and the contribution of the project to achieving the policy targets.

Name of climate change and development policies	Contribution of the project to achieving the policy targets
National Strategy for Transformation (NST) 2017 - 2024	The project is strongly aligned with the aspiration of the strategy for green economy approach and will directly contribute to the objectives by promoting and upscaling sustainable management of natural resources through agroforestry and landscape restoration.

110 Twigire muhinzi consist of extension system established and supported by RAB across the country, where champion farmer promoters (1 per villages) is train and supported to (1) implement innovative good agriculture practices in its parcels serving as demonstration plots and to (2) train/advice/guide neighbouring farmers in implementation of these goods practices

Vision 2020 Development Programme (2000)	The project will directly contribute to the achievement of the following priorities of the Vision 2020: - Extending agro-forestry systems to 85% of all agriculture; productive high value and market oriented - Private sector-led development: a private sector- driven economic growth path implies that the Government will divest from service
National Strategy for Climate Change and Low-Carbon Development "Green Growth and Climate Resilience" (NCCLCDS) (2011)	The project activities will contribute to the achievement of the multiple targets of the strategy, but in particular Component 1 and 2 of the projects will support the following programs of action: 2.Agricultural diversity of markets; 3. Sustainable land use management; 4. Integrated water resource management; 6. Small scale energy access in rural areas; 7. Disaster management; 8. Green Industry and private sector development; 13. Sustainable forestry, agroforestry and biomass.
Intended Nationally Determined Contribution (INDC)	The project activities are well aligned with the adaptation priorities and will contribute to the achievement of the targets by improving soil conservation and land husbandry upscaling agroforestry and silvopastoral systems; promoting afforestation through enhanced germplasm and technical practices in planting and post-planting processes; moreover, the project will directly contribute to the improvement of forest management for degraded forest resources; and sustainable use of biomass fuels through the increased uptake of improved cookstoves and biogas.

6) Land Use Planning policies

The Rwanda National Land Use Planning Guidelines by MINIRENA/RNRA (Final draft, 2016) is a key policy instrument in the country. The Guidelines emphasis the need for watershed protection as follows:

- Major land use changes, especially the conversion of agricultural land to commercial or residential land, must be approved by all the relevant Line Ministries and District authorities.
- Establish a rural settlement boundary to protect agricultural lands outside which land uses will be limited to agricultural pursuits, outdoor recreation and preservation.
- Crop production should be done depending on adaptation to designated agro-ecological zones, soil characteristics, recommended agricultural practices and appropriate technologies.
- Prohibiting subdivision of agricultural land less than 1 ha.
- Develop incentives and/or disincentives to discourage subdivision of large-scale farms.
- Develop a sustainable land management plan for conservation of land resource base.
- Cultivation on the slopes from 0% - 12% contour farming is recommended; 12% - 55% one is obliged to apply soil conservation measures; slopes up to 55 degrees with deep soil may be used as a last resort if extensively terraced and above 55% land should be used for perennial/permanent crops (e.g. grass, tea and bananas and trees).
- Discourage cultivation on areas identified and demarcated as riparian – the distance of cultivated land from rivers should be 10m from the highest water-mark during peak of the rainy season. The minimum on both side of the river should be 2m for small rivers and maximum of 10m.
- Distance of cultivated land from lakes should be 50m from highest water mark for all lakes.
- Stony, shallow soils on hilly areas should be used as pasture (controlled) or forest or should have stone terraces.
- Protection of the soil against erosion should be encouraged: plough and plant along the contours, practice crop rotation, apply manure to crops, leave crop residue on the ground and practice terracing.

7) Land ownership policies

In order to address its land scarcity and low productivity in agriculture, Rwanda instituted comprehensive land tenure reform and a systematic land registration program along with a Crop Intensification Programme. Participation in the program requires community agreement to land consolidation and resettlement. While the program has shown some early success, its continued application in hilly and marshy areas may prove more difficult. In 2013 Rwanda transformed the 2005 Organic Land Law (Organic Law Determining the Use and Management of Land in Rwanda) into ordinary law to comply with the Constitution, and also addressed particular weaknesses of the 2005 law. The Law N° 43/2013 of 16/06/2013 (Law Governing

Land in Rwanda) was gazetted in June 2013. This law provides that land is the common heritage of past, present, and future Rwandans. The State has supreme power of management over all land in Rwanda, and it is required to manage the land for the general interest of all, and for economic and social development. The Land Law recognizes rights to land obtained under customary law as equivalent to rights obtained under formal law, requires land registration, and sets minimum plot sizes for agricultural land.[111]

The Land Law classifies land as either individual land or state land. Individual (i.e., private) land can be obtained under principles of customary law or under formal law. State land includes: (1) state land in the public domain (e.g., lake shores, national parks, roads, tourist sites), which generally cannot be alienated; (2) state land in the private domain of the state (e.g., vacant land, swamps, plantations, expropriated land), which can be alienated; and (3) district, town, and municipality land, which is controlled by local governments.[112]

Most rural land in Rwanda is accessed through inheritance and leasing, and most urban land is accessed through purchase and leasing. Other methods of obtaining land include via government land allocations, borrowing, gift, first clearance, and informal occupation.

Despite the constitutional mandates of equality and provisions in the formal laws supporting women’s land rights, women still face some barriers in securing their rights to land. For example, women in informal marriages and consensual unions cannot typically claim their rights to land in the case of a separation, and the general understanding is that women in these situations do not have the same rights to land as men.[113]

c. 4.3 Financial inclusion strategy

Overall, financial inclusion is relatively high in Rwanda as compared to other African countries. According to FINSCOPE 2020, 93% of Rwandese are included in the financial sector. The survey indicates a narrowing gender gap in financial inclusion with only 8% of women excluded compared to 7% of male counterparts. About 36% (from 26% in 2016, 23% in 2012 and 14% in 2008) of adults in Rwanda are banked. About 25% of banked adults use digital financial tools, up from 6% in 2016. About 75% of adults in Rwanda use other formal (non-bank) financial products/services.

The informal sector continues to play a significant role in financial inclusion and increasing product portfolio choices with about 78% of adults in Rwanda using informal financial services, mainly through saving groups. The study also shows that formal financial services in agriculture are relatively limited (3% of total formal lending). The latest finscope study shows that the current institutions consist of 416 Sacco Umurenge, 23 Non Umurenge Sacco and 19 Limited microfinance institutions. The Umurenge Saccos are very locally based and have a strong focus on savings, with limitations in lending capacities and capital, especially for longer term lending to farmers and SME’s. Consolidation of these Saccos is currently ongoing and includes establishment of 30 district-level Saccos, which will have a much greater lending capacity and can speed up digitalization within the Sacco’s. TREPA will establish linkages with these Saccos eventually and share lessons learned (see also activity 2.3.8 on

[111] Government of Rwanda. 2013b. Law No 43/2013 of 16/06/2013 Governing Land in Rwanda.

[112] Idem.

[113] USAID, 2017. Rwanda: Land Tenure and Property Rights. URL: https://www.land-links.org/wp-content/uploads/2016/10/USAID-Country-Profile_Rwanda_FINAL.pdf

sharing lessons of financial products), thus eventually supporting a paradigm shift in agricultural lending. The program now works with 3 strong MFIs (limited liability companies) with broad outreach capacity in Eastern Province, Based on initial successes, the newly developed financial products and instruments can be widely shared thus initiating a paradigm shift toward climate sensitive agricultural finance of the sector.

The recently drafted financial inclusion strategy for 2019–2024 sees new developments in mobile money to be promising means of reaching out to the traditionally unbanked, including the rural population and women. Core elements of the new strategy include:

- Deepening the usage of financial services for the rural population by growing the product offerings including specific agricultural loans, value chain finance, agri-SME loans, savings, insurance, etc.
- Capitalizing on the fast outreach of informal groups and link them to more formalized financial institutions.
- Enhancing financial education and client protection principles,
- Furthering digitalization into a national payment system, aiming to have 80% of the adult population using mobile and or smart card systems by 2024.
- Expanding and professionalizing the Umurenge Savings and Credit Cooperatives (SACCOs) by building a district-level SACCO

All activities related to improving access to finance in the TREPA proposal are fully in line with this newly formulated financial inclusion strategy

Financial service providers have limited knowledge on climate changes and climate resilient agricultural production methods.

In a bid to finance economically feasible projects for farmers, financial service providers might stimulate unintentionally production methods that have negative environmental effects. Proper education to financial service providers and financial product development with financial service providers that allow for a balance between economic returns and lower climate impact are required and will be stimulated in the TREPA program

Financial barriers

(1) Communities, FFPO and government agencies have constrained financial capacity to meet the incremental costs of adaptation

Traditionally, smallholder farmers have managed their assets, building on local knowledge and generally using their own resources to operate and manage water supply and invest in agricultural inputs and tools. However, the cumulative deterioration resulting from increasing climate-related shocks has reduced productivity and impoverished smallholder farmers. Long-term investment capital is needed for smallholder farmers to invest in climate resilient agricultural systems. Community organisations and, in particular, FFPOs do not have the capacity to identify costs, plan and invest adequately in innovative climate resilient land and soil management technologies. There is absence of or limited access to agricultural risk finance products such as emergency agricultural loans and insurance. Where government investments are leveraged, the investment is not sustained due to lack of financial capacity to bear the incremental costs of addressing the severity of climate shocks on small-scale infrastructure. The upfront capital costs of these investments are outside the financial capability of farmer households or communities and, due to extensive demand and limited national financial resources, exceeds the capacity of government. In addition, communities and FFPOs lack the ability to effectively mobilise financing for land restoration and adopting climate resilient technologies.

There is a need to leverage private sector resources to partake and invest in gender responsive adaptation and mitigation projects through inclusive value chain and market based approaches so that value chain actors (including women, youth and disadvantaged groups and micro, small and medium enterprises) could be trained, empowered, rewarded and incentivized to protect and improve their productive assets (land, soil, water, forest, rivers, marine) whilst generating ecosystem services for the local community and reduce local pollution and carbon emissions.

(2) Lack of expertise in agricultural finance on the part of Financial Institutions and absence of tailored financial products for the needs of farmers

The majority of FIs suffer from a diffused lack of expertise and long- term experience in agricultural lending in general, and lending to smallholder farmers and farmer organisations in particular. There is lack of capacity to assess business opportunities for specific products and value chains, and the consequent lack of interest in developing specialized financial products and services tailored to the needs of these chains' actors, result in a very limited supply of financial products. In general, financial service providers see lending in agriculture as high risk, resulting in a relatively low lending rate in agriculture as seen in the Finscope study 2020. The available products show basic features that are like non-agricultural ones (short terms, fixed repayment terms, no grace period), with higher costs reflecting the transaction costs that are inherent to agricultural activities. Such financial products have limited added-value propositions and are usually inadequate to the needs of producers and processors. What farmers need, in fact, is a wide range of different financial services that can cover both their short- and long-term business needs. Additionally, farmers are usually not able to satisfy the requirements to access credit and savings services that are set by FIs. Often, these requirements imply having: conventional forms of guarantees (e.g. titled land, fixed assets); various forms of official identity documents (IDs); savings and regular income; and more. Rural producers and processors rarely meet even one of these criteria. Furthermore, this lack of access is compounded by the loose organization of many farmers and value chains. With targeted education to farmers and financial service providers, as well as by developing a diversified range of financial products, the TREPA program tries to overcome these barriers

All activities related to improving access to finance in the TREPAproposal are fully in line with this strategy

d.4.2 Institutional framework

Ministry of Natural Resources (MINIRENA)

MINIRENA is the Government of Rwanda's Ministry responsible for establishing norms and practices for rational exploitation and efficient land management, environment protection, water resources and evaluating their implementation. Several agencies function under MINIRENA (Table 15).

Table 15. List with agencies functioning under MINIRENA.

Agency	Description

Rwanda Natural Resources Authority (RNRA)	Rwanda Natural Resources Authority (RNRA) manage natural resources (water, forestry, mines, land and any other natural resources) until 3 February 2017, that is. As of 3rd February 2017, when it was repealed and replaced with Rwanda Land Management and Use Authority (RLMUA), Rwanda Forestry Authority (RFA) and Rwanda Mines, Petroleum and Gas Board.
Rwanda Forestry Authority (RFA)	RFA is responsible for implementing policies, laws and strategies and Government decisions related to the management of forests and natural water resources. The National Tree Seed Centre (NTSC) is responsible for the management and provision of tree seed within the country.
Rwanda Land Management and Use Authority (RLMUA)	RLMUA is the authority tasked to implement national policies, laws, strategies, regulations and Government resolutions related to the management and use of land.
Rwanda Environment Management Authority (REMA)	REMA is the authorized Government institution to determine modalities of protection, conservation and promotion of the environment in Rwanda.

National Fund for Environment and Climate Change (FONERWA)

FONERWA is responsible for the streamlining, coordination, channelling, programming, disbursement and monitoring of environment and climate finance within Rwanda.

Ministry of Agriculture and Animal Resources (MINAGRI)

MINAGRI is responsible for policies, norms and practices for the development and management of programmes for the transformation and modernization of agriculture. Areas of responsibility include standards and guidelines concerning land husbandry, soil protection and agroforestry.

Seed importation and phytosanitary control is administered and managed by the seed inspection unit within MINAGRI.

Ministry of Infrastructure (MININFRA)

Among MININFRA's responsibilities is the supervision, monitoring and assessment of national policies and programs on matters relating to habitat and urbanism, transport, energy, water and sanitation. MININFRA shares responsibility for the implementation of the Energy Sector Strategic Plan and the SE4ALL action plan.

6. Section 5. Projects on climate change in Rwanda and lessons learned

Section 5 provides a summary of relevant past, current and future projects in Rwanda and key lessons learned. It highlights how the current project will complement, replicate, and will not duplicate the activities of relevant past, current and future projects.

The project will partner and coordinate with a number of ongoing projects and activities in Rwanda and regionally. Coordination of partnerships will be led primarily by the Project Management Unit (PMU) and mainstreamed through the coordination mechanism created under Component 3. Table 16 below lists all projects with which the TREPA Project has integrated lessons learned and will seek coordination and partnership.

Table 16. List with prioritised past and current projects relevant to TREPA project.

Title	Intervention Area	Implementing Agency /Executing Agency
Ecosystem Rehabilitation and Green Village Promotion	Nyamasheke District-Western Province	FONERWA/Nyamasheke Distirct
Supporting Sustainable Climate Resilience Livelihoods for Poor Farming Households in Bugesera District.	Bugesera District, Eastern Province	FONERWA /Bugesera District
Forest Landscape Restoration in the Mayaga Region	Southern Province	UNDP/REMA, Kamonyi, Gisagara, Ruhango and Nyanza Districts
Landscape Approach Forest Restoration and Conservation (LAFREC)	Western and Southern Provinces	World Bank/REMA
Building Resilience of Communities Living in Degraded Forests, Savannahs and Wetlands of Rwanda Through an Ecosystem Management Approach	Countrywide	UNDP/REMA, MoE and MINAGRI
Trans-boundary Agro-Ecosystem Management Programme for Kagera River Basin (Kagera TAMP)	Southern Eastern Area of Rwanda	FAO/MINAGRA

Support Programme to the Forestry Sector (PAREF.be1 and PAREF.be2)	Bugesera, Ngoma, Kirehe and countrywide (NFI)	ENABEL (former BTC)/RNRA (former RFA)
Forest Management and Biomass Energy project - FMBE	Rwamagana, Northern Province	ENABEL/RFA
Sustainable forestry, agroforestry and biomass energy management for climate resilience in Gatsibo district.	Gatsibo	FONERWA / RFA
Border to border forest landscape restoration project	Gatsibo, Gicumbi	BMW Germany/UICN/RFA
Landscape Restoration and Integrated Water Resources Management in Sebeya and other Catchments	Rubavu, Rutsiro, Nyabihu and Ngororero Districts	SNV/MoE, IUCN,
Strengthening climate resilience of rural communities in Northern Rwanda	Gicumbi District	MoE/FONERWA and Gicumbi District
Mainstreaming Climate Smart Planning and Implementation into Agricultural Development	Countrywide	MoE/MINAGRI
Building Climate Services Capacity in Rwanda	Countrywide	CIAT/CGIAR
Land Husbandry, Water harvesting and Hillside irrigation Project	Countrywide	World Bank/ MINAGRI, Nyanza, Gatsibo, Rwamagana, Kayonza, Ngoma, Rulindo, Gicumbi, Rutsiro, Nyabihu, Ngororero, Gakenke, Nyamagabe and Burera Districts
The Restoration Initiative (TRI)	Global	IUCN (lead agency), FAO, and the UN Environment Program,
Rwanda's Green Fund	Countrywide	FONERWA
Grinka program	Countrywide	Rwanda Agricultural Board (RAB)
Forest Investment Programme for Rwanda	Countrywide	Ministry of Lands and Forestry
Improving the Efficiency and Sustainability of Charcoal and Wood Fuel Value Chains	North-Western Rwanda (Gishwarti-Mukura landscape)	Nordic Development Fund (NDF) and the World Bank

- **Projects implemented by IUCN and ENABEL**

The TREPA project is built on experience and lessons learned from projects conducted by ENABEL and IUCN including those below.

Support Program to the Forestry Sector in Rwanda (PAREF) and Forest Management and Biomass Energy project (FMBE)

This 3 phase project (PAREF.be 1/PAREF.be2 from 2008 to 2016 and FMBE from 2017 to 2020), funded by the Kingdom of Belgium and conducted by ENABEL (formerly BTC) in collaboration with RFA, focused on restoration and concession to private sector of public forests, on management of private woodlots under consolidated Forest Management Units lead by cooperatives of land owners, on participatory road side plantations and on support of agroforestry through FFS groups. These project intervened in 7 Districts, from which 4 are located in Eastern Province (Bugesera, Ngoma, Kirehe and Ngoma). For these districts, exhaustive forest inventories have been conducted and District Forest Management Plan (DFMP) have been designed, serving as pilot districts to set the methodology and the forestry database. The developed methodology and standard have been scale-up by RFA in other 21 Districts to design their DFMPs. National Forest Inventory has been conducted and national database on supply/demand of wood have been designed under LEAP software to support the revision of the BEST (Biomass Energy Strategy) with the Ministry of Infrastructure. A national standardised and user-friendly database is in process of development to allow easy design, implementation and monitoring of DFMPs.

The "Sustainable forestry, agroforestry and biomass energy management for climate resilience in Gatsibo District" and the "Border to border forest landscape restoration" projects – IUCN/RFA

These 2 project funded by FONERWA(The National Fund for Environment and Climate Change) and Germany Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety, both jointly implemented by IUCN and RFA (2016-2018) were focused on landscape restoration in Gicumbi and Gatsibo District, especially implementing a landscape approach through agroforestry promotion, restoration of public and private forests and design of DFMP according RFA standard (including forest inventories). The TREPA project took lessons from these project, particularly on knowledge of local context and technical issues regarding adapted species adopted by farmers. The learning from the two projects will inform scale up of best practices within TREPA geographical focus. Stakeholder engagement and awareness about landscape restoration have been significantly implemented, political leadership and local government engagement is fully implemented in the project areas and this will help to fast track implementation of TREPA activities.

Landscape Restoration and Integrated Water Resources Management in Sebeya and other Catchments - SNV/MoE, IUCN

The project will be implemented by Rwanda Forestry Authority (RFA) in collaboration with International Union of Conservation of nature (IUCN), Netherland Development Organization (SNV)).The project uses community approach towards catchment restoration through Village Land Use planning processes. Communities identifies issues facing their landscapes and develop an action plan to address them at landscape level. The project aims to restore degraded lands in Sebeya and other catchments through agroforestry, afforestation, gullies rehabilitation and river bank protection among other interventions. The project will also implement flood control measures. The TREPA project will aim to coordinate with Rwanda Forestry Authority to implement a joint learning and knowledge management between landscape restoration work in Sebeya and TREPA. This will enable strong knowledge management at RFA level as well as scaling up of best practices in other areas.

The Restoration Initiative (TRI) – IUCN

TRI is a GEF funded initiative supported technically by IUCN (lead agency), FAO, and the UN Environment Program, supporting FLR in Cameroon, Central African Republic, China, Democratic Republic of Congo, Guinea-Bissau, Kenya, Myanmar, Pakistan, Sao Tome and Principe and Tanzania. The support is provided under three core results areas, namely: Policy development and integration: providing support for country-led efforts to identify and integrate FLR-supportive policy; Implementation of restoration programmes and complementary initiatives: providing support for the promotion and implementation of integrated landscape management restoration plans; Capacity building and finance mobilization: providing support to unlock and mobilize funding for FLR and to strengthen the ability of institutions and people to plan and manage FLR. A fourth Global project on knowledge sharing and partnerships provides support for the capture and sharing of innovative experiences and best practices, raising awareness of FLR needs and benefits, and developing and strengthening critical partnerships. The TREPA project will in particular tap into the knowledge sharing opportunities provided by the Global KM project. TRI project started in in 2018 and will provide lessons in good time to inform the proposed project.

- **Other GCF projects in Rwanda**

Strengthening climate resilience of rural communities in Northern Rwanda (FP073) - FONERWA

This recently approved FONERWA GCF funded project is similar in its design to the TREPA GCF Project and will seek coordination, synergy and to integrate lessons learned. The project seeks a total of USD 32,794,442 of GCF grant resources over six years. The project will restore and enhance ecosystem services in one of the sub-catchments of the degraded Muvumba watershed, increase the capacity of communities to renew and sustainably manage forest resources and support smallholders to adopt climate resilient agricultural practices. The project will also invest in climate resilient settlements for vulnerable families currently living in areas prone to landslides and floods and support community-based adaptation planning and livelihoods diversification.

The project will specifically target the most vulnerable groups who have less resources to mitigate and adapt to climate change. This includes the extreme poor, as more than a quarter of households in the target area fall into this category and women headed households who tend to be poor and are particularly vulnerable to climate change. The TREPA project will draw early lessons learned from this intervention.

Many of the project's interventions target those who farm marginal land and are highly vulnerable to landslides, flooding and droughts. A key focus will be on developing the adaptive capacity of farmers and local institutions to ensure that the developed resilience becomes embedded within communities and local structures enabling them to continue adapting to future climate variability beyond the lifetime of the project.

The project comprises four interlinked outputs:

1. Sub-catchment B of the Muvumba watershed restored and small-scale farmers supported to adopt climate resilient practices;
2. Communities supported to implement sustainable forest management and adopt fuel-efficient cooking methods;
3. Human settlements developed and/or modified to increase climate resilience; and
4. Successful adaptation and mitigation approaches communicated and mainstreamed at the national level.

There are two expected outcomes from the project, linked to both mitigation and adaptation:

1. improved management of land or forest areas contributing to emissions reductions; and
2. strengthened adaptive capacity and reduced exposure to climate risks.

The scalable project will make a significant contribution in taking forward the implementation of Rwanda's Green Growth and Climate Resilient Strategy (2011) as part of GoR's commitment to addressing the risks of climate change. The executing entity of the project will be the Rwanda National Climate Fund, FONERWA which is an agency of the accredited agency, MOE. FONERWA will manage the project on behalf of MOE.

The TREPA project has been designed to benefit from complimentary activities aligned to the projects four components including: 1) Seek benefits from capacity built and lessons learned during the implementation of MOE project component 1 during the restoration of the Muvumba watershed. Particularly, the TREPA project will integrate restoration lessons learned and seek to access capacity and knowledge built during the implementation of TREPA project component 1, Output 1.4 Buffer zone rehabilitation scaled up to increase ecosystem resilience. 2) seek benefits from capacity built and lessons learned during the implementation of component 2 through sustainable forest management and adopt fuel-efficient cooking methods and applying these to the implementation of component 1 Outputs 1.2 Woodlots & tree plantations rehabilitated, 1.3 Silvopastoral packages scaled up, 1.5 Clean & efficient cooking technologies scaled up. Furthermore, the two projects will work together in efforts to seek to mainstream and integrate knowledge and capacity developed during implementation at the local and national level under the TREPA project component 3.

- **Government and other development partner projects**

Ecosystem Rehabilitation and Green Village Promotion - FONERWA

This closed project focused on soil erosion resulting from deforestation with subsequent biodiversity loss which are the major environmental challenges affecting communities in Nyabitekeri Sector of Nyamasheke District. The situation is exacerbated by climate related pressures such as unpredictable rainfall that has in turn led to loss of lives and property. The project thus intends to build community's resilience through provision of environmentally friendly practices that minimize soil erosion while improving livelihoods. The project has four interrelated outputs:

Output 1: Land management and soil erosion control strengthened

Output 2: Alternative renewable energy sources introduced and rainwater harvesting systems installed

Output 3: Sustainable livelihood and Food security Enhanced

Output 4: Project grant efficiently managed and coordinated

While the FONERWA project is in early implementation phase, TREPA will integrate early lessons - particularly from Output 1 and 3. In order to reduce soil erosion on the steep slopes and enhance sustainable soil productivity in the Lake Kivu watershed, the project will be develop progressive terraces on 400 ha. The area will be planted by various agro-forestry trees species including GREVILLEA Robusta, ACCACIA angussitissina and CEDRELLA Serrata, (Soil Nitrogen fixing species) will be planted on 100 ha. Another 200 has will be forested by EUCALYPTUS Microcorys, CALLITRIS Robusta with focus of Ravine area. The rationale of planting different tree species is to reduce risks of disease extermination of one specie but also increase soil productivity. The TREPA project will integrate these lessons into the agro-forestry activities under restoration activities of component 1.3 to ensure most effective species are selected to avoid soil erosion and enhance nitrogen fixing.

Supporting Sustainable Climate Resilience Livelihoods for Poor Farming Households in Bugesera District – FONERWA

Ngeruka sector is located in an inaccessible, drought affected part of Bugesera in the Eastern province of Rwanda and experiences high food insecurity and malnutrition, extreme poverty, high levels of unemployment. The project is enabling 912 poor households (3,927 people) to reduce their dependence on subsistence cultivation systems increasingly affected by low rainfall, erosion and poor soil quality. Target households will be supported to adopt conservation agriculture including agroforestry to reduce erosion as well as to develop off-farm, climate resilient livelihoods revolving around integrated cropping techniques (using maize, beans, bananas, cassava, mushrooms, etc.) and livestock (rabbit, pigs etc.) production systems to enhance household incomes and reduce vulnerability to climate change.

The TREPA project has integrated lessons learned, particularly from Output 1 and 3 focusing on agroforestry systems management through Farmer field schools and community based enterprises from restoration work. Lessons learnt from this project with inform, community based tree nursery management as part of the enterprise development as well as promoting farm based value chains

Forest Landscape Restoration in the Mayaga Region - UNDP/REMA, Kamonyi, Gisagara, Ruhango and Nyanza Districts

The recently approved GEF project aims to secure biodiversity and carbon benefits while simultaneously strengthening the resilience of livelihoods, through forest landscape restoration and upscaling clean technologies in selected Districts of Southern Province. The project has three interrelated components:

Component 1: Decision support tools for planning of forest landscape rehabilitation

Component 2: Skills and capacity for implementation of Forest landscape restoration plans

Component 3: Implementation of FLR plans secures 555 ha of natural forests, puts 300 ha of forests under participatory forest management, establishes 1,000 ha of plantations under the New Forest Company through co-finance, increases productivity of agriculture and plantation forests on 25,000 ha and reduces wood consumption by at least 25%. The UNDP project builds on the work done by the Landscape Approach to Forest Restoration and Conservation (LAFREC) project by the World Bank.

The TREPA project will collaborate with UNDP through a number of similar and complimentary activities. The TREPA PMU will work closely with UNDP Component 1 during the development of Decision support tools for planning of forest landscape rehabilitation under the TREPA project component 3 in order to avoid duplication of efforts. The TREPA Project will also coordinate training programs for extension services, benefiting from the skills and training packages established by UNDP under Output 2.2: Institutional capacity for the extension service and community knowledge. UNDP's output 2.2 will be aligned with TREPA Output 3.3 and 3.4. Furthermore, TREPA Output 3.4 will seek to co-develop KM products in alignment with UNDP projects Output 2.3: M&E plans and KM.

Landscape Approach Forest Restoration and Conservation (LAFREC) – Nordic Development Fund (NDF), World Bank and NEMA

The TREPA project will build upon the work done by the Landscape Approach to Forest Restoration and Conservation (LAFREC) project by the Nordic Development Fund and World Bank.

The project aims to demonstrate landscape management for enhanced environmental services and climate resilient livelihoods, including via forest rehabilitation and sustainable land management investments in one priority landscape. The project consists of 2 interrelated components:

Component 1: Forest-friendly and climate-resilient restoration of Gishwati-Mukura Landscape

Component 2 – Research, monitoring and management

The first component will finance technical assistance, workshops, goods, works, services and operational costs in support of the application of a landscape approach to forest restoration and conservation in the Gishwati-Mukura landscape. It aims to reverse the processes of deforestation and land degradation that have occurred in this landscape over recent decades through forest restoration, agroforestry and land husbandry approaches that will enhance ecological connectivity and hydrological functions of the landscape. In synergy with the land management interventions, the component will also enhance community resilience through promoting diversified and climate-smart livelihoods, and improving flood forecasting, early-warning and preparedness. The TREPA project will coordinate with the LAFREC project, particularly through harmonising methods, tools and capacity under TREPA component 1.1, 1.2 and 1.3 restoration activities benefiting from LAFREC's coordinated planning at the landscape level and with individual communities, as well as the support provided to implement tree-based landscape restoration approaches through provision of training, seeds, materials, and through payment for local labour.

Component 2 will finance operational costs, services, equipment and technical assistance for the project's management, and for applied research and impact monitoring that will significantly enhance the national knowledge base on forest and landscape restoration techniques and outcomes. It will also finance knowledge products and communication activities related to the dissemination of this knowledge base. Research components under TREPA Output 3.4 will benefit from the research/KM which has significantly increased the forest and landscape restoration techniques and outcomes.

The project will conclude December 2019, thus during TREPA Project inception additional lessons learned from the (including from the terminal evaluation) LAFREC project will be integrated.

Improving the Efficiency and Sustainability of Charcoal and Wood Fuel Value Chains – World Bank and NDF

Focused on North-Western Rwanda (Gishwarti-Mukura landscape) with a possibility to extend to other parts of the country. An NDF grant will benefit the WB-GEF Landscape Approach to Forest Restoration and Conservation (LAFREC) Project implemented by the Rwanda Environment Management Authority (REMA). NDF will support the National Seed Centre in order to improve and diversify the tree seed pool. The project will also target commercial tea factories' wood consumption and households' cooking needs through analysis and promotion of sustainable alternatives. Some of the key activities implemented by the project include improved woodlot management, improved tree seeds quality, efficient charcoal production and promotion of alternative sources of energy. The woodlot management part of the project will encompass forests in Gishwati-Mukura landscape. Building upon existing plans and training, the NDF-funded activities will initiate local-level planning of existing woodlots to improve management and increase productivity. The project components also include strengthening cooperatives to improve charcoal production techniques as well as the value, quality and marketing of the charcoal produced.

The TREPA project will collaborate with the Improving the Efficiency and Sustainability of Charcoal and Wood Fuel Value Chains project through ICS activities under Output 1.5 and seed and seedling supply systems under Output 3.3.

Building Resilience of Communities Living in Degraded Forests, Savannahs and Wetlands of Rwanda Through an Ecosystem Management Approach - UNDP/REMA, MoE and MINAGRI

The project aims to increase the capacity of Rwandan authorities and local communities to adapt to climate change by implementing Ecosystem-based Adaptation (EbA) interventions in forests, savannas and wetlands. The project has three components:

Component 1: National and local institutional capacity development for the use of an EbA approach.

Component 2: Policies, strategies and plans for adaptation to climate change.

Component 3: EbA interventions that reduce vulnerability and restore natural capital.

During project design, UNDP was consulted to ensure that activities involving capacity development for forestry and buffer zone management were integrated and complimentary to the TREPA project activities. The TREPA PMU will work closely with the UNDP project team to ensure that final lessons learned will be integrated during TREPA inception phase.

Trans-boundary Agro-Ecosystem Management Programme for Kagera River Basin (Kagera TAMP) – FAO/MINAGRI

The supported adaptive management and the adoption of an integrated ecosystems' approach for the management of land resources in the Kagera Basin over the medium to long-term which will generate local, national and global benefits and contribute to improved agricultural production, food security and rural livelihoods. As the project closed in 2015, the TREPA project will continue to develop the skills of government stakeholders in the management of agro-ecosystems, particularly under Output 3.1, 3.2 and 3.3.

Building Climate Services Capacity in Rwanda – CIAT/CGIAR

The project is a four-year initiative (2016-2019) that seeks to transform Rwanda's rural farming communities and national economy through improved climate risk management. The project's goal is to improve agricultural planning and food security management in the face of a variable and changing climate at both local and government levels. In order to do so, project staff works directly with technical officers, policy and decision makers within the Government of Rwanda, as well as with farmers and other key stakeholders in the country's agriculture sector.

The project delivers four specific outcomes:

Climate Services for Farmers. Agricultural extension and other relevant intermediary organizations and communicators (e.g. farmer cooperatives, rural radio networks, ICT providers, NGOs) provide farmers across Rwanda's 30 districts with decision-relevant, operational climate information and advisory services, and train them to use the information to better manage risk.

Climate Services for Government and Institutions. Agricultural and food security decision-makers in the Ministry of Agriculture (MINIGRA), and in other national and local government agencies and institutions, will use climate information to respond more effectively to climate-related risks and to inform decisions that build the resilience of farmers.

Climate Information Provision. Meteo-Rwanda designs, delivers, and incorporates user feedback into a growing suite of weather and climate information products (historic, monitored, forecast) and services tailored to the needs of agricultural and food security decision makers.

Climate Services Governance. A national climate services governance process—involving joint decision making among relevant national stakeholders— oversees and fosters sustained co-production, assessment and improvement of climate services for agriculture and food security; and will facilitate a formal interface and effective dialog between the key agencies involved. While this project have strengthened farmer access to weather information services, TREPA will continue to build on the previous investment to enhance climate knowledge through community resources centres planned under TREPA project.

Land Husbandry, Water harvesting and Hillside irrigation Project - World Bank/ MINAGRI

The objective of the Land Husbandry, Water Harvesting and Hillside Irrigation Project for Rwanda is to increase the productivity and commercialization of hillside agriculture in target areas. The project covers the following districts: Nyanza, Gatsibo, Rwamagana, Kayonza, Ngoma, Rulindo, Gicumbi, Rutsiro, Nyabihu, Ngororero, Gakenke, Nyamagabe and Burera Districts. The project has three components: (a) capacity development and institutional strengthening for hillside intensification; (b) infrastructure for hillside intensification; and (c) implementation through the ministerial Sector Wide Approach (SWAp) structure. To achieve better efficiency, the Government of Rwanda (GoR) decided that the role of Ministries should be limited to policy making and monitoring, while the implementation, management and monitoring of projects and programs will be transferred to implementing agencies. In that regards, the Ministry of Finance and Economic Planning (MINECOFIN) informed the Bank in a letter dated July 19, 2017 that implementation of the LWH project would be changed from the Ministry of Agriculture and Animal Resources (MINAGRI) to the Rwanda Agriculture and Animal Resources Development Board (RAB). It was anticipated that this should have no implications for implementation of the project as the Single Project Implementation Unit (SPIU) will be transferred entirely to the RAB. There should also be benefits from linkages with the other projects implemented by RAB and support to sustaining the project's outcomes following the projects closure in June 2018.

Rwanda's Green Fund – FONERWA

Rwanda's Green Fund set up by the Government to support environment protection and deal with the impact of climate change. The fund acts as the avenue through which development partners can contribute to Rwanda's green growth ambitions. Private sector contributions are considered as grants and project co-financing in the short-term, and investment in the long-term, among others. External capitalization sources include bilateral and multilateral development partners' contributions and access to international environment and climate funds. FONERWA is implementing several projects from which the Mayaga FLR project design has drawn lessons, and with which implementation will be coordinated. Most of its projects have addressed land management and soil erosion control; alternative renewable energy and improved energy efficiency; rainwater harvesting systems; sustainable livelihood and Food security enhancements. The project will benefit from and coordinate with the following projects.

The just concluded "Integrated Land, Water Resources and Clean Energy Management for Poverty Reduction Project" (2014-2017) supported the sustainable management and conservation of natural resources, more productive agriculture to reduce human pressure on Volcanoes National Park and reduce greenhouse gas emissions. In Gatsibo, FONERWA implemented a project (2015 – 2017) aimed at rehabilitating 500 ha of degraded forests; creating 3,000 ha woodlots for environmental protection, agroforestry on 15,000 ha for soil fertility and promoting improved cook-stoves in order to reduce pressure on forest resources. This project benefitted 19,317 poorest households which represents 17% of the total population. The two projects developed extension and training materials on sustainable land management, improved energy systems and improving household incomes, for all levels of stakeholders that the TREPA project will build on.

Forest Investment Programme for Rwanda - GOR

Rwanda developed a REDD+ Readiness Proposal (RPP) in 2014 with the objective of participating in REDD+ activities. However, the document which was to culminate in the development of a REDD+ strategy is not yet submitted to the UNFCCC. Some of the activities to have been taken up under the REDD+ have now been incorporated into the Forest Investment Program (FIP), developed into an action plan which in effect will implement the forthcoming REDD+ strategy that is expected to accrue national and international REDD+ related benefits. Rwanda's FIP has three target areas:

1. Support for Sustainable Agriculture through Agroforestry;
2. Support for Sustainable Forest and Landscape Management; and
3. Wood Supply Chain, Improved Efficiency and Added Value.

The Investment Plans includes a clear country context, justification for implementing the proposed projects, analysis of existing legal, policy and institutional frameworks for implementation and summarizes the wide range of expected benefits to rural livelihoods, national development programmes and the contribution to GHG emission reductions. It also itemizes the specific components for each target area identified by the Integrated Household Living Condition Survey (EICV 4) 2013-2014, proposes geographical intervention areas and quantifies the resources that will be required. The Forest Investment Program was submitted to the World Bank Climate Investment Fund (CIF) in November 2017. Once the funding is secured and implementation started, the TREPA project will collaborate very closely with the FIP implementation to identify and build on synergies, avoid duplication and waste – along all the proposed outputs, particularly 1.1 and 1.2.

7. Section 6: Project design and approach

Section 6 provides an overview of the design of the project, the barriers to adaptation (e.g. technical, institutional, financial, etc.), a characterisation and estimation of the beneficiaries and a description of the Theory of Change underpinning the paradigm shift that the project seeks to achieve.

a. 6.1 Barriers for adaptation

Rwanda has advanced in many aspects of mainstreaming and implementation of climate resilient initiatives, however there is a number of barriers and related gaps and opportunities for scaling up climate resilience solutions in the Eastern Province of Rwanda that were identified during project preparation and stakeholder consultations between 2017-2019. The barriers are grouped into nine categories including: information, technical/capacity, institutional, policy/regulatory, financial, business and market, social and cultural barriers. These barriers that can result in less efficient or less effective adaptation, missed opportunities and/or higher costs for future adaptation strategies.

6.1.1 Information barriers

(1) Local population and extension services have limited information, knowledge and skills to design and implement adaptation solutions related to land restoration

The rural population lacks information and capacity to mitigate the impacts from climate induced droughts, floods and soil erosion. Additionally, extension officers have inadequate capacity to guide decision-making processes based on climate forecasts. Such information is usually available from the Rwanda Meteorology Agency and disseminated through several channels, but it is not always easily accessible and is rarely used in decision making. Practical guidance on how to adopt alternative and innovative practices to adapt livelihood and agriculture development practices based on climate forecasts is not available. Combined, these factors have in turn led to inadequate capacity of communities to seek out and adopt best practices for climate adaptation. Without access to knowledge and training based on international adaptation best practices and in combination with limited access to financial resources and the technologies and materials that improve adaptive capacities, communities do not have the necessary capacity to develop and implement adaptive measures to climate proof land management initiatives.

(2) Limited or no baseline data on state and vulnerability of ecosystems and vulnerability of human livelihoods.

National government, district planners and private actors such as farmers have limited data on the state and vulnerability of ecosystems and livelihoods. The available data for landscape, forestry and farm management and the risk climate change poses to human livelihoods are inaccurate, scattered and inaccessible, particularly for the most vulnerable and remote populations. There are limited resources and capacity to collect, analyse, manage, monitor and utilize reliable and accurate baseline climatic and project data to calculate and track information for making evidence-based investment decisions and solutions. Furthermore, there is limited ability to design and enforce robust MRV systems to measure impacts related to climate resilience.

6.1.2 Technical / capacity barriers

(1) Local population and extension services have inadequate technical capacity on designing and applying climate resilient management practices for land restoration and in particular soil and water management

Natural resources and ecosystems are degraded in many parts of the country, exacerbating the natural resources' and human livelihoods vulnerability to climate change. This creates a well observed multiplier effect in the Eastern Province where degradation of natural resources further increases poverty, often leading to negative capacity and coping strategies of the local population. Given the unique landscape of the Eastern Province, continued over exploitation of resources such as poor cropping and tillage techniques and poor forestry and livestock management practices, further exasperate environmental degradation such as vegetation, forestry and soil nutrient loss which also lead to soil instability and loss of fertility . The technical staff, communities and FFPOs in the Eastern Province of Rwanda have limited knowledge of and skills in applying short-term and long-term climate adaptive solutions to soil and water management practices and technologies. The traditional knowledge on which communities and FFPO depended for agricultural planning and water management is fast becoming insufficient in the context of climate change and increased vulnerability of livelihoods.

(2) Farmer organisations are weak and have insufficient capacities to design integrated climate resilient solutions to improve local welfare and access markets

Smallholder farmers, especially women and youth, are unorganised and often underrepresented in the market and do not elicit benefits to support healthy livelihoods. Farmers are affected by the lack of information on market prices, and more specifically on increased prices fluctuations caused by climate variables. The lack of farmers associations and groups impedes their participation in equitable markets and receiving fair prices. Where such organisations exist in the Eastern Province, they often lack organisational capacity, entrepreneurship development skills, access to finance services (e.g. loans, grants), access to equitable markets and engagement with the private sector.

There is untapped investment potential for all value chain actors, due to the loose, fragmented and informal structure of farmer organisations and value chains, whose actors (both producers and processors) have relatively weak collective bargaining power, while the margins on the added value are often not paid. Farmer organizations are potentially crucial for two reasons:

(a) with effective local networking they can share, learn and innovate for climate adaptation; (b) with effective organization they can act as aggregators, in order to better obtain finance, access markets and benefit from higher prices.

(3) Financial service providers have limited knowledge on climate changes and climate resilient agricultural production methods.

In a bid to finance economically feasible projects for farmers, financial service providers might stimulate unintentionally production methods that have negative environmental effects. Proper education to financial service providers and financial product development with financial service providers that allow for a balance between economic returns and lower climate impact are required and will be stimulated in the TREPA program

6.1.3 Institutional barriers

(1) Weak national framework for facilitating the creation and sharing of climate knowledge

Besides limited infrastructure and knowledge to develop and disseminate climate-sensitive technologies and information, there is a weak framework at national level for facilitating the creation and sharing of knowledge about what works and what does not work related to climate, land and water management. There is no local or provincial knowledge management mechanism that extracts lessons learned from recent interventions to integrate into a complete package of technologies for the restoration, improvement, modernization, operation and maintenance of farms, forests and landscapes.

(2) The institutional capacity and coordination to implement climate-risk informed landscape management strategies is weak

The sectoral nature of land use planning is complicated by a myriad of actors at local, provincial and national levels making it increasingly challenging for institutions to coordinate and work together. There are weaknesses and overlaps in the role of government institutions and this is evident in the lack of local land-use planning and harmonisation of activities at landscape scale. The absence of a coordinating mechanism constrains the operation and management of the cascade and its water resource as a planning unit. Component 3 provides a detailed analysis of the specific institutional capacity gaps and how the project will address them.

6.1.4 Policy and regulatory barriers

(1) Lack of coherent and cross-sectoral policies aligning climate and development

There is a lack of resources and capacity to formulate coherent policies that align climate and development and enable cross-sectoral collaboration and coordination. Climate change adaptation in policy remains highly sector specific which results in ineffective adaptation measures, as climate adaptation is a cross-cutting issues. National forest and agriculture sector policies analysed failed to explicitly include consideration of climate risk-informed landscape consideration.

6.1.5 Financial barriers

(1) Communities, FFPO and government agencies have constrained financial capacity to meet the incremental costs of adaptation

Traditionally, smallholder farmers have managed their assets, building on local knowledge and generally using their own resources to operate and manage water supply and invest in agricultural inputs and tools. However, the cumulative deterioration resulting from increasing climate-related shocks has reduced productivity and impoverished smallholder farmers. Long-term investment capital is needed for smallholder farmers to invest in climate resilient agricultural systems. Community organisations and, in particular, FFPO do not have the capacity to identify costs, plan and invest adequately in innovative climate resilient land and soil management technologies. There is absence of or limited access to agricultural risk finance products such as emergency agricultural loans and insurance. Where government investments are leveraged, the investment is not sustained due to lack of financial capacity to bear the incremental costs of addressing the severity of climate shocks on small-scale infrastructure. The upfront capital costs of these investments are outside the financial capability of farmer households or communities and, due to extensive demand and limited national financial resources, exceeds the capacity of government. In addition, communities and FFPO lack the ability to effectively mobilise financing for land restoration and adopting climate resilient technologies.

There is a need to leverage private sector resources to partake and invest in gender responsive adaptation and mitigation projects through inclusive value chain and market based approaches so that value chain actors (including women, youth and disadvantaged groups and micro, small and medium enterprises) could be trained, empowered, rewarded and incentivized to protect and improve their productive assets (land, soil, water, forest, rivers, marine) whilst generating ecosystem services for the local community and reduce local pollution and carbon emissions.

(2) Lack of expertise in agricultural finance on the part of Financial Institutions and absence of tailored financial products for the needs of farmers

The majority of FIs suffer from a diffused lack of expertise and long- term experience in agricultural lending in general, and lending to smallholder farmers and farmer organisations in particular. There is lack of capacity to assess business opportunities for specific products and value chains, and the consequent lack of interest in developing specialized financial products and services tailored to the needs of these chains' actors, result in a very limited supply of financial products. The available products show basic features that are similar to non-agricultural ones (short terms, fixed repayment terms, no grace period), with higher costs reflecting the transaction costs that are inherent to agricultural activities. Such financial products have no added-value proposition and are usually inadequate to the needs of producers and processors. What farmers need, in fact, is a wide range of different financial services that can cover both their short- and long-term business needs. Additionally, farmers are usually not able to satisfy the requirements to access credit and savings services that are set by FIs. Often, these requirements imply having: conventional forms of guarantees (e.g. titled land, fixed assets); various forms of official identity documents (IDs); savings and regular income; and more. Rural producers and processors rarely meet even one of these criteria. Furthermore, this lack of access is compounded by the loose organization of many farmers and value chains.

6.1.6 Social and cultural barriers

(1) There is a need to develop gender responsive and inclusive adaptation solutions to ensure the effectiveness of climate adaptation

Traditional gender roles and patriarchal attitudes towards women in rural Rwanda mean that women have limited control over assets and decision making at the household, community and FFPO level. This weakens their adaptive capacity and makes them more vulnerable to shocks and stresses linked to climate change. Women's involvement in certain livelihoods is also limited by gender relations which limits the ability of women to take up certain off-farm livelihoods. The project has been designed to engage on these issues and will work in partnership with local NGOs that have expertise in this area. It will also work closely with the District Authorities which have prioritized increasing the role of women in community and FFPO decision making in their DDPs.

(2) Lack of inclusive participations in the planning, implementation and monitoring and evaluation of interventions

Stakeholder consultations reveal that there is perceived limited engagement with local actors for the design and innovation of solutions, planning and implementation of interventions. This generates the perception of top down supply push interventions that do not meet the need of the local community and FFPO. This results in lack of trust between the public, private and CSO sectors, which compromises the sustainability of interventions and also lack of incentive to protect and conserve the ecosystem goods and services so many communities and FFPO rely on.

(3) Traditional cultural views on livelihoods.

Cultural views on livelihoods mean that people's mindsets are set on very specific agricultural products (mostly beans and maize and cattle) which can lead to a lack of diversification. This can hinder people's focus on legitimate economic opportunities that just might be outside of the traditional norm. The project includes a number of awareness and advocacy programmes to address these types of issues. By focusing on supporting only market-oriented livelihoods, the project will demonstrate the viability of alternative livelihoods which will act as an incentive to low income households currently engaged in subsistence agriculture.

b.6.2 Project design and approach

The main objective of the proposed project is to restore drought-degraded landscapes in the Eastern Province in Rwanda through adopting an integrated landscape approach and working with national and sub-national government and stakeholder beneficiaries to achieve climate resilience through implementing concrete adaptation actions.

The areas and population affected by droughts (main part of the rural population dependent on their own rain fed crops production) is much more important than the impact of more intensive rain season on flooding which is limited to plains subject to overflows from Akagera-Nyabarongo. This is why the TREPA project is focusing first on the drought impact, for which drivers and solutions can be fully addressed locally (soil water retention capacity, vegetation/tree cover, land management practices, etc) at sub-catchment levels.

However, while addressing in priority the main drought issues, the TREPA project action targeted under output 1.1 to 1.4 are at the same time increasing the soil protection and the water retention capacity in the targeted upstream water catchment of the EP, contributing partly to the reduction of flooding risks. The landscape restoration approach adopted by the project will identify (in strong collaboration with farmers and local authorities), for each targeted piece of land, the best restoration option according to its location and roles/potential impact in the water catchment. Under the output 3.1, local landscape restoration to adapt to climate change will be established in this sense, addressing at the same time issues raised by a longer drought period (first priority) and stronger rains during the rainy season.

The project aims at building resilience to the impacts of climate change while advancing equitable social welfare and income generating opportunities, as well as safeguarding the environment, in three main ways: i) building and strengthening the currently weak institutional capacity and systems to support communities and household to adapt to and manage climate risks; ii) strengthening communities' awareness and understanding of climate change, its impacts and adaptation, and enhancing communities' ownership of adaptation plans and interventions, including generating behavioural change for effective climate change management; and iii) facilitating community-based local adaptation planning to deploy resilience building measures and adaptation technologies that will strengthen and support vulnerable food insecure households and communities to meet their immediate and future food and nutrition security needs under conditions of increasing climate risks.

To achieve this objective, the project focuses its actions on vulnerable settlements in seven Districts of the Eastern Province. All areas are a priority area for adaptation as they are highly exposed to climate-induced drought and soil erosion, defined by the Ministry of Environment. Underlying vulnerability to those hazards, in the form of poverty, inadequate infrastructure, ecosystem degradation and mismanagement of natural resources exacerbate their impacts and make the population and target area highly vulnerable to climate change.

The actions proposed by the project have been designed to target the poorest and most vulnerable people in the Eastern Province. To do this, an interdependent set of soft and hard measures has been proposed to ensure that resilience at the individual, household, FFPO, community and institutional level is strengthened sustainably. The "soft" measures focus on increasing community FFPO and capacity and the capacity of officials and institutional systems at the sub-national level. All capacity building activities are designed to support, enhance and sustain the 'hard' investments that the project will make.

The hard investments made by the project will all be in small-scale protective and basic service infrastructure and ecosystems. These investments have been fully identified, costed and through a comprehensive environmental and social safeguard compliance analysis. They are presented in below in Section 6.4.

The specific needs of women and youth will be considered at all stages of the project. Extensive consultations have been conducted in formulating the project proposal, which are detailed in Annex 8 of the Proposal Package.

The components have been designed to translate important national policy targets into action on the ground. Rwanda's Green Growth and Climate Resilience Strategy (GGCRS) provides the country's roadmap for becoming a climate resilient, low carbon economy by 2050. GGCRS' strategic objectives include the achievement of sustainable land use and water resource management and reduced vulnerability to climate change. The strategy contains 14 Programmes of Action towards its achievement, including Sustainable Land Use Management and Planning and Sustainable forestry, agroforestry and biomass energy. The project will contribute towards realization of each of these targets at different levels (individual, household, community, FFPO and institutional) in an integrated fashion, through the three inter- linked components.

A gender transformative approach is a cross-cutting issue mainstreamed in the project design. The project identifies actions and procedures across all three components aimed at mainstreaming gender and ensuring that it provides women and men with an equal opportunity to build resilience, address their differentiated vulnerabilities and increase their capability to adapt to climate change impacts. Mechanisms to manage potential risks to the promotion of gender equality and the empowerment of women as well are also identified. The ability of women in the three targeted districts who are involved in agricultural activities to act as agents of change will be strengthened, within many sub activities, specific actions have been developed that target women exclusively (see GCF Funding Proposal Annex 8). Awareness raising on gender issues on its own will not deliver a gender transformative approach, and therefore a collection of communications approaches, activities, and tools will be used to positively influence behaviour.

Opportunities to increase women's participation in the project's activities and decision-making processes have been identified. These include: (i) inclusion of sex-disaggregated indicators and targets in the project results framework, to ensure participation of women in awareness-raising activities, capacity building, and any management committees; (ii) targeting of gender-differentiated vulnerabilities into project interventions so that groups most vulnerable to climate variability and change receive support; (iii) designing women capacity building and skills enhancement programmes.

To respond to the challenges and local context set out above, the project has been designed based on lessons learned from existing project experiences (see Section IV), as well as scientific evidence from peer-reviewed literature and the Intergovernmental Panel on Climate Change (IPCC).

The components of the project are as follows:

Component 1: Restored landscapes that support climate resilient agro-ecological systems and livelihoods in Eastern Province

Component 2: Climate resilient market development and supply chains incentivize public and private investments in forests, rangelands and agroforestry

Component 3: Strengthening of national and local institutional capacity and cross sectoral coordination to mainstream climate resilience in land management and planning

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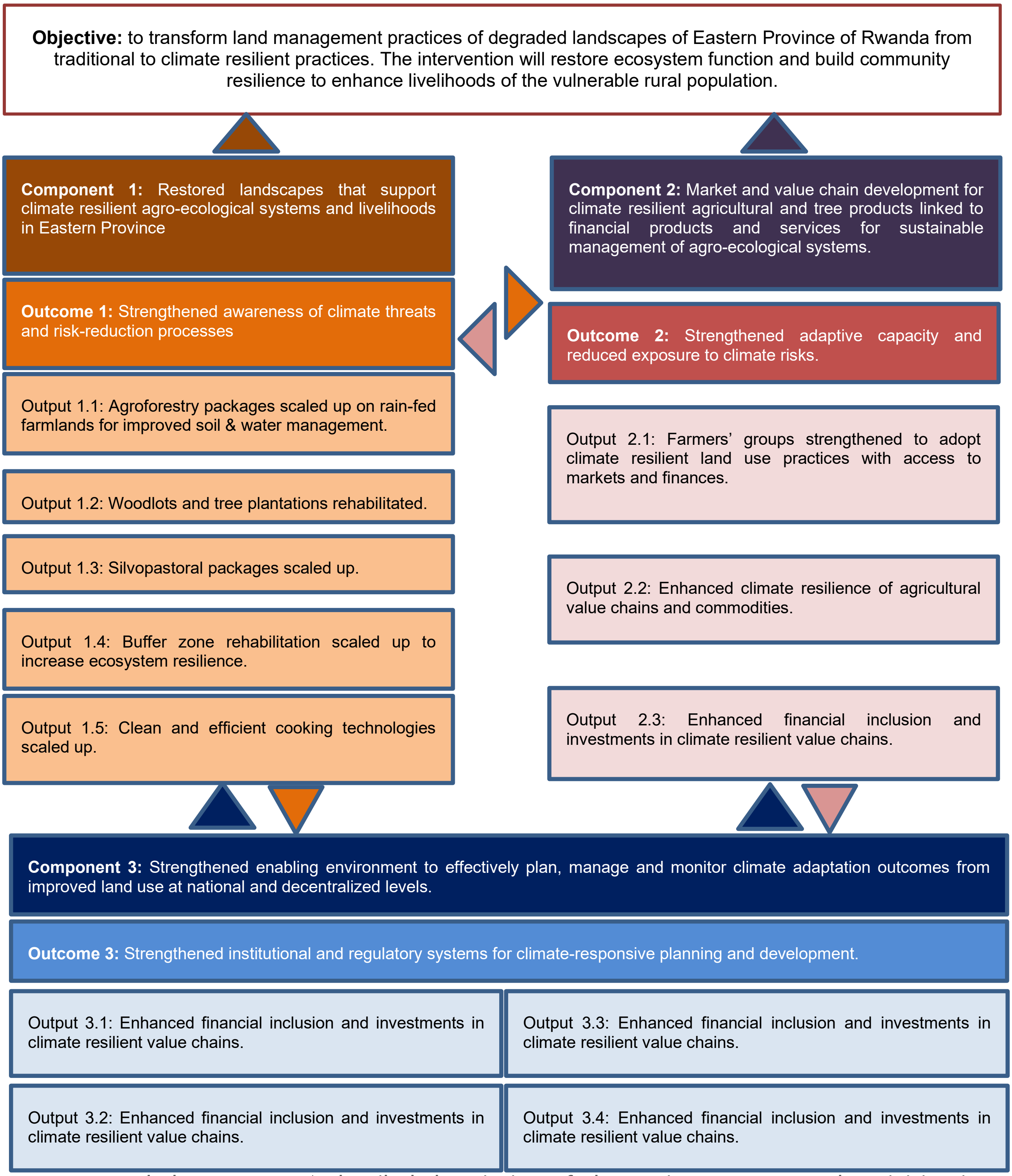


outcomes and the outputs. A detailed description of the project outputs and activities is provided in Section 7.

c. 6.3 Theory of change

In order to address the identified barriers to adaptation, the project is based on a robust Theory of Change (ToC) (

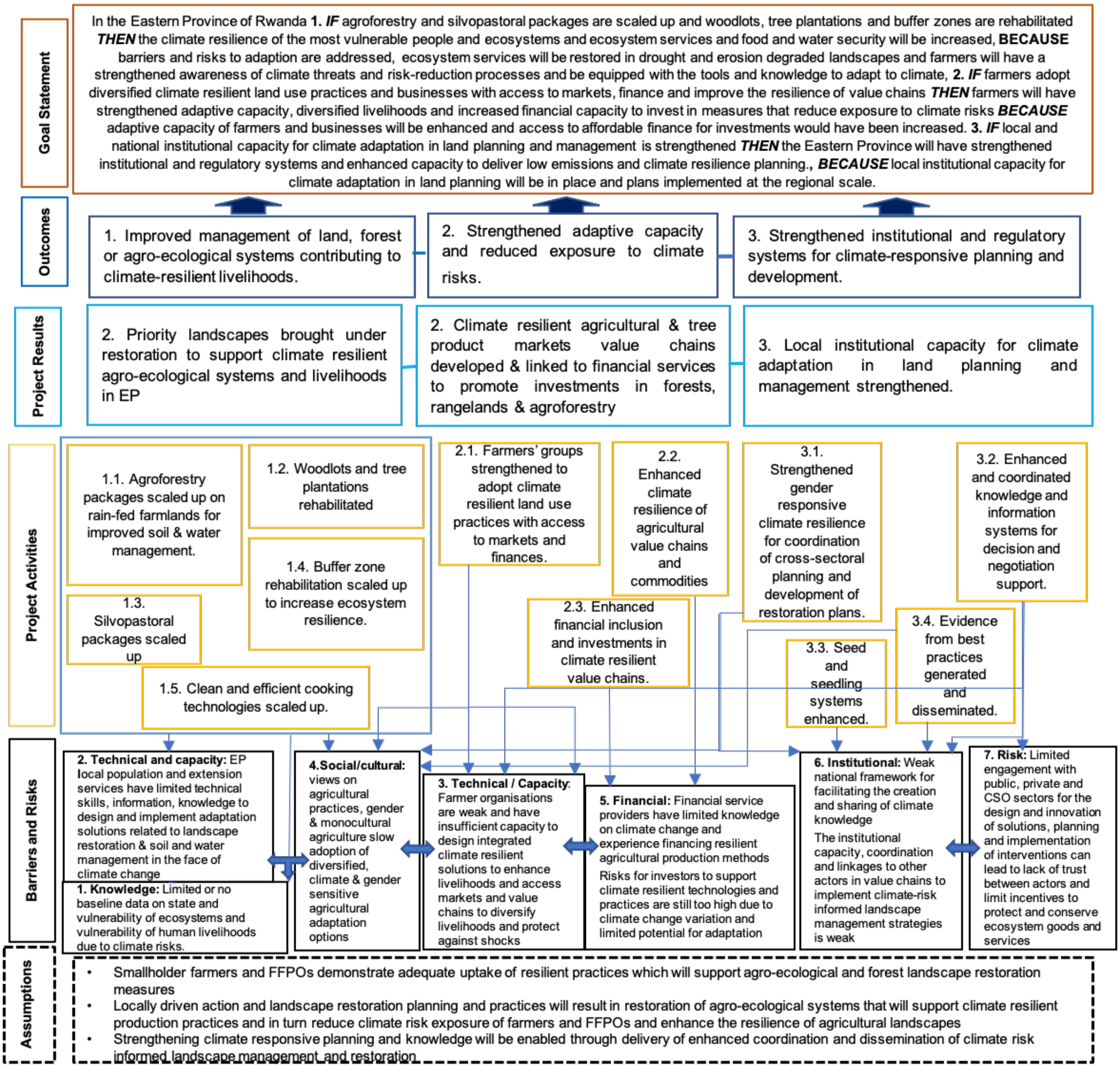


Figure 13. Theory of change for TREPA project.), which will lead to paradigm shift. The ToC shows how degraded and climate sensitive landscapes will be transformed by adaptive water and soil management practices and technologies to build resilience of agro-ecological systems and livelihoods. The project is designed with three integrated components (See Section B.3) to deliver a paradigm shift through cross-cutting outputs that bring adaptation results with mitigation co-benefits.

The outputs in Component 1 will contribute to Outcome 1 (Restored landscapes that support climate resilient agro-ecological systems and livelihoods in Eastern Province) by applying transformative and adaptive land management practices and technologies to build climate resilience in landscapes. The outputs in Component 2 improve the enabling environment for

Component 1 and also directly contribute to Outcome 2 (Agricultural markets and value chains are climate resilient and reinforce climate resilient ago-ecological systems) by building climate resilience of selected value chains and enhancing the conditions for access to equitable market by smallholder farmers.

A key feature in Component 2 is a new Climate Smart Lending/Guarantee Platform (CSLP). This will provide the funds to empower the communities and FFPO of Rwanda's Eastern Province to transform their drought-dominated, heavily degraded lands by means of new pay-for-performance incentives for farmer adoption of restoration and climate-resilient forest and agroforestry practices. Equally essential are the provision of adequate know-how and services through the strengthening of the tree seed/seedling infrastructure and the capacity delivery hub.

Similarly, the outputs in Component 3 strengthen the ability of national and local institutions to support farmers and the private sector, and thus contribute both to Components 1 and 2 and to Outcome 3 (National and local institutions are empowered to effectively mainstream climate adaptation in land planning and management). The knowledge generated and disseminated by the project will provide an enhanced evidence base to support further promotion and investment in interventions to build resilience in the landscapes as part of Rwanda's response to climate change.

The upscaling of the project results will be supported through the mainstreaming of the landscape restoration approach into various sectoral and cross-sectoral strategies and plans. Taken together, these three Outcomes contribute to the project-level impact of restored drought-degraded landscapes in Eastern Province of Rwanda and enhanced climate resilience of ecosystems and communities capacity to adapt to climate change and also to the GCF Fund-level impacts (**A01)** Increased resilience and enhanced livelihoods of the most vulnerable people, communities, and regions; and (**A04)** Improved resilience of ecosystems and ecosystem services. This will lead to a paradigm shift, which transforms assisted and unsustainable land management interventions to self-driven coordination in climate-informed planning and implementing agroforestry, forestry and water management practices to build climate resilience in landscapes and sustain improved agro-ecological systems and livelihoods.

As detailed below, the project will have an holistic approach to the agriculture sector in the Eastern Province through its 3 components. Activities undertaken will have increase the resilience of the whole agriculture sector, including irrigation sector, and will positively impact the value chains that have been assessed the most vulnerable in this feasibility study. The project has also been designed to complement the work and initiatives supported by the Government (through MINAGRI and multilateral support) in some specific value chains (tree crops, bee-keeping and fodder) which are complementary to the ones supported in the basline (section 5 of this feasibility study).

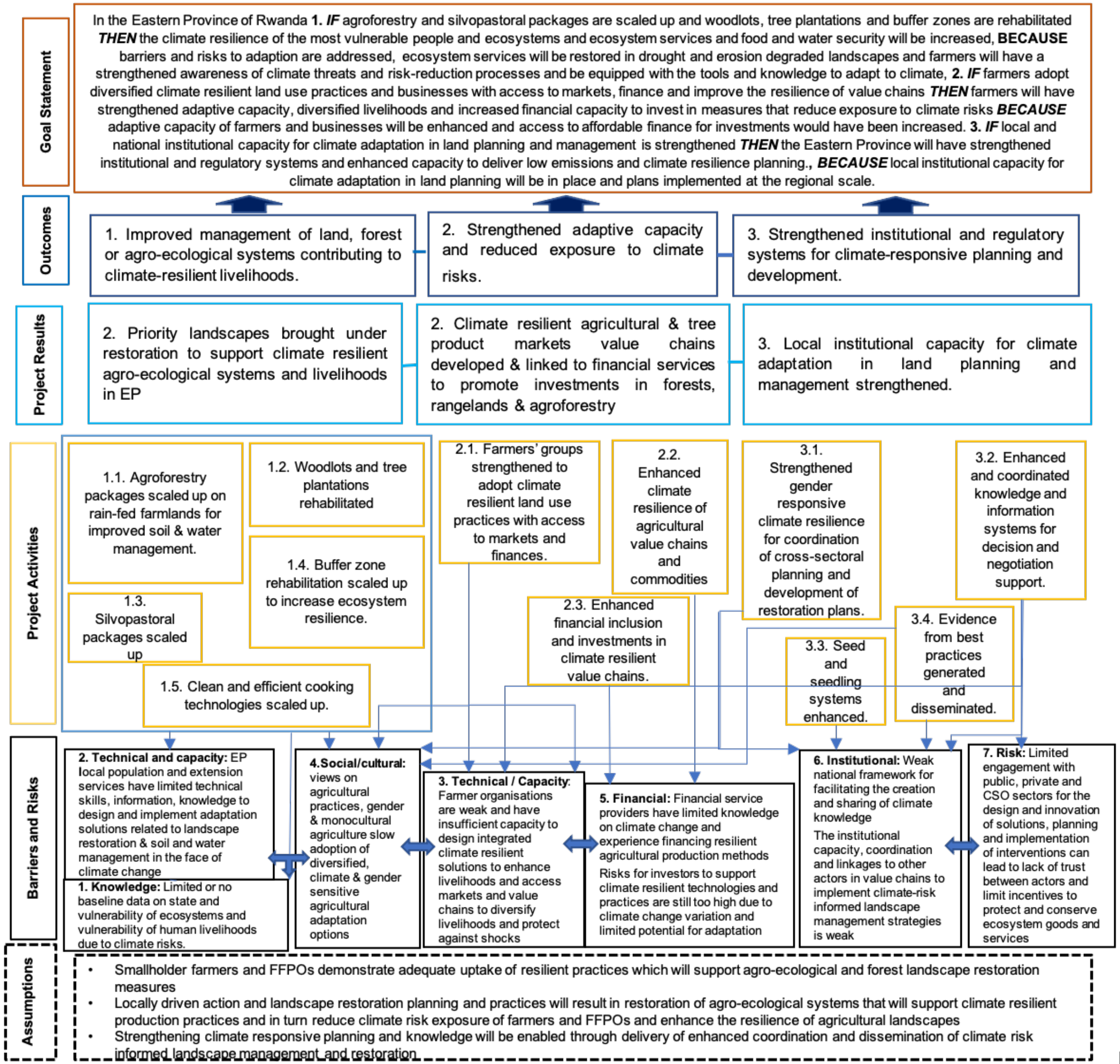


Figure 13. Theory of change for TREPA project.

d.6.4 Project beneficiaries

Although most of Rwanda's rural areas are relatively food self-sufficient, poorer households cannot meet all of their annual food needs from their own fields alone. One of the main limiting factors is access to land and the ability to cultivate it, the main difference between poorer and wealthier households. In addition to own-production, poorer households depend on their labor capacity and sales of small ruminants to purchase food from the market. In many areas, poorer households also sell their labor in exchange for food. To better understand the impact of livelihoods on vulnerability in the Eastern Province and especially as they relate to agriculture, Famine Early Warning System Network (FEWS NET) conducted a "Livelihood Zoning" (Figure 14). Highlights from the assessment indicate that:

- Bugesera Cassava Zone is the only food-deficit production zone in the country, but deficits occur only in poor production years. This zone is prone to drought.
- Eastern Semi-Arid, Eastern Agro-Pastoral, and parts of the East Congo-Nile Highlands Farming Zones are at risk of acute food insecurity during poor production years.
- The three eastern livelihood zones (Bugesera Cassava, Eastern Agro-Pastoral, and Eastern Semi-Arid Agro-Pastoral) are all prone to drought.
- Poor households living in the Eastern Agro-Pastoral, Eastern Semi-Arid Agro-Pastoral, and Eastern Plateau Agriculture Zones rely on purchases to acquire significant portions of their annual food needs.

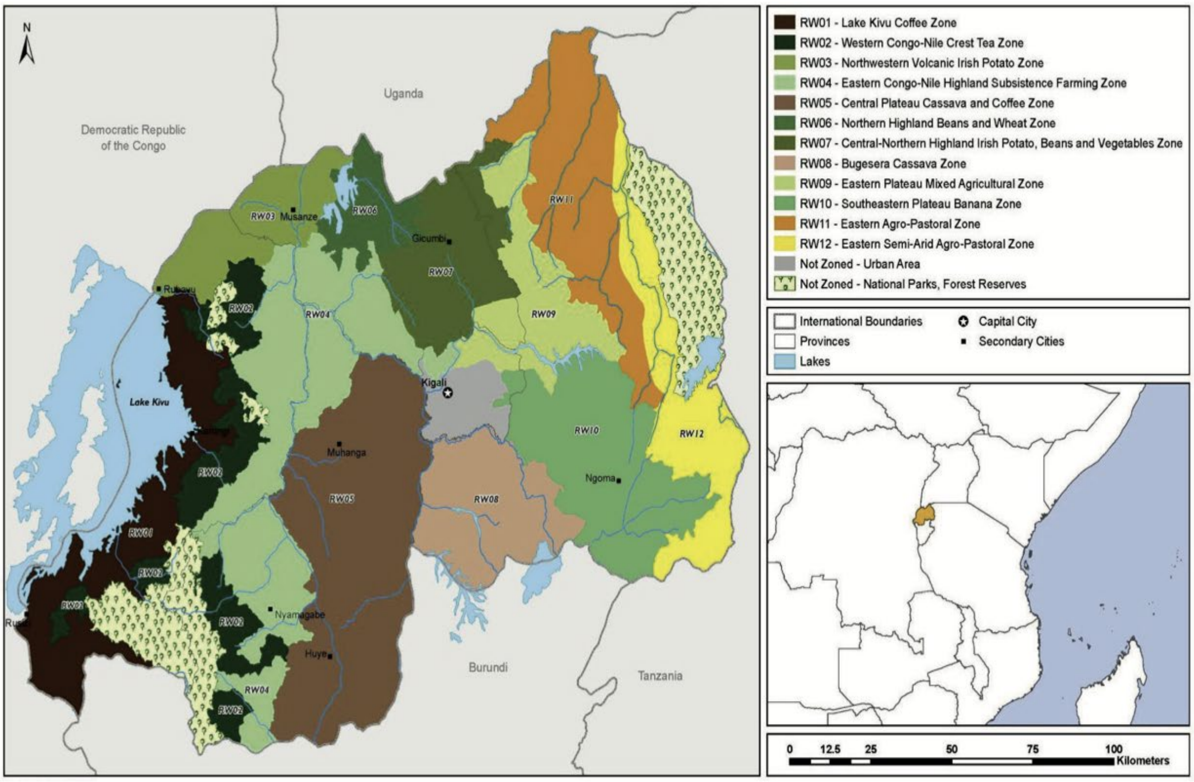


Figure 14. Map of livelihood zones in Rwanda.[114]

TREPA project will engage farmers from the livelihood zones:

- RW08 – Bugasera Cassava Zone
- RW09 - Eastern Plateu Mixed Agricultural Zone
- RW10 - Southeastern Plateu Banana Zone
- RW11 - Eastern Agropastoral Zone
- RW12 - Eastern Semi-arid Agropastoral Zone

The population in these zones have diverse socio-economic conditions and livelihood activities and strategies based on agricultural production and cattle rearing. For the purposes of the TREPA project, the beneficiaries are grouped under five groups coming from the livelihood zones adjacent to the Eastern Province (Table 17).

Project beneficiaries, understood as farmers with whom the project will work directly in prioritized areas will be selected according to the following criteria:

Farmers (maize, beans, rice, sorghum, fodder, bees): Beneficiaries in this group include smallholder farmers producing basic crops.

Factors/criteria for selection of beneficiary farmers:

- They live in poverty conditions and their production is below subsistence, which limits their access to financial resources for implementing climate change adaptation measures. Banana and Cassava are usually extensively grown by higher resource endowed farmers and hence less vulnerable people;
- Live in areas of high exposure to drought and water stress;
- Have limited alternative strategies to cope with agriculture loss due to frought;
- They practice Family Agriculture (FA)[115];
- They less than 1 ha of available land for farming activities (own or rented; they can prove it);
- Household with 4 or more members;
- Children under 7 with some degree of malnutrition;
- Availability and interest of all household members;
- Female headed households will be prioritized.

[114] FEWS NET, 2012. Rwanda Livelihood Zones and Description: https://fews.net/sites/default/files/documents/reports/RW_livelihood%20descriptions%202012%20final.pdf

[115] Limited Access to productive land and capital resources; Predominant use of family labor. The head of the household takes part directly in the productive process; in other words, although there may be some division of labor, the head of the household does not act exclusively as manager, but is one of the workers in the household; agricultural/forestry/fishing aqua cultural activity is the household's main source of income, and may be complemented by other non-agricultural activities performed inside or outside the family unit (services related to rural tourism, environmental benefits, production of crafts, salt agro industries, occasional jobs, etc.).

Most of the agroforestry systems promoted in TREPA will be on maize and beans (annual crops) land rather than in Banana and Cassava plantations (perennial crops) and this would link the value chains of maize and beans to the restoration activities in component 1 (e.g. agroforestry). The rice value chain is mentioned since irrigated fields in marshlands are for paddy rice. Our interventions will climate proof these irrigation schemes threatened by sediments coming from surrounding unprotected hillsides. Most of the time farmers on these hillsides (where agroforestry will be done) are the ones farming rice in the marshlands.

Forest landowners (for PFMU establishment):

- Small landowners in the project area who have land of less than 5 h each, which are degraded and/or expose to soil erosion and/or drought, and suitable for forest restoration activities;
- Female landholders and landowners will be prioritized.;
- Availability and interest of all household members.

Local contractors for management of District forests:

- Local forest grower (individual) or cooperative, with experience in woodlot management,
- Where females are well represented (>50%)
- Linked to more professionalized wood product value chains

Herders (goats and cattle):

- Owners of ranches suffering from vegetation/soil degradation expose to drought and erosion, where restoration and change of practices is highly required to better adapt to climate change

Table 17. Description of project beneficiary groups in the Eastern province in Rwanda.[116]

Beneficiary category	Livelihood zone	Description of beneficiaries
Group 1	RW08	The population in this zone experiences one out of every two years food insufficiency, resulting in deficit crop production. Households can typically recover from initial losses during the second harvest. However, households, especially poor ones, are at risk of food insecurity. Key livelihood activities are agricultural production, livestock rearing and on- and off-farm labour
Group 2	RW09	The population in this zone is food self-sufficient and is rarely in need of external food or cash assistance. High/ Moderate exposure & risk to dry spells. Key livelihood activities include local agricultural labour, agricultural production (banana, maize, beans, sweet potatoes) and small livestock rearing.
Group 3	RW10	The population in this zone is rarely at risk of acute food insecurity and has not needed food or cash assistance over the past ten years. However, it is exposed to crop and animal disease/pests, prolonged dry spell and windstorms. Key livelihood activities include Local

[116] FEWS NET, 2012. Rwanda Livelihood Zones and Description: https://fews.net/sites/default/files/documents/reports/RW_livelihood%20descriptions%202012%20final.pdf

		agricultural labour and production (bananas, beans, cassava), poultry and cattle rearing.
Group 4	RW11	The population in this zone experiences one out of five years, prolonged dry spells and/or windstorms, which result in food deficits. Key livelihood activities include local agricultural labour and crop production (Maize, bananas, and beans) and cattle rearing. Cattle and goats, and poultry are the main types of livestock.
Group 5	RW12	The population in this zone is reliant on agriculture and livestock. The zone is historically prone to drought. Although agriculture is the main activity of the zone, pastoral and agropastoral groups are present and most households own some livestock: cattle and goats.

Direct beneficiaries:

In Eastern Province, the project will benefit a total of 556,525 direct beneficiaries of which just over 50% of beneficiaries are female (18.2 % of the total Eastern Province population of 3,051,454). Direct beneficiaries represent 4.4% of the total population of Rwanda. Detailed estimations of direct beneficiaries are presented in Table 18 and Table 19 with further elaboration on the methodology for the calculation.

The interventions under outputs 1.1, 1.2, 1.3 and 1.4 aim to increase resilience of the beneficiary population through agroforestry systems, tree plantations, silvopastoral systems and protection and increased climate-resilience of fragile, ecologically sensitive and erosion prone lands. These interventions will directly benefit an estimated 556,525 beneficiaries.

The interventions under output 2.1, 2.2 and 2.3 aim to support targeted households to quickly transition from subsistence farming to surplus production, including the capacity to interact with financial and output markets. Activities under these outputs will target roughly 60% of the total beneficiary population in the seven districts, of which just over 50% are estimated to be women/girls. These interventions will enable 260,000 farmers to access finance to increase productive assets and protect their assets from potential rainfall deficits, soil loss and erosion and that would affect crop harvest and food security. For interventions under output 2.2, a total of 110,479 farmers will benefit from improved access to market opportunities, including through farmer associations and cooperatives, throughout the duration of the project. All targeted farmers across the seven districts will benefit from improved access to financial services, including saving, credit, and financial literacy, to enhance investments in climate-resilience agriculture through interventions under category E.

Output 1.5 will target and support around farmer 100,000 house holds (HHs) and 15,000 woodlot owners. There is an opportunity to work strategically with targeted rural actors concurrently on (1) forest landscape restoration to increase the supply of (woody) biomass and (2) reduce cooking biomass consumption. The reduction of biomass consumption with ICS can be immediate while impact on supply side from restoration will take more time, but this biomass consumption reduction is essential to avoid overexploitation of biomass resources and ensure the success and sustainability of restoration and progressive increase of supply of wood.

HHs of farmer groups /wood producer's cooperatives targeted in output 1.1 to 1.4 (115,000 HHs – 15% of rural area of the EP) will be the priority HHs to be targeted by output 1.5 on reduction of wood consumption through ICS dissemination. Before supplying more wood biomass on their parcel, these HHs which use traditional 3-stones or low efficient stoves will first reduce their consumption by using highly efficient ICS. The linkage is essential to ensure technical feasibility/sustainability but also to increase consistently the incomes and benefit at HH level.

Table 18. Number of beneficiaries per category of interventions[117]

Intervention type	No. of households	Total # of direct beneficiaries	Beneficiary breakdown by gender (50% female)	
			Female	Male
Access to agroforestry systems techniques to sustain agricultural production (Output 1.1)		440, 263	220,131	220,131
Access to restored tree plantations (Output 1.2)		48,145	24,072	24,072
Access to sylvopastoral systems techniques for resilient rangelands (Output 1.3)		5,425	2,712	2,712
Increased climate-resilience of fragile, ecologically sensitive and erosion prone lands (Output 1.4)		120,535	60,268	60,268
Access to improved cooking fuel and techniques (Output 1.5)	100,800	444,325	222,162	222,162
Access to market opportunities through farmer associations and cooperatives (Output 2.1)	14,747	67,840	40,704	27,136
Access to market opportunities through improved value chains (Output 2.2)	9,690	42,639	21,320	21,320
Access to financial services to enhance investment in climate-resilience agriculture (including saving, credit, and financial literacy) (Output 2.3)	95,000	261,594	155,797	105,797
Access to improved seeds and seedlings to enhance the resilience of agricultural systems (Output 3.3)		63,237	31,619	31,618

Table 19. Detailed estimation and description of methodology to calculate beneficiaries per project activity

[117] **Beneficiary assumptions to avoid double counting demarcate unique beneficiaries to each component to avoid overlap. Calculations have been made based on the following assumptions:** It is assumed that the direct beneficiaries of the project include all beneficiaries from output 1.1 (440,263 unique beneficiaries) plus 80% of output 1.2 (38,516 unique beneficiaries, assuming an overlap of around 20% between these outputs), plus 100% the beneficiaries of output 1.3 (5,425 unique beneficiaries, assuming there is no overlap between ranching and agroforestry/plantation land owners), plus 60 % of beneficiaries from output 1.4 (72,321 unique beneficiaries assuming around 40% overlapping with output 1.1). All other outputs overlap with 1.1, 1.2, 1.3 and 1.4 beneficiary population.

Activity	Total Number of beneficiaries (of which 50% female)	Comments / Methodology for estimation
Output 1.1 Diversified agroforestry packages scaled-up		
Activities 1.1.1, 1.1.2, 1.1.4, 1.1.5: disseminate agroforestry techniques	440, 263	440,000 Farmers (40,000 ha /0.4 ha per HH X 4.4 pers per HHs) 100 FFS facilitators/ promoters 140 Sector agronomists /forest extensionists 23 officers (7 District Forest Officers + 7 District Agronomists + 9 RFA officers)
Activity 1.1.3: Tree nursery	2,263	2,000 farmers 263 administration staff (see detail above)
Output 1.2. Woodlots and tree plantations are rehabilitated and sustainably managed for productive and ecological services		
Activity 1.2.1: Restoration of 700 ha of degraded District owned tree plantations	1,033	308 local small contractors (700 ha / 10 ha per local small contractor x 4.4 pers per HHs) 700 people contractor's family (may be around 50%) but also can be recruited locally in neighbouring HHs. (700 ha X 1 pers local casual labour per ha) 25 officers (7 DFO + 7 District Proc Officer + 7 District Economic Affair officers + 4 RFA officer)
Activity 1.2.2: Restoration and concession of State tree plantations	550	550 permanent staff of 20 contracting company (10,000 ha x 11 pers-day, per-ha, per-year / 200 pers-day/year) +direct human-power = 10,000 ha x 1 pers local casual labour per ha = 10.000 pers (at least 50% female) ++ 10 RFA officers + 7 DFOs
Activity 1.2.2: Restoration of small holder private tree plantations	46,562	43,197 tree plantations smallholders (6,545 ha x 1.5 HHs/ha X 4.4) 3,272 persons for direct human-power from cooperatives HH (may be around 50% in average) but also will be partly be recruited locally in neighbouring HHs 70 forest extensionists 23 officers (7 District Forest Officers + 7 District officer in charge of cooperative+ 9 RFA officers)
Output 1.3 Scale-up climate resilient silvopastoral packages to restore degraded rangelands		
Activity 1.3.1. Characterize the climate resilience features of the existing pasture lands, identify priority areas and design silvopastoral plans	5,425	4,400 farmers (10,000 ha x 0.1 HHs per ha x 4.4 = 4,400 persons) 1000 people for direct human-power (10000 ha x 0.1 pers local casual labour per ha = 1000 pers) 9 forest extensionists 16 officers (3 District Forest Officers + 3 District Agronomy Officer + 3 District officer in charge of cooperative+ 5 RFA officers + 2 RAB officers)
Activity 1.3.2. Select and produce fodder trees, shrubs, grasses, and herbaceous legumes with high drought resilience potential to		

increase the climate adaptive capacity of the pasture lands		
Activity 1.3.3 Disseminate and support establishment of agroforestry fodder trees, improved grasses and herbaceous legumes to improve grazing land and build resilience of degraded lands		
Activity 1.3.6. Conduct twice per year capacity building workshops for 30 key actors for water management in pastoral land, in 5 districts		
Output 1.4 Protective restoration measures are scaled up to climate-proof fragile, ecologically sensitive and erosion prone lands		
Activity 1.4.1: Protect lake/river shore and road side	118,169	112,000 people (1400 km x 20 HHs/km x 4 pers/HHs = 112.000 persons) 700 people for direct human power (700 ha x 1 pers local casual labour per ha) 21 forest extensionists 23 officers (7 District Forest Officers + 7 District officer in charge of cooperative+ 9 RFA officers)
Activity 1.4.2: Restore and protect 400 ha of Akagera Buffer zone	2,316	1,600 people from Group 5 (Akagera Buffer Zone - 400 ha x 1HHs/ha x 4 pers/hhs) 700 people for direct human power (700 ha x 1 pers local casual labour per ha) 6 forest extensionists 10 officers (3 District Forest Officers + 3 District officer in charge of cooperative+ 4 RFA officers)
Activity 1.4.3: Support local nurseries in production of selected non-conventional multipurpose trees/shrub seedlings for lake/river shore and Akagera buffer zone.	50	50 people (5 nurseries x 10 persons) (already accounted under Activity 1.1.3)
Output 1.5 Clean and efficient cooking energy technologies promoted through support to private sector and communities to transition/reduce biomass fuel consumption		
Activities 1.5.1 to 1.5.5: ICS dissemination	444,325	443,520 people 4 permanent staff ICS production (100,800 ICS x 0.027 pers-day per ICS / 800 day per pers for 4 year production) 30 hubs employees 700 forest extensionists 25 officers (7 District Forest Officers + 7 District officer in charge of Economic Affair + 9 RFA officers + 2 MININFRA officer) 46 persons (direct human-power = 100,800 ICS x 0.36 pers-day local casual labour per ICS / 800 days production = 46)

Output 2.1 Farmers' groups strengthened to adopt climate resilient land use practices with access to market and finances		
Activity 2.1.1: Integrate targeted famers into existing FFPOs or where appropriate form new ones	67,987	67,840 cooperative members (424 per coops) 7 project facilitators + 1 accountant + 1 project manager and driver 35 data collectors 102 district officers (7 district cooperative officers + 95 sector cooperative officers)
Activity 2.1.2: Conduct capacity assessment on organizational and financial management of existing FFPOs and develop a comprehensive strengthening plan	6,829	6,784 members of cooperatives 7 project facilitators + 1 accountant + 1project manager and 1 driver 35 data collectors
Activity 2.1.3: Capacity enhancement programme for farmer groups and cooperatives (FFPOs)	68,018	10 project staff, + 21 district officials, 67,987 FFPOs/cooperatives members will be involved (7 districts * 9,713 FFPOs/cooperative members)
Activity 2.1.4. Support smallholder farmers` organizations (Cooperative and Producer Groups) to conduct advocacy around climate change related policies and market reforms to regularize prices and subsidies	17,881	15,750 cooperative representatives 2,100 Citizen Voice Action champions who will facilitate community gatherings at sector level 10 project staff, + 21 district officials
Output 2.2 Enhanced climate resilience of agricultural value chains and commodities		
Activity 2.2.1. Tree crop value chain development	33,198	**Seed enterprises** Direct benefits: 3 enterprises * 15 operators (at least 10 women and at least 5 youth per enterprise) * 4.4 HH members Enterprises will principally be run by women and youth; Average HH size is 4.4. **Nursery -** Same as in 1.1.3 **Contractual farms** Direct benefits: 2,500 ha managed by 3,750 HH with 4.4 members each; Further direct benefits: 3,750 HH * 1 external labourer * 4.4 HH members. On average, each household manages 0.67 ha and hires one external labourer to work on the farm; average HH size is 4.4. External labourers are assumed to belong to different households.
Activity 2.2.2 Bee Product value chain development	8,660	Direct benefits: 20 cooperatives * 80 member households * 4.4 HH members; Labour for operations of bee forage farms: 30 people * 10 ha * 4.4 HH members On average, each cooperative has 80 member households and annual labour demand is 30 persons per ha; average HH

		size is 4.4. External labourers are assumed to belong to different households.
Activity 2.2.3 Fodder value chain development	581	Operating milk storing and cooling stations: 2 stations per district * 3 districts * 12 staff * 4.4 HH members On average, each enterprise will operate with 20 staff; average HH size is 4.4. Operating milk storing and cooling stations: 2 stations per district * 3 districts * 12 staff * 4.4 HH members On average, each station will operate with 12 staff; average HH size is 4.4.
Activity 2.2.4 Building local capacity for climate resilience in value chains	200	Training participants. Assuming that some trainees (about a third of them) will receive training repetitively.
Activity 2.2.5 Establish/rehabilitate seven Rural Resource centers and market infrastructures for climate resilient value chains	3,555	3,200 cooperative representatives 324 market actors 10 project staff, + 21 district officials
Activity 2.2.6 Organize trade show to promote competition among value climate resilient commodities participants	68,373	67,840 cooperative members 70 Trainer of Trainees 440 Community volunteers 23 officers (7 District Forest Officers + 7 District Cooperative Officers + 9 RFA officers)
Activity 2.2.7. ICT supported climate risk, market information and knowledge products for value chains		
Output 2.3 ***Enhanced financial inclusion and access for climate resilient investments***		
Activity 2.3.1 to 2.3.5	261,594	Overall total 260,000 direct and indirect: 60,000 credit clients (35,000w, 25,000m) 150,000 savings clients (90,000w, 60,000m) 50,000 financial literacy training (30,000w, 20,000m) 90 staff of financial institutions 4 ICCO staff 1,500 small entrepreneurs
Output 3.1 Mainstreamed gender-responsive climate resilience for coordinated cross-sectoral planning & community landscape restoration plans developed		
Activity 3.1.3 Deliver 5 training sessions at central and district level, to enhance capacities for funding mobilization, planning, and delivery of climate adaptation actions	350	Deliver in collaboration with other partners 10 training sessions for 35 people.
Activity 3.1.5 Identify and train cross-sectoral teams of technicians to become landscape restoration planners and managers in collaboration with communities	50	Undertake training of selected teams of technicians (50 people) on integrated landscape restoration

Activity 3.1.7 Train 28 staff in the district authorities and provide technical assistance	28	Organize and facilitate training of 28 district staff (4 per district) in operating acquired technical tools and systems
Output 3.2 Enhanced and coordinated knowledge and information systems for decision support		
Activity 3.2.2 Organize 4 trainings for 18 staff from districts agencies,	21	Organize and facilitate training of 21 staffs (3 per district) operating the knowledge and information systems in Eastern Province
Output 3.3 Seed and seedling supply systems enhanced to provide diverse climate adapted species and varieties		
Activity 3.3.1 Climate proof seed sector policy and business Activity 3.3.2: Climate proof seed sector knowhow Activity 3.3.3 Breeding for climate change Activity 3.3.4: Capacity for delivery of climate proof material:	63,027	6,400 farmers accounted in (Activity 1.3 & 1.1.3) 43,197 smallholder plantation owners (Activity 1.2.2) 200 private seed and vegetative propagule dealers 300 fruit tree grafters 10 National Tree Centre Seed Specialist 10 RAB horticulturalists 12,000: 200 tree nursery cooperatives with membership each of 60 persons indirectly benefiting (200*60) 150: 5 Rural Resource Centres membership of 30 (30*5) 50 Government officials: District Sector Working Groups 10 members by 5 districts 10 National sector working groups 5 Ministries 200 Forest and agroforestry extensionist 500 people for direct man power (5 BSOs, 5 RRCs, & Central Nurseries)
Output 3.4: Evidence from best practices generated through applied research and co-learning		
Activity 3.4.1 Produce research publications on the role of agroforestry systems for building climate resilience in semi-arid landscapes	200	200 farmer trials (around 200 households) are established and monitored across the project area at the end of Year 5.
Activity 3.4.2 Produce 2 publications on the role of agroforestry systems for food security and building socio-economic resilience of local communities.	500	At least 500 more households produce, consume and sell nutritious fruit trees by end of Year 5
Activity 3.4.3 Locally test user-friendly improved cooking stoves (ICS) and produce 4 knowledge materials to train 6 local producers and 12 national/district staff and inform best practices	100	100 ICS producers trained in the project area by end of Year 5.
Activity 3.4.4 Produce 4 knowledge and research materials on the socio-economic barriers to adoption of climate resilient practices for land restoration and	800	800 Farmer trials on agroforestry options for increased crop-tree-livestock productivity established by end of Year 3.

identified opportunities for economic incentives		
Activity 3.4.5 Conduct capacity building sessions for x and develop x (number) knowledge sharing tools to foster scaling-up of agroforestry systems for climate resilient landscapes and promote sustainable use of biomass energy	800	Training and dissemination materials in fruit trees promising technologies developed and disseminated to 800 stakeholders by year 5. 200 Agroforestry FFS groups are established by Year 3. 50 National staff trained in ICS testing and ICS design by end of Year 5.

Indirect beneficiaries:

Roughly 40% of the total population of the Eastern Province (population of EP is 3,051,454) will benefit indirectly. Discounting the direct beneficiaries of 556,525 represents 664,057 total indirect beneficiaries in the Eastern Province. Nationally 20% of the total population (excluding the direct and indirect beneficiaries from Eastern Province) may benefit indirectly[118], being approximately 1,333,284 people. The total number of indirect beneficiaries is 1,997,341 or 15.8% of the total population of Rwanda.

Impact potential:

Social co-benefits

Social benefits will be delivered throughout the project activities and include:

- Awareness will be raised about climate change effects and adaptation in 556,525 people living in the Eastern Province;
- Deliver capacity building to approximately 150,000 people, with at least 50% representation of women, in a wide range of topics aimed at increasing ecosystem and social resilience;
- Create significant social capital through co-designing and co-managing a range of adaptation strategies. The project will indirectly promote social cohesiveness among villages in the target areas;
- Additionally, the project will result in health and nutritional improvement for 126,483 families (556,525 people);[119]

[118] Benefits mainly accruing to nationwide nature of a number of the activities such as national seed/seedling banks.

[119] Assumption is that all direct beneficiaries 556,525/4.4 (average number per household) will benefit from health and nutrition improvement

- Increase in crop diversity will reduce exposure of 100,059 families (440,263 people) to the risks of climate change-related crop failure.[120]

- Farmers will benefit from increased social cohesion created through working into association/cooperative establishing joint saving and landing system

The project has been designed to deliver on the adaptation goals set out in Rwanda's NDC and to contribute to two of the GCF's adaptation results areas:

- GCF adaptation results area 1 (A1) – Increased resilience of vulnerable people, communities and regions: The project will develop actions in strategic agroecosystems that will not only support the restoration of ecosystem services for regulation of the hydrological cycle but will also generate income and improve the livelihoods of prioritized communities. In support of these actions, FFPOs, considering gender mainstreaming, will be organised and strengthened to increase their capacity to access extension services, finance and markets. The project will ensure that government extension service providers have the knowledge and tools to deal with the effects of climate change. A microfinance lending mechanism will be developed (Outcome 2), which will allow farmers to have funds to develop forestry, agricultural, agroforestry and conservation activities through which ecosystems and livelihoods resilience will be promoted. These interventions will increase the resilience of 75,000 smallholder farmer families (556,525 people) in the Eastern Province against drought and floods.[121] Of this total, an estimated 200,000 people are adult women, who tend to be more vulnerable than men.

- GCF adaptation results area 2 (A2) - Health and well-being, and food and water security: The project will improve food and water security by supporting climate resilient agricultural and livestock practices that are less susceptible to extreme weather events. Furthermore, agroforestry, forest management, silvopastoral and other interventions will contribute to improved water security by decreasing runoff and enhancing infiltration during rainy periods, and conserving groundwater and soil moisture during dry periods.

- GCF adaptation results area 4 (A4) – Increased resilience of ecosystem and ecosystem services: The project will have a positive impact to improving ecosystems and restoring/sustaining their services, particularly the soil conservation and the regulation of hydrological cycle by promoting landscape restoration activities (agroforestry, silvopastoral activities, woodlot restoration). The project will contribute altogether to the restoration of 51,250 ha. Such restoration actions from the project will reduce erosion, decrease loss of soil organic matter, and thus increased water infiltration rate, which increases water recharge.

[120] Assumption that this is everyone from the agroforestry interventions under output 1.1. with the same assumption that has been applied to the 75k farmer families benefitting total from the project. This number has come from IUCN. This means that 7.42 people per family is very conservative estimation. However the average household number per family in Rwanda is 4.5.

[121]

8. Section 7: Technical description of project interventions

Section 7 provides a technical analysis of the interventions under each component at the output, activity and sub-activity level. The projects theory of change will present how the activities undertaken address the barriers and contribute to a chain of results that lead to the projects intended outcomes given a number of underlying assumptions

a. Component 1: Restored landscapes that support climate resilient agroecological systems and livelihoods in Eastern Province

Component 1 aims at strengthening the capacity of the national and local institutions and enable them to effectively mainstream climate adaptation in land planning and management to ensure climate resilient landscape governance. The table below summarises the outcome and outputs comprising Component 1.

Outcome/Outputs	Description
Outcome 1	Livelihoods and agroecological systems supported through restored and climate resilient landscapes
Outputs	**1.1** Diversified agroforestry packages scaled up
	1.2 Woodlots & tree plantations rehabilitated
	1.3 Silvopastoral packages scaled up
	1.4 Erosion buffer zone protection scaled up
	1.5 Clean & efficient cooking technologies scaled up

Output 1 aims to strengthen and restore climate resilient landscapes which support livelihoods and agro-ecological systems. Restoration packages will be elaborated in management/restoration plans developed as part of component 3. Component 1 will be supported by climate resilient market development and supply chains under component 2. Combined the three components will improve restore/improve the environment, reducing vulnerability to climate change while increasing and sustainably managing ecosystems, forest resources and water resources to optimize their economic as well as ecological function. Landscape restoration strategies and investments deployed under component 1 interventions include: diversified agroforestry; woodlots & tree plantations; silvopastoralism; erosion buffer zone protection, and clean & efficient cooking technologies.

A list with suitable species for these interventions as well as their beneficiary preferences is included in Annex 1 for reference. Gender preferences for each of the species has been assessed and also included. During project implementation monitoring and evaluation of each activity will be combined with outcomes for climate resilience, livelihoods and community preference in order to fine tune the most appropriate species mix and management practices for each location and intervention.

It is important to note that, the ha restored remain the key indicators of the proposed restoration actions (under output 1.1 to1.4), however, metrics such as soil moisture content, nutrient content etc. will be measured during implementation. Output 3.3 (see indicators under this output) give special attention to the diversification and quality improvement of the tree species which have to be better adapted to climate change while ensuring increased yield to ensure the provision of diversified and improved tree seeds and seedling for restoration under output 1.1 to 1.4. The current BAU practice is Eucalyptus spp and Pinus spp dominating tree plantations, while Grevillea dominate the agroforestry landscape. In silvopastoral area (ranch), native species such as Acacia spp, are still dominating. The opportunity of improving the tree species diversification depend on the type of land use and the landowner who will choose the species among a proposed panel of those best climate adapted. In private woodlots where owners are first looking to improve yield, even if some species will remain dominant, the diversification of genetic origin adapted to climate change and good yield will be the focus. In public forests, the authority will have more flexibility to integrate more diversified species but will also focus on characteristics that improve climate adaptation. In large agroforestry targeted area, the diversification of climate adapted multi-purpose species will be the key focus. In silvopastoral lands, natural regeneration will be promoted and re-planting of native species such as azote and fodder species will be the focus. Setting an indicator on the diversification of different species will be difficult. The first objective is to have land restored and secondly, species need to be climate adapted, preferably with increased yield (these conditions being preferable to farmers and the success of adaptation).

Regarding the species selection and the risk on water competition from the use of Eucalyptus, it has to be noted that over the output 1.1 to 1.4 and 3.1, field assessment will be conducted in participatory approach with farmers to support them in the identification and choice of the best adapted production system and related species (considering soil/water/climate change context and farmer preference/priority needs), while output 3.3 will support National Tree Seed Center and nurseries in providing good genetic quality seedlings for these best adapted species (see proposed list in FS).

The overall approach is the landscape restoration, where different sustainable management systems will co-exist depending on their location and context in the landscape. The objective is to increase the resilience of ecosystems and dependent communities to climate change, while contribution to GHG impact mitigation by targeting:

· 40.000 ha of agroforestry and 11.800 ha of silvopastoral/protective lands where a mixed of native and exotic tree species (excluding Eucalyptus) will be used;

· 10.700 ha of public forest where a mixed of fast growing species (Pinus, Eucalyptu, Callitris, Acacia, etc..) will be selected according the soil conditions

· Only 6545 ha (0,7 % of the EP land area) small-holder woodlot, where the existing very degraded Eucalyptus plantation will be replaced by a new productive one. For these woodlots, farmers want Eucalyptus due to its fast growing and coppicing capacity, allowing them to have regular incomes. Compare to the BAU degraded plantation, this will increase significantly the sustainable supply capacity of wood, the carbon sequestration, the restoration of forest ecosystem services, while reducing the pressure on neighbouring biomass resources subject to depletion (tree in crops, crop residues, shrubland areas)

The use of Eucalyptus species will be restricted only to restore existing very degraded Eucalyptus plantation (1.2.3), without extension of their current area. However, with the establishment of farming contracts with sawmill/wood pellet factory companies, the champions woodlot growers could be motivated to shift to other high value commercial value lowering the risk on water competition.

Even if the Eucalyptus spp have the reputation of using a lot of water, it has to be acknowledge that these species are using much more less water than other tree and crops species per tons of dry matter biomass produced ("Eucalyptus in Rwanda", Nduwamungu J. and all 2007, and "Eucalyptuses in Rwanda – cure or curse?, Anders Pedersen, 2018, "Water use by short rotation Eucalyptus woodlots in southern Rwanda",,, Canisius PM, 2015), meaning they are more efficient in term of water and nutrient usage.

Also, most of the tree plantations are located on the upstream areas of water catchment on sloppy marginal lands not adapted for crops, and are not located in downstream areas which are kept for agriculture. In consequence, risk of competing with crops for groundwater resources is very limited.

Anyway, to mitigate any minor risk on water use, the project will ensure the selection of species/origin which are adapted to drought condition and are using less water, while applying silviculture techniques (longer coppice period, avoid removal of leaves and small branches to secure the increase of soil organic matter, avoid big clear cutting during dry season, etc) allowing the restoration/improvement of forest ecosystem services (soil erosion and fertility control, water regulation).

Eucalyptus spp have been planted by farmers themselves from the years 1960, progressively selecting the species/origin not bringing water and nutrient conflict. If these Eucalyptus were presenting a serious risk on water competition, farmers themselves should have claimed it and be reluctant to this species, while it is not the case.

Output 1.1 Diversified agroforestry packages scaled-up

The table below summarises Output 1.1 which will implement and scale-up diversified agricultural packages.

Key aspects	Description
Overview	The objective is to restore the drought-degraded *Eastern Province* with highly productive and climate resilient farmlands and ecosystems that will enhance climate resiliency of beneficiary farming communities and FFPO. This will be achieved by promoting the best forestry and agroforestry practices in 100 identified areas of 400 hectares each. Approximately 98,000 hectares of landscape will be restored to climate-resilient, productive landscape. Building on the existing Twigire Muhinzi system[122] for effective and prompt dissemination of agroforestry knowledge and best practices on plant species that are identified from experimental climate-resilient plots; by improving access to finance for the farmers; improving or developing, when absent, value chains system for agroforestry products; and establishing a network of farmers for knowledge sharing and opportunities for trainings.
Adaptation benefits	1. Enhanced livelihoods of the climate vulnerable FFPO, farming communities and their families in *Eastern Province.* 2. Increased climate-resiliency of the farmlands to climate impacts through

[122] *Twigire muhinzi consist of extension system established and supported by RAB across the country, where champion farmer promoters (1 per villages) is train and supported to (1) implement innovative good agriculture practices in its parcels serving as demonstration plots and to (2) train/advice/guide neighbouring farmers in implementation of these goods practices*

	agroforestry techniques (Wise and Cacho 2002). 3. Climate resilient ecosystems built including forests that will reduce topsoil erosion, improve water quality; protect source water; and ensure uninterrupted water supply for household needs, drinking and irrigation (Wilson and Lovell, 2016. Garrity *et al.*, 2010). 4. Reduced stormwater runoff resulting in flood risk mitigation (e.g. Matthews et al. 2004; Ranieri *et al.* 2004).
Barriers addressed	1. Lack of investment funding to restore or stop farmland degradation is a major barrier to build a climate resilient Eastern Province. 2. Poor soil water retention capacity with negative impact on ground water level and soil microclimate. 3. Lack of climate-resilient ecosystem services, loss of wildlife habitat and plant species that farming communities' livelihood depend on. 4. High flood risk due to loss of forest cover, shrub cover and wetlands. 5. Absence of strong farming community network (even in FFPO) for sharing best practices, lesson learned, knowledge and technology.

Description of the intervention

Output 1.1 will implement six (6) major project activities including an activity for monitoring and evaluating the results and progress of these six (6) activities[123]. The major project activities

[123] The projects knowledge management activities fall under projects model for scale up and replication called "TREPA-Rep". The model, provides a framework for constant monitoring and evaluation, adaptive learning and management and knowledge collection, creation and peer to peer learning. Following project closure Rwanda Forestry and Water Authority will maintain the TREPA-Rep model to ensure continued sustainability, replication and scaling up of the projects interventions

include mapping of 100 strategic areas with approximately 400 hectares in size each for scaling-up agroforestry. The detailed mapping will take into consideration factors such as climate risks, vulnerable communities and FFPO in the area, and degraded land among many other factors. Agroforestry provides a potential restoration solution to degraded land in Rwanda, and more importantly the *Eastern Province,* which is highly exposed to climate-induced drought.

Implementing an agroforestry system can accelerate the enrichment and recovery process of degraded areas or those more exposed to climate elements, conserving environmental services an allowing farmers to earn additional income from increased productivity of their cultivated land and the incorporation of fruit and/or timber species (Martínez-Rodríguez, Viguera, Donatti, Harvey, & F., 2017) y (Mendieta & Rocha, 2007). Agroforestry provides multiple adaptation benefits including the reduction of topsoil loss, retention of soil nutrients, provision for essential farm resources such as a livestock fodder, fruits, and fuel wood for cooking energy and construction materials.

Considering four basic criteria is recommended when selecting species: (i) the characteristics required by the producer (either for timber or fruit production, nitrogen fixation or forage); (ii) availability of information regarding the selected species (ecology, uses and management); (iii) consider the most abundant species used as agroforestry systems in the Rwanda and Eastern Africa territory; and (iv) knowing the origin of the species (broad genetic diversity) (de Sousa et al., 2017).

Other key aspects for selecting and managing agroforestry systems for annual crop planting are the functional attributes of each species. These are classified in four groups: (i) complete plant attributes; (ii) informed uses; (iii) reproduction; and (iv) tolerance to adverse environmental conditions.

Table 20 shows a list of the fodder, timber and fruit tree species that have been selected for the agroforestry systems proposed based on their resilience capacity against temperature and precipitation changes expected in Eastern Province. The species selection has also been informed by the successful Tuwigire Muhinzi system, are local species (often native to the region), non-invasive and have demonstrated high acceptance by the farmers in Rwanda and in other countries in East Africa.

Table 20. List of the considered tree species for the agroforestry system and their function.

Tree/shrub species	**Common name**	**Amount of precipitation requirement (mm annually)**	**No of months drought it resists**	**Potential uses**
Grevillea robusta,	Grevillea	700-2000	more than 6 months	Timber, Firewood. Mulch for coffee, tree shade coffee

through knowledge and learning products produced during the project's lifetime for more information see Annex 7.

Senna spectabilis	Kesiya	800-1000	More drought resistant than 6 months	Green manure, Firewood, Stakes for climbing
Leucena diversifolia	Lesiana	650-3000	More resistant to drought than 6 months	Fodder, green manure, firewood and stales for climbing beans
Leuceana tricandra	Lesina	650-3000	More resistant to drought than 6 months	Fodder, Green manure, firewood, stakes for climbing
Leuceana Palida	Lesina	650-3000	More resistant to drought than 6 months	Fodder, Green manure, firewood, stakes for climbing
Calliandra calothyrsus,	Kaliyandra	700-4000	More resistant to drought than 6 months	Fodder, Green manure, firewood, stakes for climbing
Maesopsis eminii,	*umuhumuro*	1000-2000	More resistant to drought than 6 months	Timber, Firewood. tree shade coffee
Pterygota mildbraedii,	*umuguruka*	1000-1500	More resistant to drought than 6 months	Timber, Firewood. tree shade coffee
Markhamia platycalyx,	*Umusave*	800-2000	More resistant to drought than 6 months	Timber, Firewood. Handceaft
Casuarina cunninghamiana,	*kajwarina*	360-2200	More resistant to drought than 6 months	Timber, Firewood. Windbreak
Azadirachta indica,	*muarobaini*	450-1500	More resistant to drought than 6 months	Medicine tree
Sesbania sesban,	*umunyegenyege*	500-2000	more resistant to drought than 6 months	Green manure, firewood, stakes for climbing beans
Tephrosia vogelii	*Umuruku*	850-2650	more resistant to drought than 6 months	Green manure
Acacia spp.,	*iminyinya, imigemge*	500-2000	more resistant to drought than 6 months	Shade in pasture, firewood, charcoal,
mangifera indica	*mango*	850-1000	Resistant to drought	Nutrition and income generation

Persea american	Avocado		Resistant to drought	Nutrition and income generation
Carica papaya	papaya	1 000-2 000	Resistant to drought	Nutrition and income generation
Psidium guajava	Guava	1000-2500	Resistant to drought	Nutrition and income generation

The agroforestry system proposed is based around increasing the productive capacity of land, through cultivating productive fruit, fodder and tree based products (timber and fuel wood) tree species, while contributing to landscape restoration and improved provision of ecological services. Farming of many of these products and their value chains rely on women for production and trading. Investing in such species will create economic opportunities for women, a climate vulnerable group.

Fodder trees and rangelands: Drought resistant fodder trees such as *leuceana diversifolia*, *Leuceana tricandra*, *Leuceana palida*, *Calliandra calothyrsus* and *Vernonia amydhalina* were tested and proven to have niche adaptation characteristics to the contexts of Eastern Province. They also provide fodder with less methane emissions from enteric fermentation. Timber trees will also be introduced in rangelands, either scattered in the rangelands or as natural fences. Additionally, tree-based forages are the only means of livestock food supply especially during droughts when pasture shortages can be catastrophic to livestock production.

Timber products: The tree products such as timber, firewood, fruits and nuts, for example macadamia, are all tradable goods that can be sold locally as well as in the sub-national, national and regional markets. These species also support the quality of honey production, growing mushrooms and provide raw materials for handcraft. Moringa, a product from one of the identified agroforestry species, has seen a rapid demand in the international markets. The project will also produce wood stakes for bean climbing bean cultivation, for which the major production challenge is the availability of stakes. Climbing beans when cultivated correctly on stakes, can produce up to three times the harvestable amount of wild beans, contributing to reduce malnutrition and increased income generation capacity

Fruit trees: The project will develop the fruit sector to reduce malnutrition and generate income for smallholder farmers in the Eastern Province. Despite the potential to grow fruit trees, many challenges still affect the sector. These include limited access to quality seeds and planting materials, poor agronomic practices, limited skills for pests and disease management and lack of diversification of fruits. TREPA project will build on ICRAF expertise and the Twigire Muhinzi system to diversify fruits, improve agronomic practices and control pests and diseases, and strengthen links to market.

Agroforestry nurseries: To bridge the gap in site specific agroforestry knowledge and techniques, at least one agroforestry nursery in each area will be established. The nurseries will experiment plots and produce seedlings and saplings of plant species that are best suited for the communities and FFPO in need and the species that are climate-resilient.

Farmers in these areas will receive trainings in new agroforestry species cultivation and new farming techniques that will provide the maximum climate adaptation benefits and mitigation co-benefits. A network of farmers and trainer farmers will also be established or strengthened to enhance the agroforestry knowledge and farming techniques. The networks will be connected to and will have access to the latest agroforestry research findings as well as opportunity to share the project experience with other farmers in different parts of the country and in other countries. While engaging local communities and FFPO in climate resilient landscape restoration activities, youth have to be largely included in training, decision making, and implementation. The first task will be to identify and characterize the priority youth to be involved based on criteria that will be set in collaboration with local communities, FFPO and authorities.

Gender aspects have been mainstreamed in all activities and informed by the RFA (2016) "*Guidelines for the integration of the gender aspect in the context of District Forest Management Plans (DFMPs)*", which includes agroforestry.

Economic analyses (see Annex 3) show that a significant return on investment and adaptation benefits for farmers that make the transition from traditional agriculture to agroforestry (See see Annex 3 and GoR, 2014). Furthermore, evidence shows a positive relationship between tree cover and indicators of children's dietary quality from increased consumption of fruits and leafy vegetables.

Agroforestry and forestry are as an essential driver of economic development and an area of great opportunities for young employment in Rwanda such as fruits sector, timber, poles, honey, mushroom. Harnessing opportunities in agroforestry entrepreneurship and innovations along the value chains contribute to improving livelihood, increases productivity and returns to investment and provides new employment opportunities, hence attracting more young people, In the TREPA project youth will be involved in nursery, tree planting and management, fruits and wood products business, honey, among others.

Table 21 presents a summary of the current practices and expected changes achieved by the project. It shows a list of the opportunities and innovations regarding agroforestry systems.

Table 21. Expected practice changes and innovations promoted in Output 1.1.

Items	BAU practices	Expected changes	Opportunities & innovations
Monitoring & Evaluation	Many small agroforestry tree planting initiatives are supported by District, NGO, etc, but there is no mapping and real data registration on supported activities.	Supported agroforestry areas will be mapped and baseline data collected	Methodology defined and experienced with FMBE project. The agroforestry DFMP database software using GPS tablet (under development) will ease this data collection on the field. The new agroforestry/DFMP database will includes user friendly tools allow direct mapping on the field of every consolidated sub-unit of 5-10 ha, the registration of list of owner and of names of farmer leaders/FFS facilitators/FPs, the registration for each sub-unit of the number of existing and /or planted trees per species, the archiving and consultation of the signed MoU, as well data from M&E mission/report (updated number of tree per species, constraints/solutions, etc.)
	Most of the agroforestry tree planting initiatives supported by District, NGO are not subject to continuous and regular mission of M&E	Organise, not only during but also after the project duration, continuous and regular missions of M&E on supported agroforestry areas, to control the respect of good practices according modalities set in signed MoUs, but also to identify constraints and proposed solutions	
Agroforestry practices	Trees/shrub are seen by farmers as competitors of crops, explaining their low current density in average (21 trees/ha)	Agroforestry trees/shrubs understood as profitable for the overall parcel production, soil protection and product diversification, with a density increased to around 120 tree/ha in average	Demonstration plots to be established in each targeted village will support quicker adoption by farmers
	Only few tree species are known and accepted by farmers (Grevillea, fruit trees)	Farmers know and accept more diversified agroforestry tree/shrub species in their parcel once extension services are functional	

	Farmers plant trees with crops, some species/variety are not sufficiently resilient to climate change (drought)	Farmer adopt species/variety more climate change resilient	
Tree/shrub seedling production	Insufficient access to quality tree/shrub seedling and seeds	Quality seeds and seedlings distributed in agroforestry intervention areas	
	Use of poor genetic quality tree reproductive material for seedlings production, and often use of species not well adapted to the land context and /or to the climate change	Use of genetic quality TRM, and selection of best adapted species considering land/soil (Agro-ecological factors) context and adaptation to climate change (longer drought period)	Taking advantage of the existing Tree Seed Centre and of its tree seed stand, new tree seed stands, and orchards have to be established based on a selection and genetic improvement program, including cloning for some of best climate adapted & productive species
	Use of bad soil quality with no appropriate fertilizer	Use of good soil quality and appropriate fertilizer	
Access to micro-credit/saving system	No access of farmers to micro-credit/saving system design for agroforestry business	Access of farmers to micro-credit/saving system specifically designed for agroforestry	Taking advantage of lessons learned from World Vision and IUCN experience

Implementation Sites

The intervention aims to achieve maximum adaptation benefits by up-scaling diversified agroforestry. In order to maximize the benefits, the specific location of the project will be mapped out taking into several factors. 100 such locations will be selected as part of Activity 1.1.1. Each of the location will be approximately 400 hectares in size and will be strategically selected.

Best Practices and Lessons Learned

Currently, there are two projects under implementation in Eastern Province to introduce and to improve agroforestry systems. Lesson learned and agroforestry best practices have been identified and are applied in the TREPA project. For the TREPA project, the projects that were analyzed to document the agroforestry best practices and lesson learned in Eastern Province are below:

- Agroforestry tree planting campaign in Rwamagana District (2.200 ha 2018-2020) with the support of the RFA/FMBE project supported by ENABEL;
- Agroforestry tree planting campaign in Gatsibo District (8584 ha in 2017-2019) with the support of IUCN in collaboration with ICRAF.

The projects are implemented using and adapting the existing Forestry Field Schools (FFS)/Tuwigire Muhinzi extension system established by MINAGRI/RAB. In each district many groups of neighbouring farmers have been established into FFS groups in order to improve their agriculture practices. The groups are supported by the facilitator assigned per group of 15-20 farmers. The facilitators are trained, supported and supervised by Master Trainers of RAB. Using training plots where the groups experiment new techniques on the field for their own on-job learning process. Additionally, Farmer Promoters (FPs) are supported in implementation of improved agriculture techniques in their own parcels. Until now these FFS group and FPs are supported in conventional agriculture practices. The TREPA project will train the group in agroforestry techniques.

As the FFS and FP groups are already well organized, and they have the mutual willingness of improving their production systems. The groups are ideal for dissemination of TREPA's agroforestry techniques by adding trees, shrubs and new types of crop to their cropping system to increase productivity, soil conservation and the diversification of stocked species with the aim of becoming more resilient to climate change. The TREPA project takes these successful design elements and applies them to implementation of agroforestry interventions. For detailed information on how existing best practice systems are integrated into TREPA design, see Annex 8.

Additionally, in last 20 years ICRAF has been experimenting with agroforestry demonstration plots and research in Rwanda as well as also in the province. Based on the experiment and research findings ICRAF developed agroforestry guidance that will be used by trained agronomists and sector forest extensionists under the TREPA project to make informed choice of species and techniques best suited for the local conditions (soil, slope, expected product type, etc.). In this way, the TREPA project builds on the success of these existing established systems and will seek to improve and scale up their interventions.

Description of Activities

Output 1.1 comprises of the following activities and sub-activities:

Activity 1.1.1: Identify 100 sub-areas of intervention (400 ha each) for agroforestry dissemination over *Eastern Province*.

This activity uses community participatory mapping and geo-referencing to identify the site intervention among 40,000 ha where soil erosion is prevalent. It is critical that this activity is conducted at the project inception as site choice will need to be made based on the latest characteristics of ecological and soil stability conditions (based on physical observation and latest existing thematic maps) and willingness of farmers to participate (based on participatory approaches) at the time mapping. The slopes will be characterized (different % of slopes) before deciding on the agroforestry packages suited for specific contexts based partly on ICRAF guidance and participatory approaches (farmer and extension services) to ensure "right tree for right place and right purpose." The agroforestry interventions options will be packaged based on farmer needs and preferences at the farm, village and landscape level. The activity will involve local government staff (District Forest Officer, District Agronomist, forest and agronomy extensionists) and will be technically supported by national and international agroforestry and landscape restoration experts availed by TREPA. This activity consists of the following sub-activities:

Sub-activities	Description
Sub-activity 1.1.1.1	Based on existing thematic maps, identify most exposed crop/agroforestry lands over the EP
Sub-activity 1.1.1.2	Based on local consultation, select the 100 sub-areas where agroforestry will be disseminated
Sub-activity 1.1.1.3	Participatory mapping of agroforestry block of intervention

Activity 1.1.2: Train 160 farmers groups on agroforestry techniques and establish 160 MoUs with local authorities

Working with support from MINAGRI, this activity aims to adopt Farmer Field Schools (FFS) and Twigire Muhinzi (see Annex 8) approaches as strategies to scale-up agroforestry technologies. Farmers promoters/FFS facilitators and sub-unit farmer leader will be sensitized and trained on agroforestry technologies and specific skills to transfer knowledge and information to the large number of farmer leaders. MINAGRI will provide extensionists to organise farmers into 160 innovative groups or cooperatives to facilitate effective transfer of information and knowledge and will evolve into cooperatives to allow access to finance and to value chains supported by component 2 at rural resource centres (output 2.1) or farmer field schools established (under component 1). Each farmer promoter/facilitators will supervise between 20-30 sub-unit's farmer leaders, which will supervise each 10-20 farmers (total minimum 32,000 farmers 16,000 men and 16,000 women). Through extensionist support, MINAGRI will support capacity development in agroforestry techniques of farmer groups by incorporating agroforestry into the existing crop intensification programme. This activity consists of the following sub-activities:

Sub-activities	Description
Sub-activity 1.1.2.1	Organize, sensitize and train farmer's leaders/promotors
Sub-activity 1.1.2.2	Identify and implement agroforestry systems and species that will be applied
Sub-activity 1.1.2.3	Established MoUs between local authorities and supported farmer groups to sustain agroforestry investment
Sub-activity 1.1.2.4	Organize regular learning exchange meeting between farmer's groups and reward champions

Activity 1.1.3: Establish and sustain one agroforestry/fruit trees nursery in each of the 100 sub-areas of intervention

This activity will be done with the support of the national agroforestry expert seconded by a tree nursery expert, both availed by TREPA, taking advantage of ICFAF and IUCN experience. While identifying/assessing groups in charge of nursery, the project will target a ratio of 1:1 men to women to ensure good integration of women in targeted groups. The MoUs that will be signed between selected groups and local authorities has to integrate specific gender measures ensuring place of women in decision and implementation processes. Seedling of tree species addressing interests of both men and women will be growth in these nurseries. This activity consists of the following sub-activities:

Sub-activities	Description
Sub-activity 1.1.3.1	Select existing private actors and/or FFS groups champions that will be in charge of nurseries and signed long term MoUs.
Sub-activity 1.1.3.2	Establish 100 nurseries, train responsible staff and produce seedlings
Sub-activity 1.1.3.3	Support cooperative establishment and develop management capacity

Activity 1.1.4: Provide technical assistance to farmers in planting agroforestry/fruit trees and in implementation of agroforestry technologies in their owned parcels

Provide technical assistance to farmers to support them (on the job training) in hole digging, in tree/shrub seedling planting and beating-up, in weeding and in tree protection and maintenance. Seedlings will be provided freely to farmers (see activity 1.2.3).

Special attention will be given to the support and guidance (on the job training) of farmers on right management of fruit trees which are requiring specific technics and skills to maximise the production. Also, for farmers introducing for the first time in their parcel a new species/variety of crops they will have to be closely guided to ensure the full success. Advice on right use of agriculture input will be provided and contact with providers will be facilitated. MINAGRI' s staff will support in training farmers in fruit grafting and good management of fruit trees and right use of new climate resilient crop species/varieties. Through the existing FFS and Innovation platforms, MINAGRI will facilitate the preparation and coordination of tree planting seasons harmonizing efforts with the preparation of the usual agricultural season.

This activity consists of the following sub-activities:

Sub-activities	Description
Sub-activity 1.1.4.1	Technical assistance to farmers in planting agroforestry/fruit trees
Sub-activity 1.1.4.2	Technical assistance and training to farmers in good management of fruit trees and right use of new climate resilient crop species/variety

Activity 1.1.5: Establish and sustain 1 demonstration plot of 1-2 ha in each of the 100 sub-areas

This activity will involve a forest/agronomy staff of District/Sector staff technically trained and guided by international and national agroforestry experts, taking advantage of ICRAF experience and knowledge. MINAGRI will support the efforts to distribute high quality grafted fruit trees to farmers in the Eastern Province. Lead farmers will receive composts, lime where soils are acidic, and free fruit seedlings to set up demonstration sites in their own fields. The ministry's staff will also facilitate in the organization of champion FFS groups, which will manage demonstration plots. As these plots will serve as demonstration for other farmers, gender considerations will be addressed (such as choice of species and design of rainwater collection considering both men and women's interests, women's representation in decision making and implementation, etc). This activity consists of the following sub-activities:

Sub-activities	Description
Sub-activity 1.1.5.1	For each of the targeted 100 villages/sub areas, select 1 champion FFS group and 1 site of around 1-2 ha in which demonstration plot will be established

Sub-activity 1.1.5.2	Establish framing contract between selected FFS groups and local authorities for maintaining the demonstration plot
Sub-activity 1.1.5.3	Established demonstration plots, train responsible farmer leaders and ensure maintenance

Activity 1.1.6: Monitoring, control and evaluation of supported agroforestry areas

Agroforestry area that will be mapped and registered in the agroforestry database which is embedded in the RFA DFMP database. GPS tablet and specifically designed user friendly agroforestry functionalities will allow direct mapping on the field, of every consolidated block of 5-10 ha, the registration of list of owner and of names of farmer leaders/FFS facilitators/FPs, the registration for each block of the number of existing and /or planted trees per species, the archiving and consultation of the signed MoU, etc.

Organize continuous and regular missions of M&E on supported agroforestry areas, to control the respect of good practices according to modalities set in signed MoUs, but also to identify constraints and proposed solutions. The Agroforestry/DFMP database software will allow the registration of M&E data per block using the tablet/GPS: new current number of trees per species, constraints, solution, corrective actions, etc. This activity consists of the following sub-activities:

Sub-activities	Description
Sub-activity 1.1.6.1	Collect and register baseline data in agroforestry database
Sub-activity 1.1.6.2	Perform regular M&E

Output 1.2. Woodlots and tree plantations are rehabilitated and sustainably managed for productive and ecological services

The table below summarises Output 1.2 which will implement and scale-up diversified afforestation and reforestation packages.

Key aspects	Description
Overview	The objective of the proposed intervention is to rehabilitate the degraded woodlots in the three (3) woodlot ownership types as well as to introduce sustainable forest management practices to decrease the supply and demand gap in wood products in the Eastern Province. The

	intervention aims to rehabilitate 40% of the smallholder privately-owned woodlots; to develop local cooperative groups to manage district-owned woodlots through coppicing; approximately 60% of district-owned woodlots will be rehabilitated, and responsibility of woodlot management will be transferred to local communities and FFPO for cooperative management; and rehabilitate 10% of state-owned woodlots that are not viable to private investors and improve sustainable practices and productivity in approximately 50% state-owned woodlots. The intervention will also attract private investor to management the woodlots by ensuring long term financial and ecological sustainability.
Adaptation benefits	9. Enhanced livelihoods of the climate vulnerable communities and their families in Eastern Province. 10. Increased resiliency of the woodlots to climate impacts through sustainable forest management practices. 11. Improved climate resiliency of forests that will reduce topsoil erosion, improve water quality; protect source water; and ensure uninterrupted water supply for household needs, drinking and irrigation (Wilson and Lovell, 2016. Garrity *et al.*, 2010). 12. Reduced stormwater runoff resulting in flood risk mitigation (e.g. Matthews et al. 2004; Ranieri *et al*. 2004). 13. Established sustainable forest management that will ensure

	wood products demand is by the supply of sustainable supply.
Barriers addressed	1. Lack of investment fund to rehabilitation degraded woodlots or stop future degradation is a major barrier to build a climate resilient Eastern Province. 2. Need for a strong smallholder woodlot owner community network for sharing best practices, lesson learned, knowledge and technology that will result in a highly productive, climate-resilient woodlots and its ecosystem services. 3. Absence of a database with the woodlot ownership information and clear delineation of the woodlots ownership boundaries. 4. Inadequate training of the government officers to use the database to effectively implement the sustainable forest management plan. 5. Large supply-demand gap of wood products that is driving over-exploitation of the woodlots. 6. Lack of private sector that can ensure financially and ecologically sustainable forest management in the future.

Description of the intervention

Output 1.2 will implement three project activities. Demand for wood in the province is estimated at 1.65 million m3/year while the current sustainable supply capacity of overall forest, shrubland and agroforestry tree resources is only approximately 0.53 million m3/year. The supply and gap demand have resulted in unsustainable and illegal exploitation of woodlots. Especially, in district-owned and smallholder privately-owned woodlots. The intervention will reduce illegal forestry deforestation and degradation, yield higher woodlot production through sustainable forest management practices as well as through rehabilitation of the degraded woodlots. This in turn will decrease the supply-demand gap that will ensure sustainable use of woodlot resources. Table 1 presents a summary of the main expected forest management practice changes and innovations. The activities are designed to rehabilitate degraded woodlots in three types of woodlot ownership, namely, 1) smallholder privately-owned 2) Districts-owned; and 3) State-owned. The detailed description of the interventions designed for each type of ownership is below:

Smallholder Privately-owned woodlots: The smallholder-privately-owned woodlots account for 54% of the total woodlot cover in the province. On an average, smallholder privately-owned woodlots are understocked, estimated at 16 m3/ha. The average potential for the smallholder privately-owned woodlots is estimated between 50-70 m3/ha. Unsustainable woodlot management practices, over-exploitation, forest tree species composition and woodlot fragmentation are attributed for the low productivity and degradation of smallholder privately-owned woodlots. The smallholder privately-owned woodlots will be the main focus of the intervention, primarily because of the woodlot cover share; lack of access to finances for smallholder woodlot owners to improve the state of the woodlots; absence or underdeveloped value chain systems for the woodlot products; low capacity to implement sustainable forest management practices; and absence of innovation for sustainable forest management. In order to overcome these barriers, the intervention will focus on building capacity of the smallholder woodlot owners in gathering their land into consolidated Forest Management Unit lead by newly established and trained cooperatives, sustainable forest practices; rehabilitation of degraded woodlots; analyses to develop strategies for woodlot rehabilitation; and strengthen or create the value chain system; and increase access to finance/financial inclusion for farmers. The intervention aims to rehabilitate approximately 26% of these ownership type woodlots.

Districts-owned tree plantation: The district-owned woodlots take the smallest share, only 3.8% of total woodlot cover in the province. The biomass productivity of the district-woodlots is low, primarily due to a lack of sustainable woodlot management practices and illegal exploitation. The proposed intervention aims to first restored the very degraded district plantation (700 ha, 38% of District owned forest) and support their long-term concession to local forest actors (individual or cooperative) to ensure their sustainable management through coppicing. Approximately 80% of the district tree plantation will be transferred to local private actor.

State-owned Tree plantations: The state-owned tree plantations account for 46% of the total woodlot cover in the province. Compared to other two woodlot ownership types, the state-owned woodlots have better stock. Estimated wood stock in the state-owned woodlots is approximately 54 m3/ha with a yield of approximately 5.89 m3/ha/year. However, this is far below the potential stock of between 80-100 m3/ha with a yield of 11-12 m3/ha/year. The reason for the low productivity of state-owned woodlots are inadequate woodlot management practices, forest species composition, and loss of woodlots to mining activities. Currently, the cadastre system is not private contractor investment friendly to attract private investors to manage the woodlots. The proposed intervention will improve the cadastre system and will group public forests to be contracted into consolidated Forest Management Units with recommended management plans to attract private investors to manage the woodlots in financially and ecologically sustainable approach. The proposed intervention will also rehabilitate degraded woodlots that are geographically not viable and/or unattractive to the private investors. The proposed intervention aims to rehabilitate 7% of very degraded state-owned woodlots (700 ha) while improving approximately 50% of State forest (10.000 ha) through their long-term concession to private investor under sustainable management plans.

Implementation Sites

The proposed intervention aims to rehabilitate approximately 6545 hectares of smallholder privately-owned woodlots, 700 hectares of district-owned woodlots, and 700 hectares of very degraded state-owned woodlots + 10.000 ha State forest through concession. The rehabilitation sites will be selected in all seven (7) districts of the province. The implementation sites in state-owned or district-owned woodlots will be selected based on low wood stock; steep slope that are highly suspectable to erosion; areas with degraded soil; and woodlots that are not viable for private investors. Woodlots for long term concession and sustainable management of state-owned forests by private investors will be based on financial feasibility assessment, woodlots in need of rehabilitation, and susceptible degradation.

The implementation sites for smallholder privately-owned woodlots will be based on landscape restoration opportunity assessment prepared in consultation with local communities, analyses of available maps, geological data, soil data, and any other relevant data to make an informed decision. The sites will be analysed for susceptibility to erosion; current state of woodlot; severity of soil degradation; potential for woodlot connectivity; and private-land owners with an interest to convert their land into a woodlot.

Best Practices and Lessons Learned

The District Forest Management Plan and Simplified Forest Management Plan along with delineation of Forest Management Unit have identified some best practices and established a platform to introduce an effective woodlot rehabilitate and sustainable woodlot management program. The District Forest Management Plan is delineating Forest Management Units (FMUs). Each FMU is aggregating several stands into one coherent management entity according to the land ownership (each ownership is getting their owned separated FMUs), the main purpose of the forest, the species/regime, etc. For each FMU (50-300 ha), a Simplified Forest Management Plan (SFMP) is designed. The local forest management plan is referring to these SFMPs. These DFMP and SFMP are designed in line with the District Land Use Master Plans. The detailed methodology and the technical modalities for the design and implementation of the plans have been developed. To implement the plans, officer level positions such Rwanda Forestry Authority Officers, District Forest Officers, and Forest Sector Extensionists are created and personnel are recruited. However, due to lack of adequate training and skills of the officers a challenge is observed in adequately monitoring the implemented plans. This challenge will also be felt during the implementation of the proposed intervention. ENABEL bring their experience of development of the specific GIS and Excel database created for every publicly registered forest stands in each district.[124] However, a comprehensive database for all districts is about 4

[124] Another challenge in implementing the intervention is the lack of clarity on the ownership of the woodlots and clear delineation of the woodlot ownership boundaries. Specific GIS and Excel database are created for every publicly registered forest stands in each district. A new user-friendly database is currently being developed suitable for key forest actor (Central/District/Sector forest officers, private forest operator officers) to easily use the database. The database development is supported

years away and will require support from the TREPA project to continue the development work. Once the database is available, training the officers is an important step to effectively use the database for implementation and monitoring of the forest management plans.

Implementing a sustainable woodlot management plan will also require the buy-in from the smallholder woodlot owners. Therefore, there is an immediate need for capacity building and awareness raising activities for the smallholder private woodlots owners. Table 22 presents a summary of the current practices and expected changes achieved by the project. It shows a list of the opportunities and innovations regarding forest management practices.

by the ENABEL Forest Management and Biomass Energy project. The new database, that use GPS and web-based application, will allow the forest actors to easily implement the intervention (from cadastre, inventory, silviculture/harvesting planning & monitoring, cut permit, etc.) directly on the field or from decentralized office with easy forest location and delineation tools. The beta version of the database will be available for use by the end 2019 in three (3) pilot districts (Rwamagana, Gasabo and Gakenke).

Table 22. Main expected forest management practice changes and innovation.

Items	BAU practices	Expected changes	Opportunities & innovations
Public (State & District) forest cadastre	Public Forests of Kayonza and Nyagatare not yet registered, many with no clear location/demarcation know by local forest officers	All public forests of these 2 District registered with accurate data and limit in DFMP database.	The new DFMP database[125] includes user-friendly tools using GPS tablet allowing easy, quick and right assessment, demarcation and registration of stands on the field.
	In other 5 District where cadastre has been conducted in 2015-2017, several public forests remain with ownership/demarcation conflict cases to be solved. On top of it the data and parcel limit in LAIS are often not complete and/or not accurate.	Data and right limit of every public forest are updated/corrected in DFMP and LAIS database.	The new DFMP tools mentioned above allow also update of data and limit of forest already registered, while making direct & automatic comparison with LAIS data and creating automated conflict cases report.
	Limits of parcels on the field not materialized, leading to confusion/conflict cases	Borders of every public lands are clearly demarcated, planting a differentiating species on the border line where required	Some species (such as Euphorbia sp., Sisal, etc) are already used traditionally in rural areas and well known as "border demarcation species"
Public (State & District) forest management plan	DFMPs with public FMUs and related SFMPs not design for Kayonza and Nyagatare	DFMPs with public FMUs and related SFMPs are designed, based on public forests inventory and quick qualitative assessment (QQA)	Methodology well known and defined, based on experience of DFMPs design in 2015-2018 of 5 Eastern Province districts.

[125] Under development with the support of RFA/ENABEL-FMBE project, to be delivered by end of 2019.

	Existing DFMP are based on heavy and not user friendly Excel and shape files, difficult to be mastered and to be used by RFA officers and DFO/FSE for right implementation, M&E and update of these plans.	Every DFMPs/SFMPs are integrated in a new user friendly DFMP database using GPS tablet, allowing DFO/FSE and RFA officer to easily register and access to stand information, conduct M&E with automated reports, design /update plans with automated overall statistic/graphic/maps computation.	The new DFMP database mentioned above is based on this experience and will includes user friendly tools where: - Data from inventory and QQA can be registered on the field using GPS/tablet, with automatic computation of statistic per stands; - Based on management decision taken by operators (species, silviculture regime, Conversion/management), automatic computation of silviculture treatment planning are done; - Operator can easily create and update FMUs, with automatic computation of statistic, financial analysis and SFMPs report creation
Silviculture practices	Old stumps exhausted not replaced	Renewal (new planting) of the forest into productive plantation	
	Coppicing every 2-4 years	Coppicing every 8 years optimising the productivity and profitability	Taking advantage of SFMPs establishment (see above) and of its control/respect
	No or insufficient coppice reduction after coppicing	Reduce the number of coppice per stumps, 1-2 years after coppicing, to 2 or 3 most performant stems	
	In high forest, no appropriate thinning /pruning	Application of thinning and pruning at the appropriate period in line with SFMPs prescription	Taking advantage of SFMPs establishment (see above) and of its control/respect

	Harvest method not secure and leading to too much waste of the good part of the wood.	Application of right method of harvesting, using appropriate equipment (saw mill and protective assets, etc.)	
	Stump extraction for energy use	When making restoration or at renewal time of the forest, old stumps are not extracted but simply reduce and debarked, avoiding soil structure disturbance and keeping/providing organic matter to fertilize the soil	
	Cut permit delivered with no regard on SFMPs	Cut permit delivered only based on respect of the SFMPs	The new DFMP database software, registering SFMPs, can deliver cut permit only at the time foreseen by the SFMPs. No cut permit can be delivered without having registered forest and approved SFMPs
Soil/forest protection measures	An important part of forest in sloppy area don't have anti-erosive ditches (AED) or there are not maintained	Systematic establishment of AED in sloppy lands and regular maintenance	Conventionally in Rwanda, AED of 40x50x300 cm are established in every 20-50 m (depending of the slope) on sloppy area to force running water to enter in the soil and limit erosion
	No fire break in exposed areas	Systematic establishment of fire break in land expose to risk of fire spreading from neighbouring areas	To limit accidental fire propagation during dry season, fire break of 10 m wide (where combustible vegetation is removed) are established on strategic limit and/or every 200 m in threatened forests
Seedling production	Use of poor genetic quality tree reproductive material for seedlings production, and often use of species not	Use of genetic quality TRM, and selection of best adapted species considering	Taking advantage of the existing Tree Seed Centre and of its tree seed stand, new tree seed stands and orchards have

	well adapted to the land context and /or to the climate change	land/soil context and adaptation to climate change (longer drought period)	to be established based on a selection and genetic improvement program, including cloning for some of best climate adapted & productive species
	Use of too small bag in nursery, limiting good growth of seedling roots	Use of appropriate bags	
Tendering and contracting of restoration/afforestation works	At District level, the tendering is often based on lower price method, not giving sufficient importance to quality. Payment method not always clearly linked to a quantity of works truly verified/counted in the field. Often tasks are only for seedling production, or a separate one for planting, while a same operator has to be responsible for the overall cycle (nursery, planting, maintenance, guarding, etc..)	Tendering based on quality/price evaluation method, including all required tasks to a same operators, and payment made in appropriate instalments based on quantity truly realized on the field.	Taking advantage of lessons learned in ENABEL/UICN project, using the improved tender and contract template where detailed technical specifications and modalities are provided, as well method for provisional and final works reception clearly linked to instalment payment.
Concession of public forests	Low staffing and financial means of the RFA/District to managed properly their public forests	Contracting (long term concession) to local private operator/institution or to international investors	Taking advantage of: - the new policy and FSSP instruction requiring the concession of 80% of public forests to private operators - of DFMP/SFMP produced and managed through the user-friendly DFMP database software (see above)
	No access of private investor to public forests	Public forest mapped and inventoried and organised into State /District FMUs for concession to private forest operators	

	No detailed regulations (ministerial instructions) on modalities and procedures for long term concession tendering and contracting	Ministerial instruction provides technical guidance for tendering and contracting procedures	Lessons learned from public forest contracting done from 2012 to 2018. New tendering template to be adapted.
	Current contract too much oriented to the modalities for stumpages fees payment of existing volume (not differentiating timber/service/firewood), not sufficiently looking at long term concession modalities, not, and for some of them without a clear and updated detailed SFMPs	Contract clearly linked to an approved and updated SFMPs, providing clear guidance on long term concession, enforcing participative approach and gender, with stumpage fees payment better adapted to wood volume type	New contract template to be developed with RDB based on draft proposed by FMBE project and lessons learned from RFA forest contracting done from 2012 to 2018.
Small-holder forest management	Not mapped nor registered. Managed individually and over-exploited/very degraded/old, without any plan	Small forests registered and gathered into private FMUs, restored into productive plantation, and managed by cooperatives according to agreed SFMPs	Methodology and process successfully piloted by ENABEL/FMBE project in 2017-2019 in Rwamagana. The new DFMP database software includes a tool (using GPS tablet on the field) allowing easy and quick demarcation and registration of private stand, design of FMU and automated production of SFMPs based on simple choice made by user.
	No investment capacity of small-holder	Small-holder grouped into cooperatives, getting access to finance facilities under output 2.3. Restoration of forest supported by TREPA provide a long-term growing capital to the cooperative, increasing their capacity to access to finance	New innovative financial mechanism for the private FMU middle/long term forest business cases have to be developed with local finance institutions.

Description of Activities

Output 1.2 comprises of the following activities and sub-activities:

Activity 1.2.1: Restore 700 ha of degraded District owned tree plantations and provide technical assistance for their sustainable management

The project will restore 700 ha of degraded district owned forest land by promoting the adoption of a Simplified Forest Management Plan (SFMP), as recommended by 2013 forest law. Awareness campaign for local stakeholders will promote district forest concession as a sustainable strategy in a long term.

Sub-activities	Description
Sub-activity 1.2.1.1	Design first SFMPs of District owned forests of Kayonza and Nyagatare
Sub-activity 1.2.1.2	Support district land ownership/demarcation conflict cases solving and management plan updating
Sub-activity 1.2.1.3	Plant differentiated species to demarcated district forest land borders on the field
Sub-activity 1.2.1.4	Restore 1000 ha of District forest which are the most degraded and/or located in sloppy areas most exposed to soil degradation
Sub-activity 1.2.1.5.	Ensure awareness and identify local stakeholders for district forests concession
Sub-activity 1.2.1.6.	Support long term contracting of restored 700 ha of District forest to selected local actors

Activity 1.2.2 Restore, in collaboration with RFA and Districts, an area of 700 ha of very degraded State-owned tree plantations and in long term concession of 10,000 ha of State FMUs to private investors

The project will adopt an integrated approach for restoration of 700ha highly degraded state-owned tree plantation and support RFA and Districts providing guidance on processes for long-term concession of 10,000 ha.

Sub-activities	Description
Sub-activity 1.2.2.1	Design DFMP of Kayonza and Nyagatare

Sub-activity 1.2.2.2	Support State forest stand ownership/demarcation conflict cases solving and management plan updating
Sub-activity 1.2.2.3	Restore 700 ha of very degraded State forests which are the most exposed to soil degradation
Sub-activity 1.2.2.4	Conduct awareness campaign on State FMUs concession
Sub-activity 1.2.2.5.	Support long term contracting of 10.000 ha of State FMUs
Sub-activity 1.2.2.6.	Monitoring and evaluation of contracted State FMUs

Activity 1.2.3 Restoration, in collaboration with smallholders, the area of 6,545 ha of very degraded private tree plantations and their sustainable management under private FMUs according to approved SFMPs

This activity aims to develop a participatory land mapping with the communities to identify blocks of small-holder private lands (on average 40 ha per block, so around 160 groups) which are degraded and/or located in sloppy areas most exposed to soil degradation for which restoration is highly required. The mapping will be guided by Forest Sector Extensionists (trained and supervised by TREPA forestry experts) assisted by DFMP software tools and related GPS/tablets, which will provide automatic statistics, maps and register owners. When the list of owners and map of parcels is completed, groups will then be trained and supported (on the job training) in administrative process to establish cooperatives, including election of committee members and elaboration of their internal rules, where all required elements referring to the respect of SFMPs and to investment/benefit sharing mechanisms will be integrated (this will be done under output 2.1). The restoration works (anti-erosive ditches, old stump debarking/reduction, produce high quality seedlings and re-planting/beating-up) in selected small-holder forests will be tendered to forest private operators. TREPA forest experts will work with RFA officer, District Forest Officers and of Forest Sector Extensionists in monitoring and evaluation of contracted State FMUs.

Sub-activities	Description
Sub-activity 1.2.3.1	Identify 6545 ha of blocks of private forest lands to be restored
Sub-activity 1.2.3.2	Build capacity of local stakeholders on new private FMU approach and methods
Sub-activity 1.2.3.3	Establish an MoU for each small-holder group to engage in private FMUs management

Sub-activity 1.2.3.4	Support smallholders in private FMU cooperatives establishment
Sub-activity 1.2.3.5.	Restore the targeted 6545 ha of smallholder forests
Sub-activity 1.2.3.6.	Design and approved SFMPs of private FMUs and support their right implementation

Output 1.3 Scale-up climate resilient silvopastoral packages to restore degraded rangelands

The table below summarises Output 1.3, which will implement and scale-up climate resilient silvopastoral packages to restore rangelands.

Key aspects	Description
Overview	The objective of the proposed intervention is to strengthen the resilience of pasture lands prone to drought by promoting and upscaling silvopastoral systems and sustainable pasture management. This will result in improved livestock production, which support livelihoods and enhance their resilience during prolonged drought periods.
Adaptation benefits	1. Improve soil properties due to greater uptake of nutrients from deeper soil layers, enhanced availability of nutrients and soil organic carbon from leaf-litter and increased nitrogen input by N_2-fixing trees.[126] 2. Enhance the resilience of the soil to degradation, nutrient loss, and climate change, while enhancing water holding and infiltration capacity of the soil and reduce evapotranspiration which

[126] Nair VD, Haile SG, Michel GA, Nair R, 2007.Environmental quality improvement of agricultural lands through silvopasture in southeastern United States. Scientia Agricola 64:513–519.

	contributes to the regulation of the hydrological cycle by reducing runoff intensity. [127,128] 3. Overall, these results improve the animal welfare[129], livelihood of livestock communities and Rwanda economic growth
Barriers addressed	1. Mindset of livestock communities to the change 2. Carrying capacity matching with pasture productivity 3. Drought related shocks contributing to feed shortages and pasture degradation 4. Prevalence of termites which destroy trees and grasses 5. Insufficient of availability of water particularly during the dry season 6. Low trees diversification as an option for resilience to climate change for smallholder livestock communities 7. Poor rangelands management and livestock feeding 8. Fodder deficit during the dry season 9. Lack of development plans at district level that focus on silvopastoral systems with diverse feed and forages 10. Poor institutional coordination – supported through co-learning measures that promote adaptation to climate change built into local institutions, networks and agencies

[127] Ibrahim M, Guerra L, Casasola F, Neely N, 2010. Importance of silvopastoral systems for mitigation of climate change and harnessing of environmental benefits. *In:* Abberton M, Conant R, Batello C (Eds) Grassland carbon sequestration: management, policy and economics. Proceedings of the workshop on the role of grassland carbon sequestration in the mitigation of climate change. Integrated Crop Management, Vol. 11. FAO, Rome, Italy. http://www.fao.org/docrep/013/i1880e/i1880e09.pdf .

[128] Jose S., 2009. Agroforestry for ecosystem services and environmental benefits: an overview. Agroforest Syst 76 (1):1–10.

[129] Broom DM, FM Galindo, Murgueitio E., 2013. Sustainable, efficient livestock production with high biodiversity and good welfare for animals. Proceedings of the Royal Society Biological Sciences 280:2013–2025

Description of the intervention

The objective of Output 1.3 is to enhance climate resilience of drought-prone pastures by up-scaling silvopastoral systems and adopting sustainable pasture management plans. Synergies between cattle, grass forages and trees mean that a combined system can produce more income than either system on its own. The design of silvopastoral systems fit farmers' needs by focusing more on growth and cattle productivity. In particular the project will:

- Increase the productivity of drought-prone pastures by introducing high quality grasses and fodder trees with high adaptation potential to drought and termites;
- Establish better controlled fenced grazing areas with improved pastures and access to water for cattle to improve animal performance during prolonged dry periods;
- Introduction of leguminous fodder shrubs in dairy nutrition, taking advantage of silvopastoral tree species that offer medicinal benefits such as animal de-wormers, improve digestibility of low nutrition dry grass forages, offer shade to improve animal thermo-regulation, tree shelter belts that shield livestock from strong winds soil nitrogen fixation and improved natural regeneration through animal dung;
- Design silvopastoral plan, integrated with the District Land Use Plan, where area dedicated for cattle are identified taking into account forage and feed production capacity and water access opportunities;
- Mainstream climate change and resilient practices in relevant policies based on generated evidence to encourage better adoption of silvopastoral systems by the farmers.

Plans on fodder trees planting/restoration on farmer ranch lands (differentiated in target locations from agroforestry fodder tree packages under output 1.1) will be elaborated in collaboration with the local communities and technical (extension and local government) services. Areas meant to produce fodder and for water retention will be demarcated during community consultations for action plans. Already, important forage grass such as Brachiaria grass known to increase milk production while reducing methane emission from cattle have been identified while tree fodder such as *Calliandra, Leuceana, Acacia, Gliricidia* are well accepted but not well adopted due to local capacity barriers. Improving adoption of better management practices will require technical assistance considering needs of cattle owners, local milk cooperatives, livestock feed producers and traders.

Given that water is another bottleneck in the rangelands - two ways are proposed to address the issue. Building rain-water reserves to harvest and store rainwater properly will go a long way to help ameliorate water shortage problems such as long-distance animals trek for drinking water with negative impacts on milk production. Secondly, integration of trees and shrubs helps store moisture as their leaves favour water infiltration thereby increasing ground water recharge. Additionally, during droughts, moisture content and nutritive value of tree fodder of certain trees species are much higher than dry grass. Trees planted as windbreak provide shading improving animal thermo-regulation; reduce evapotranspiration enabling grass and herbaceous forages to remain green for a longer period of time.

These interventions will require sound planning considering scarce grazing land resources compared to available number of cattle heads. TREPA will leverage the cattle insemination programme undertaken by The Rwanda Dairy Development Project to crossbreed local Ankole cattle with exotic breeds for improved milk and meat production. This offers an opportunity to TREPA project to convince farmers to reduce the number of cattle per rangeland.

Successful tree planting in drought-prone areas is however based on proper species selection considering the 'right trees to the right place and for right purpose' and access to quality planting materials addressed in component 3.3. Multi-purpose trees will used if they include fruit trees provide household food and nutrition, and fodder trees not easily damaged by the feet of the cattle unlike grass forages.

Best Practices and Lessons Learned

This project will build on the MINAGRI/IFAD project - the Rwanda Dairy Development Project (RDDP) implemented in parts of Eastern Province to improve adoption of cross-bred cattle through Artificial Insemination services (AI). Improved breeds however require change of feeding practices, better control of vector borne diseases and better off-take plans of animal products through farmer marketing cooperatives and acquisitions of affordable inputs. Improved feeding practices will be achieved through improve utilization of available local feed therefore enhances the impacts of these programs.

Additional infrastructural projects implemented by MINAGRI on Land Water Husbandry (LWH) including irrigation to support water access for grazing cattle herds will be complementary. TREPA focus on improving rainwater harvesting techniques and reserves and ICRAF experience on the silvo-pastoral systems improvements will help optimize farmer benefits and help create a more resilient livestock production systems in Eastern Province.

Description of Activities

Output 1.3 comprises of the following activities and sub-activities:

Activity 1.3.1 Characterize the climate resilience features of the existing pasture lands
Existing pasture lands will be characterized and livestock farmers clustered according to the size of their grazing lands. Tree and grass species that exist on their grazing land will be identified and grouped according to the level of their resilience to climate change. Pasture productivity will be estimated considering current and future climate projections while assessing the impact of adaptation benefits of this project implementation. In addition, a study will be conducted on the carrying capacity of the grazing land annually. The pastures will be categorized and mapped in categories of high degraded and vulnerable lands that need strong intervention, moderate degraded and low degradation with minimum intervention.

Sub-activities	Description

Sub-activity 1.3.1.1	Identification and clustering livestock farmers according to the size of grazing lands
Sub-activity 1.3.1.2	Identification of existing tree and forage species composition in grazing land
Sub-activity 1.3.1.3	Identification of existing grasses and plant species composition in grazing lands and support degraded pasture lands by re-seeding with grass and suited fodder tree species
Sub-activity 1.3.1.4	Estimation of pasture productivity, cost benefit analysis in current climate trends and prediction of the change after intervention and in future climate trends
Sub-activity 1.3.1.5.	Conduct carrying capacity study of the grazing land
Sub-activity 1.3.1.6.	Design silvo-pastoral plan, integrated with the District Land Use Plan

Activity 1.3.2 Select fodder trees, shrubs, grasses, and herbaceous legumes with high drought resilience potential to increase the climate adaptive capacity of the pasture lands

Sites will be identified for tree nursery establishment and nurseries will be established in project sites. It will be managed by the livestock communities under supervision of ICRAF and RAB. MINAGRI through RAB will support the process of selection of fodder trees, shrubs, grasses, and herbaceous legumes and extensionists will assist communities of pastoralists to manage them. The Ministry's livestock specialists will support this process together with ICRAF, based on their long experience from fodder experimental trials in the Eastern Province.

The preferred agroforestry trees and grasses will be identified according to livestock farmers' needs in livestock communities. A list of potential species is included in Annex 1. Tree and grasses seeds sourcing and prioritization will be combined with output 3.3 work on quality germplasm access. Trainings will be conducted on nursery management for fodder trees and multiplication of grass forages for wider distribution and local enterprise development.

Sub-activities	Description
Sub-activity 1.3.2.1	Identification of sites and tree nursery construction
Sub-activity 1.3.2.2	Identification of preferred agroforestry trees, grasses and fodder legumes in the area by livestock communities through rapid participatory survey
Sub-activity 1.3.2.3	Tree seeds and forage species acquisition

Sub-activity 1.3.2.4	Training on tree and forage nurseries set-up, management, planting material distribution and enterprise development

Activity 1.3.3 Purchase and disseminate agroforestry fodder trees, improved grasses and herbaceous legumes to improve grazing land and build resilience of degraded lands

This activity aims to select, organize, sensitize and motivate lead farmers on using improved fodder technologies. Model pastureland will be established for fodder trees and different grasses as pilot demonstration for farmers in project sites. Farm demarcation and paddocking will be established using agroforestry fodder, timber, poles and fruit trees. Farmers will be supported in planting agroforestry fodder trees, grasses, timber, fruits, in farmlands. Farmers will also be trained on management of existing trees in pasture lands using Farmer managed natural regeneration (FmNR) approach.

Sub-activities	Description
Sub-activity 1.3.3.1	Stakeholders engagement: Dialogue/ negotiation, selection, organization and awareness creation for farmer promotors on improved fodder technologies and their motivation
Sub-activity 1.3.3.2	Establishment of pilot demonstration as model pasture lands including different grasses and fodder legumes
Sub-activity 1.3.3.3	Support farmers in planting agroforestry fodder trees, timber, fruit trees and grasses in farmers pastures, in contour or scattered in pasture
Sub-activity 1.3.3.4	Establish farms demarcation and paddocking using agroforestry, timber and fodder trees
Sub-activity 1.3.3.5	Management of existing trees in pasture lands using FMNR technics (Farmer Managed Natural Regeneration) for improving biodiversity

Activity 1.3.4 Organize two Training of Trainers (ToT) sessions per year for 30 lead farmers on management grazing lands for climate resilient pasture productivity

This activity aims to train farmers on tree management practices including harvesting tree leaves and pruning to improve grazing land productivity and milk production. Farmers will be trained on practices of mixing fodder tree leaves and grasses to improve cattle nutrition. Experiences of ICRAF and RAB in feeding livestock with trees fodder and high-quality grasses will be adapted to the context of the Eastern Province and tailored to the specific needs of the livestock communities. MINAGRI will support the training of pastoralist communities on fodder trees and grass forage growing and managing grazing lands. The MINAGRI's livestock extension and veterinary services and programmes such as "One cow per poor family" will bring on board professionals and equipment to facilitate the training of trainers. The transport facility used by these agents will also be used during the campaigns among livestock keepers.

Farmers will be trained on manure recycling to restore degraded land and maintain high productivity of pasture lands. Farmers will also be trained on harvesting time of grasses to optimize the use of grasses, reduce fodder deficit during the prolonged dry season and grazing management to restore degraded lands and enhance fodder budgeting, i.e. grazing rotation. Livestock communities will be also equipped and trained for fodder conservation. An acquisition of hay baling boxes for 60 farms with 3 boxes each and 500 plastic tubes for silage making will provided.

Sub-activities	Description
Sub-activity 1.3.4.1	Training 30 leader farmers (ToTs) on management of trees (harvesting tree leaves for feeding the cows, pruning, thinning) for improving milk and meat productivity
Sub-activity 1.3.4.2	Training 30 farmers on mixing fodder tree leaves and grasses for improved animal nutrition
Sub-activity 1.3.4.3	Training30 farmers on manure composting for enhanced rangeland productivity
Sub-activity 1.3.4.4	Training on harvesting time of grasses for optimizing grasses use, reduce fodder deficit during the dry season and grazing management for restoring degraded lands and fodder budgeting (grazing rotation)
Sub-activity 1.3.4.5	Acquisition of hay baling 3 boxes for each of 60 farms and 500 plastic tubes for silage making

Activity 1.3.5 Assess water availability and rainwater potential harvesting in 60 pastures and purchase 60 water tanks of 5000 m^3 and construction of 60 water troughs to reduce drought stress for the livestock.

Building on the Master Plan for Irrigation and Rainwater Harvesting (2010), water availability will be mapped in pastures of the Eastern Province, followed by the construction of water trough for livestock communities. Sites for rainwater harvesting will be identified and mapped in pasture lands for the construction of 5000 m^3 dams for each targeted pasture. The livestock community will be therefore sensitized for water infrastructure management to maintain rainwater harvesting facilities. Ideally, it will be good to provide for each individually pasture one tank for rainwater harvesting if budget allows but in case where it will not be possible, farmers will be grouped and share available water and then livestock communities will be trained on water management.

Sub-activities	Description
Sub-activity 1.3.5.1	Mapping water availability in pastures of the Eastern Province for boreholes

Sub-activity 1.3.5.2	Water construction for livestock communities
Sub-activity 1.3.5.3	Identification and mapping of sites for Rainwater harvesting in the pastures
Sub-activity 1.3.5.4	Organize and training 15 livestock communities for water infrastructure management (water through, rainwater harvesting and water use)

Activity 1.3.6 Conduct twice per year capacity building workshops for 30 leaders farmers, 7 government extension staff, 7 church leaders and 7 local authorities in charge of development in 7 districts

This activity aims to organize capacity building workshops for stakeholders including lead farmers, government extension church leaders and local authorities. Government extensionists will be trained on fodder production and pasture management using grasses, water and trees. Extension materials will be produced and published, and information will be disseminated through radio, TV, and newsletters. Regular learning exchange visits between livestock farmer groups will be organized to share the experience and champion farmers will be rewarded.

Sub-activities	Description
Sub-activity 1.3.6.1	Meeting with livestock communities
Sub-activity 1.3.6.2.	Identification of knowledge gaps in management of rangelands for government extension service and farmer leaders
Sub-activity 1.3.6.3	Awareness raising for 7 local authorities and 7 church leaders for mobilizing livestock communities
Sub-activity 1.3.6.4	Training 7 government extension staff and 30 farmer leaders on fodder production and pasture management (grasses, water and trees)
Sub-activity 1.3.6.5	Develop extension materials (Training manuals, posters and leaflets) and involve media for information dissemination through radio, TV and newsletters
Sub-activity 1.3.6.6	Organise regular learning exchange visits between livestock farmer's groups and reward champion farmers

Output 1.4 Protective restoration measures are scaled up to climate-proof fragile, ecologically sensitive and erosion prone lands

The table below summarises Output 1.4, which will implement and scale-up diversified agricultural packages.

Key aspects	Description
Description	The objective of the proposed intervention is to climate-proof fragile, ecologically sensitive ecosystems and erosion prone areas upon which populations are dependent, by scaling up protective restoration measures in Eastern Province. This will enhance climate resiliency of ecosystems and the communities that depend on these ecosystems for their livelihoods. The focus of the restoration intervention is on the following areas: a) rivers banks, lakes or marshland shorelines; b) roadside areas; and c) Akagera National Park buffer zone. The aim is to protect or restore approximately 700 hectares of rivers banks, lakes or marshland shorelines and approximately 700 kilometres of roadside areas through activities such as tree planting coupled with Community Vigilance Committee (CVC) and community management approach. In addition, restore approximately 400 hectares of Akagera National Park buffer zone by planting vegetation and implementation of silvopastoral activities. The long-term sustainability of the climate-proofing activities will be promoted through active local communities' involvement, ensuring the local government support by signing the Memorandum of Understandings (MoUs), and establishing local nurseries that will supply seedlings and samplings with the highest climate benefits based on the research carried-out at the local level.
Adaptation benefits	1. Reduced exposure to land erosion and floods communities and their families living in the Akagera buffer zone vicinity.

	2. Increased climate resilience of the sensitive ecosystems and livelihoods in the Akagera buffer zone to climate impacts through silvopastoral activities (e.g. Mulubarhn et al, 2014; Montagnini, 2013). 3. Improved water quality, improved aquatic ecosystems and reduced erosion by protecting and restoring river banks, lakes and marshland shorelines and roadside areas. (e.g.Jägerbrand and Alatalo, 2014; Gebbs, 2016). 4. Reduced flood risk by protecting the rivers shorelines that will act as natural levees (e.g. Engineering with Nature).
Barriers addressed	1. Lack of investment funds to restore or protect sensitive ecosystems; roadside areas; and over exploited Akagera buffer zone. 2. Absence of a community-based tree protection group and a knowledge and technology sharing network. 3. Over dependence on sensitive natural ecosystems and ecosystem services

Description of the intervention

Output 1.4 has the objective to reduce the exposure of local communities and infrastructure to the risk of climate-induced floods and soil erosion by restoring fragile ecosystems near riverbanks, lake and marshland shores. The output comprises of two major types of interventions: A) tree planting in river banks, lake and marshland shorelines and roadside areas close to waterways; and B) promote silvopastoral activities in the Akagera National Park buffer zone.

<u>Tree planting in lakes, rivers, and marshland shorelines roadside areas</u>: The primary objective is to enhance climate resilience of ecosystems by increasing vegetation cover and reducing soil erosion in the riverbanks, lakes and marshland shorelines. The secondary objective is to improve water and soil quality, conserve biodiversity and increase sustainable woody biomass supply for the community use. This will be achieved through a participatory tree planting and management approach drawing lesson learned and best practices from past projects. Multi-purpose tree and shrub species will be selected, and management arrangements will be designed in consultation with the local communities. Taking in consideration the government's interest to increase fruit production in rural areas, the

intervention will plant on an average 10% fruit tree species such as macadamia, mango, citrus, and avocado.

The current management practices to tackle land degradation and build climate change resilience are inconsistent and ineffective due to absence of baseline information and innovative resilience practices. The first step of the strategy is to establish a baseline and strategically select the areas that are most vulnerable to climate change impacts. This will be carried-out in conjunction with other project outputs (output 1.1 and 1.2). In roadside areas, similar activities will be carried-out to assess and map the priority road section in urgent need for restoration and protection. Identified priority rivers, lakes, marshland shorelines, and road areas will be sub-divided into section of around 5 to 10 hectares based on local administrative organization and cell or village representation.

In the absence of regulations on rivers and lake shorelines and roadside planting management, ministerial decrees will be developed with RFA to ensure adequate participatory management and define rules for harvesting and benefit sharing mechanisms. The communities that are managing the 5 to 10 hectares sites will (1) benefit from tree harvest and (2) will be rewarded at the time of final cut/harvesting through a payment in nature (% of wood) or in money (X RWF/m3). The violation of the rules will result in penalties according to the new developed regulations.

Silvopastoral activities in the Akagera Buffer Zone: Excessive wood harvesting and grazing by the communities in the buffer zone vicinity are major risks to ecosystems in the buffer zone. Designing and implementing silvopastoral activities in consultation with these communities is crucial to ensure success of the intervention and long-term sustainability of the ecosystems. Incorporating traditional knowledge and practices when designing a silvopastoral plan is an important step to secure buy-in from the communities. For example, water retention is important to Brachiaria. Brachiaria (preferred by communities), or singalgrass, is known to increase milk production as well as reducing methane emission from cattle.However, due to large quantity of water required to grow Brachiaria, water reserves must be built to ensure undisrupted water supply for growing Brachiaria. Due to the immense importance of Brachiaria in the community, traditional knowledge and practices will be included in designing and implementing silvopastoral activities.

Another important aspect in designing and implementing activities will be the vegetation species selection. Selected species should provide climate change benefits, contribute to local biodiversity conservation, and yield plant products that can be utilized by the local communities. In last 20 years ICRAF has been experimenting and conducting research in Rwanda, including Eastern Province, to identify the best silvopastoral plants species with multiple benefits. In line with output 2.3 and based on the experiment and the research findings ICRAF developed guidance that will be used by the communities and Community Vigilance Committee (CVC) to select the most appropriate plan species for each implementation sites.

In addition, the nurseries supported by Output 1.1, will also provide support to the silvopastoral activities by supplying seedlings as well as sharing knowledge.

For the restoration of these public lands, Community Vigilance Committees (CVC) will be established (based on Enabel experience in PAREF.be2 and FMBE project). MoU will be signed between these CVC and local authorities, defining tasks, benefit sharing mechanisms, modalities (including rules for local community's labours employment) and commitment from each party in the restoration and sustainable management of these protective plantations. Forestry service providers are hired by the project to ensure the proper seedling preparation and planting, while the service provider will hire labour in local communities according to agreed modalities (at least 30% women, targeting most vulnerable).

Table 23 presents a summary of the current practices and expected changes achieved by the project. It shows a list of the opportunities and innovations regarding protective restoration measures.

Table 23. Expected practice changes and innovations promoted in Output 1.4

Items	BAU practices	Expected changes	Opportunities & innovations
Participatory management of road side and river/lake shore plantation	While buffer zone, road side and river/lake shore are public areas with specific protection status, forestry regulations do not provide and detail participatory management modalities and benefit sharing mechanisms to be respected. So by default practices on the field are variable but for now they are not ensuring adequate participatory management of neighbouring farmer which are encroaching and not protecting trees on these areas, as tree ownership and benefit sharing are not clear.	New regulation addressing these special areas provide detail modalities for their participatory management an Participatory management of these specific protected areas through establishment of Community Vigilance Committee (CVC) and MoUs defining management prescription and benefit sharing mechanism enforcing the tree protection.	Participatory approaches (with CVC establishment) experienced successfully in 2015-2019 by RFA projects (FMBE and PAREF) in Eastern Province (Rwamagana, Ngoma, Kirehe) with ENABEL support. Methodology well known and defined. Approach yet to be supported by new regulation that RFA is intending to establish by 2021.
	No systematic and centralized data registration on road/river/lake shore plantation	Centralized and harmonized registration and M&E of data on plantation and CVC of road/river/lake shore	This data collection will take advantage of the under development DFMP database software using GPS tablet, in which specific functionalities will be added.
Silviculture practices	Tree excessively pruned and damaged and/or early harvested	Tree well maintained and pruned/harvested	Good tree management respected according proper rules defined in CVC's MoUs

	Harvest method not secure and leading to too much waste of the good part of the wood.	Application of right method of harvesting, using appropriate equipment (saw mill and protective assets, etc.)	Taking advantage of training and manual develop by PAREF/FMBE project, and lessons from professional forest company (such as SORWATE)
Seedling production	Use of poor genetic quality tree reproductive material for seedlings production, and often use of species not well adapted to the land context and /or to the climate change	Use of genetic quality TRM, and selection of best adapted species considering land/soil context and adaptation to climate change (longer drought period)	Taking advantage of the existing Tree Seed Centre and of its tree seed stand, new tree seed stands and orchards have to be established based on a selection and genetic improvement program, including cloning for some of best climate adapted & productive species
	Use of too small bag in nursery, limiting good growth of seedling roots	Use of appropriate bags	Taking lessons from FMBE project and /or nursery managed by professional forest company (such as SORWATE)
Tendering and contracting of restoration/afforestation works	At District level, the tendering is often based on lower price method, not giving sufficient importance to quality. Payment method not always clearly linked to a quantity of works truly verified/counted in the field. Often tasks are only for seedling production, or a separate one for planting, while a same operator has to be responsible for the overall cycle (nursery, planting, maintenance, guarding, etc..)	Tendering based on quality/price evaluation method, including all required tasks to a same operator, and payment made in appropriate instalments based on quantity truly realized on the field.	Taking advantage of lessons learned in ENABEL/UICN project, using the improved tender and contract template where detailed technical specifications and modalities are provided, as well method for provisional and final works reception clearly linked to instalment payment.

Implementation Sites

The implementation sites for the intervention are grouped into three types a) riverbanks, lake and marshland shorelines; b) roadside areas; and c) Akagera buffer zone.

The rivers banks, lake and marshland shorelines implementation sites will be selected based on the following criteria: 1) erosion prone shorelines due to steep gradient that are exposed or have insufficient vegetation cover for soil stabilization; 2) shorelines that are subject to illegal activities resulting in high-risk for erosion and shorelines failing; and 3) shorelines included in the priority watershed according to participatory landscape restoration opportunity mapping (conducted during Output 3.1) and having an ecological inter-relation with upstream restoration areas targeted by other Output (such as 1.1, 1.2, 1.3).

The roadside implementation sites will be selected based on the following criteria: 1) exposed roadside areas; 2) roadside areas with steep gradient; and 3) along the roads in priority watershed identified by the participatory landscape restoration opportunity mapping (conducted during Output 3.1) and having ecological inter-relation with restoration areas targeted by others Output (such as 1.1, 1.2, 1.3).

For the Akagera buffer zone implementation sites will be selected based on criteria: 1) for silvopastoral activities, within 100 meter buffer on the western border fence, four (4) sites will be selected based on a need analysis; and 2) for vegetation planting activities, steep gradient areas that are most degraded within the buffer zone will be selected.

Best Practices and Lessons Learned

In Rwamagana, Ngomam and Kirehe districts of Eastern Province, a RFA pilot projects was implemented from 2015 to 2019. The pilot project successfully introduced a well defined CVC approach along with signing of the MoUs to define management practices and the benefit sharing mechanism to enforce the tree protection along rivers and lakes shorelines as well as roadside areas. Analysis of result from the pilot project show the seedlings and samplings survival rate between 40% to 80%. For the CVC approach, in each 5 to 10 hectares of implementation site, a group of neighbouring farmers was formed and trained on the protected band area participative management approach and modality. This group elected the members of the CVS that were responsible for management of the project implementation site. A MoU was also signed between the CVC and local authorities, stipulating management prescription (protective species to be planted, density, spacing, harvesting rules, etc.), roles and responsibilities of parties, penalties, sanction, and the benefit sharing mechanisms. These practices will be applied in TREPA.

The tree species that will be selected will be the ones adapted to drought and not requiring watering, with a mixed of native and exotic multi-purpose species (including fruit trees), excluding Eucalyptus.

Furthermore, silvipastoral practices were also implemented as part of the project. For example, the harvesting methodology, identification of vegetation species that are best suited for local areas are well documented. Therefore, lesson learned and identified silvopastoral best practices during the project will be applied in TREPA project to achieve maximum positive results from the project.

The second project that was analysed for the best practices and lesson learned was the Howard Buffet Foundation supported project in Akagera National Park. In Akagera National Park buffer zone, the Rwanda Development Board (RDB) and the African Parks Network entered into a 20-year renewable agreement for the joint management of Akagera in 2009. Lesson learned from the activities in the buffer zone, the Park Management has concluded that silvopastoral activities in collaboration and with support from the district and local authorities is integral part of the long-term sustainable management of the buffer zone.

Description of Activities

Activity 1.4.1: Restore 700 ha of lake/river shorelines and 700 km of roadside through tree/shrub planting and participatory management

This activity focuses on detailed participatory scoping and identification, mapping and classification of potential priority river/lake shorelines and roadside requiring restoration (considering erosion and water management risks, existing tree density), using existing thematic maps (forest cover, road, river, etc.). **To ensure the effectiveness and sustainability of this activity, the project team will establish 210 river/lake shorelines and roadside Community Vigilance Committee (CVC) and sign participatory management MoUs. It will further** conduct training and support RFA/District foresters and Sector extensionists in establishment of CVC using the method experienced successfully by RFA/FMBE project in Rwamagana in 2018-2020.

Sub-activities	Description
Sub-activity 1.4.1.1	Identified priority lakes and rivers shorelines and roadside to be protected reassessed at time of inception for changes since project submission
Sub-activity 1.4.1.2	Establish 210 river/lake shorelines and roadside Community Vigilance Committee (CVC) and sign participatory management MoUs
Sub-activity 1.4.1.3	Conduct participatory tree/shrub planting campaign

Activity 1.4.2 Restore and protect 400 ha of Akagera Buffer zone through tree/shrub planting and implementation of participatory silvopastoral plan

This activity focuses on the restoration and protection of 400ha buffer zone by facilitating the participatory design and implementation of 20 silvopastoral plans for buffer zone and neighbouring ranches. TREPA silvopastoral experts, in collaboration with District and sector officer in charge, will support CVCs (and related ranches owners) in design of silvopastoral plans where the protected buffer zone will be used as a specific area for wood/fodder production and beekeeping. The TREPA project will contract a forest operator to produce required tree seedling and ensure their proper planting on buffer zone while involving CVC according modalities set in MoUs. Gender attention will be given for the labour employment (at least 50% of manpower should be women).

Sub-activities	Description
Sub-activity 1.4.2.1	Establish 20 buffer zone's Community Vigilance Committee (CVC) and sign 20 participatory management MoUs
Sub-activity 1.4.2.2	Participatory design and implementation of 20 silvopastoral plans for buffer zone and neighbouring ranches
Sub-activity 1.4.2.3	Conduct participatory tree/shrub planting campaign on the buffer zone

Activity 1.4.3 Provide technical support to 3 local nurseries in production of selected climate resilient multipurpose trees/shrub seedlings

This activity aims to provide technical support to at least one local nursery for multipurpose silvopastoral/fruit trees seedlings per sub-area. This activity will take advantage of the agroforestry nurseries establishment, which is foresee in output 1.1 to avoid duplication, ensure better nursery sustainability and be more cost efficient by benefiting of synergies.

Sub-activities	Description
Sub-activity 1.4.3.1	Assess and identify at least 3 champion nurseries
Sub-activity 1.4.3.2	Provide technical support and additional required equipment/tools to nurseries for specific tree seedling production

Activity 1.4.4 Provide technical assistance to the seven Districts to perform monitoring and evaluation of restored areas under protection integrating climate resilience

The focus of this activity is to provide technical assistance to RFA in design of required regulation for management of the specific cases of roadside plantation and river/lake shore plantation integrating climate resilience. The project specialists will support RFA with technical inputs to the process of formulating a regulation (such as ministerial decrees) to enforce their proper participatory management and integrate climate resilience. The project will support the District Forest Officers and Forest Sector Extensionists in monitoring and evaluation of restored lake/river shorelines and Akagera buffer zone integrating climate resilience indicators. It will consist in field mission for: (1) provision of technical guidance to local actors to strengthen the understanding/implementation of agreed MoUs; (2) oversight of MoUs and (3) production of periodic District reports on management of these type of restorations. The MoU's control and M&E of these areas under special protection will be done using the user-friendly DFMP software tools and related GPS/tablets. The national and international forestry experts will provide technical support for the on the job training of officers in these M&E activities.

Sub-activities	Description
Sub-activity 1.4.4.1	Provide technical assistance to RFA in design of required regulation for management of the specific cases of roadside plantation and river/lake shore plantation integrating climate resilience.
Sub-activity 1.4.4.2	Integrate new specific functionalities for M&E of these protected areas in the DFMP database (see output 3.2)
Sub-activity 1.4.4.3	Organise annual M&E field missions for the restored areas under special protection

Output 1.5 Clean and efficient cooking energy technologies promoted through support to private sector and communities to transition/reduce Biomass fuel consumption

The table below summarises Output 1.5, which will implement and scale-up diversified agricultural packages.

Key aspects	Description
Overview	The project will support the adoption of improved biomass cookstoves (ICS) for rural farmers in the project's main agroforestry, forest landscape restoration and silvopastoral locations.
Adaptation benefits	1. Reduces woodfuel consumption, thereby reducing associated deforestation and degradation, and maintaining water infiltration and retention capacity of soils; 2. Reduces vulnerability of soils to erosion due to climate related rainfall variability; 3. Improves soil fertility by reducing the use of crop waste for fuel and

	increasing the proportion of organic matter returning to the soil; 4. Indirectly enhances effectiveness of other landscape adaptation measures
Barriers addressed	1. Limited availability of high-performing stoves in rural markets. 2. Inadequate consumer awareness of high performing stove models / inability to differentiate between high- and low-performing stoves. 3. Small and scattered market, limiting economies of scale. 4. Constrained financial capacity of communities and government agencies to meet incremental costs of ICS adoption for adaptation. 5. Limited access to competitive financial products and services to enhance affordability.

Description of Intervention

Output 1.5 contributes to climate resilience in Eastern Province by reducing biomass consumption for energy. The measures included in Output 1.5 will help to avoid overexploitation of forest resources and thereby ensure the success of the agroforestry, silvopastoral and forest landscape restoration activities described in Outputs 1.1 through 1.4.

According to results from the National Forest Inventory conducted in 2015, the current sustainable supply of existing forest and tree resources in the Eastern Province covered only 32% of demand for woody biomass. Total biomass supply is estimated at 549,562 m^3/year while total local demand is estimated at 1.7 million m^3/year. The rapid clearance of wooded areas due to overexploitation of woodfuel resources impacts the ecosystem services provided by forests and wooded areas. In particular, reduced forest cover and forest degradation reduces soil water infiltration and storage and increases vulnerability to erosion due to climate related drought and rainfall events.

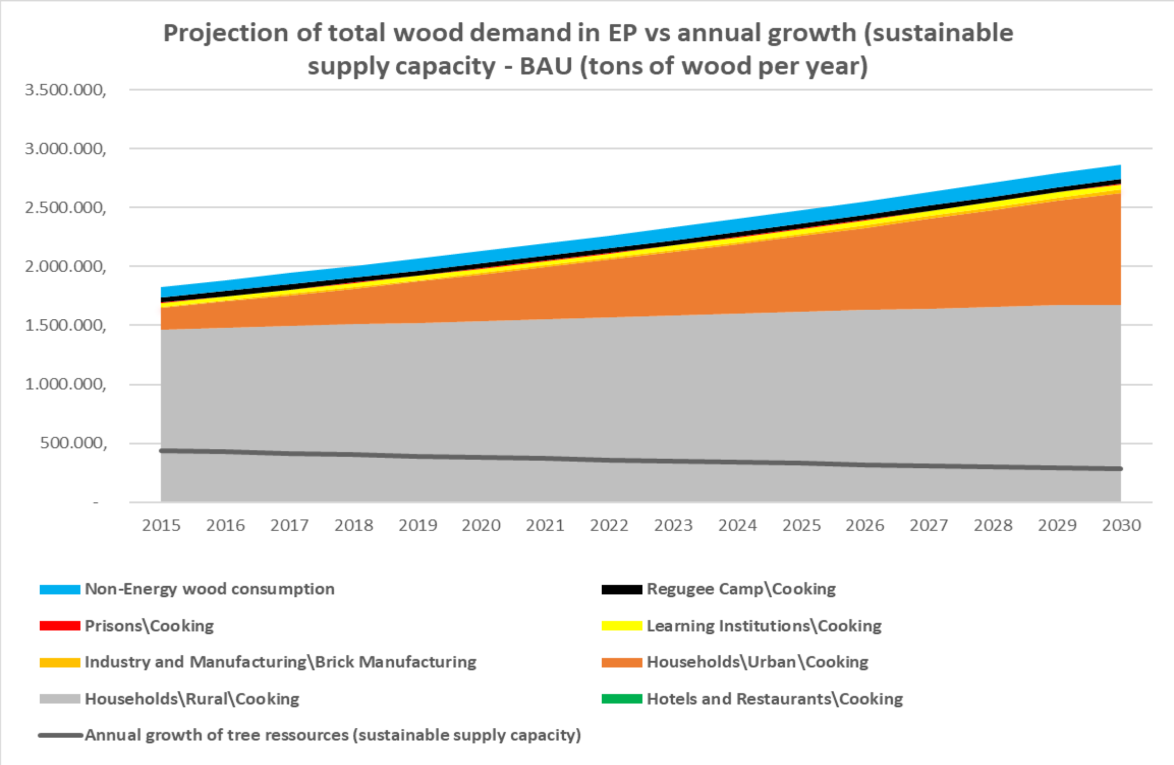


Figure 20. Projection of total wood demand in EP vs annual growth.

A 2018 survey of 600 rural households in Eastern Province (Rwamagana) by RFA-FMBE project supported by ENABEL was conduted and provides the baseline for this intervention, see Annex 9 for full details.

The project responds to the beneficiaries needs identified in the 2018 survey and will contribute to climate resilience in the Eastern Province by promoting the use of high-efficiency biomass cook stove technologies aligned with the Government of Rwanda's BEST Strategy (MININFRA, April 2019), which aims to:

- Increase supply of woody biomass through improved sustainable management of wood biomass resources
- Reduce the demand of wood biomass by *institutional consumers* by shifting to alternative fuels, primarily LPG
- Reduce the consumption of wood by *urban households* through:
    - switching to alternative fuels, primarily LPG
    - replacing traditional charcoal with improved charcoal technologies
- Improve efficiency of biomass usage by *rural households* by:
    - strengthening woody pellets gasifier and briquettes value chains (for households with problems in accessing wood)
    - increasing penetration of high efficiency Improved Cook stoves (ICS) for firewood (for households with easy access to wood)
- Strengthen coordination and capacity building, monitoring and evaluation, to effectively manage the biomass energy sector.

While the restoration activities described in Outputs 1.1-1.4 above will take time to reduce climate vulnerability, the transition to efficient cooking technologies will immediately reduce the rate at which forested areas are cleared and thereby contribute to reduced vulnerability in the short term.

In line with BEST targets (indicated in annex 9), the project aims to increase average rural cookstove efficiency in the project areas from approximately 16% in 2018 to over 40%, with a commensurate decrease in per-household woodfuel consumption.

Technology of intervention

The project will work to address simultaneously four challenges related to more efficient cooking in Eastern Province: (1) need to use higher efficiency stoves, (2) need to use cleaner / more efficient fuels, (3) need to improve stove and fuel affordability, (4) need for policies and regulations enforcing a shift to clean / efficient ICS and fuels. Taken together, these efforts will drive scale-up and improve access to a range of existing cooking technologies (stoves & fuels). Each proposed technology will be tested and supported to further improve efficiency before being sponsored for household adoption. Households will be offered a choice of stove technology best suited to their resources, constraints and preferences. The proposed stove technologies (described in detail in Annex 9) may include but are not limited to:

- Woody pellet gasifier stove (such as MINIMOTO model)
- Wood gasifier stove (such as the "TLUD Karundura" model):
- Woody & multi-biomass improved metallic full consumption stove (such as "Songa", "Rahisi" or "Ruhaka" models)
- Improved fixed mud stove:

Implementation Sites

Given the TREPA project's overall focus on reducing the climate vulnerability of rural agricultural production in Eastern Province, output 1.5 will address the cooking energy needs of over 100,000 households in rural areas targeted by the project's agroforestry, forest restoration and silvopastoral activities. Of this total, approximately 75,000 households will be directly engaged in other project activities. Specific sites will be identified via the stakeholder focused planning process described in each output. For output 1.1, cookstove interventions will reinforce agroforestry activities at sites identified based on mapping and characterization of 100 villages' sub-zone of intervention (400 ha each) for agroforestry dissemination, while for forest restoration activities under output 1.2 cookstove interventions will reinforce work done at sites identified for each of the 7 districts based on the following criteria outlined in Annex 9

Best Practices and Lessons Learned

The WB / GEF **Sustainable Energy Development Project (SEDP)** was approved for implementation in 2009 and ran until 2014. This project focused on rehabilitation of Rwanda's electricity sector and promotion of renewable energy technologies. However, it included a component aimed at promotion of efficient charcoal production and local manufacture of energy efficient stoves. Among other lessons learned, this project highlighted the importance of tailoring ICS solutions to the needs of urban and rural markets, and of working to stimulate end-user adoption. These lessons have informed the design of the TREPA project, which places heavy emphasis on consumer awareness, appropriate technology, and affordability.

The WB Rwanda Improved Cookstove Project, approved in 2017, provides support via GHG emission reduction purchases to two commercial cookstove vendors, Inyeneri and DelAgua. While DelAgua distributes highly subsidized EcoZoom biomass stoves, Inyeneri has developed a business model focused on the sale or barter of fuel pellets to cover the cost of the stove over time. The TREPA project has learned lessons from this ongoing initiative in that these companies have helped to identify and promote high quality stove products in rural areas. The TREPA project will be brand-agnostic, so long as the product meets minimum performance standards. In addition, companies providing improved fuels including pellets are required to demonstrate sustainable sourcing of their fuel supplies.

Description of Activities

Activity 1.5.1: Conduct a large scale and intensive awareness campaign across the Eastern Province on ICS and cooking fuel solutions and opportunities.

The first action is to identify, compare and select, in collaboration with MININFRA, District and different actors of the biomass energy sectors (supported by the TREPA biomass expert), the different models of ICS responding to the minimum requirements (see Sub-activity 1.5.4.1 below) and needs of EP rural households.

In collaboration with ICS producers/cooking fuel dealers and both central (RFA, MININFRA) and local authorities (Districts), TREPA biomass and communication experts will develop a communication strategy, tools and messages specifically targeting and adapted to each profile of households. In order to maximise the impact of the awareness campaign, messages to be delivered must be clear, adapted to needs and attractive in term of sufficiently detailed and pragmatic solutions. These messages and communication tools must consider gender aspect in their design in order to properly reach the women who play an essential role in the cooking processes. On top of wood savings and household air pollution reduction, the wood collection time reduction will have to be highlighted as an attractive and positive impact.

Based on the strategy and tools identified above, this activity will focus on implementing the awareness campaign. While specifics must await the development of the communications strategy, likely measures may include a dedicated radio soap program, special Umuganda with ICSs demonstration events in every targeted village, television spots (for leaders/decision makers), integration of ICS items and demonstration in sensitization/training sessions delivered to cooperatives and groups supported in the context of the restoration activities (see output 1.1 to 1.4).

Sub-activities	Description
Sub-activity 1.5.1.1	Select the ICS models adapted to household needs
Sub-activity 1.5.1.2	Develop the communications strategy, tools and messages adapted to rural households
Sub-activity 1.5.1.3	Conduct awareness campaign in rural areas of the Eastern Province

Activity 1.5.2: Support access to ICSs for over 100.000 rural Households of EP

In collaboration with ICS producers/cooking fuel dealers and central (RFA, MININFRA) and local authorities (Districts), TREPA biomass and micro-finance experts will develop, for each type of ICS/fuel to be promoted, the category/profile of households to be targeted and the related subsidy/microcredit schemes to be implemented to facilitate their adoption of the stoves with minimum concessionality. These schemes will be designed to align with the procedures and rules of identified local partner financial institutions identified in output 2.3, and comply with the modalities of collaboration to be signed between these finance institutions, the concerned local companies selling the identified fuel/ICS combinations and the "Cooking fuel and technology" hubs (see 1.5.3 below).

Leaflets/guidelines will be developed to provide easy understanding of modalities and conditions required to access subsidies/microcredit, and dedicated staff of partner microfinance institution and hubs have to be trained to be able to guide clients in these procedures. The micro-finance scheme and modalities will be tailored to facilitate access to finance for women.

Note that the GCF-sponsored subsidy will be targeted only at the poorest households. The microcredit schemes supported under Output 2.3 will also be used to facilitate purchase of ICS for other households under this Output 1.5.

This sub-activity will identify, sensitize and support private actors to invest in clean biomass fuel/technologies in order to scale up the sustainable supply and adoption of ICS.

This sub-activity includes: organisation of a forum of concerned private sector actors, support in the preparation of feasibility/financial studies for promising solutions (such as for briquette factory), support in business plan development, facilitation of networking with other private actors, technical support in establishment of PPP and negotiation of potential governmental incentives (see relation with output 2.4).

The subsidy for ICS dissemination targeted at the poorest rural household does not provide grant support to ICS suppliers to reduce their ICS sale prices nor are GCF grants used to payback/service private sector loans. Rather the project will directly procure the ICS at the normal market prices and provide them to the beneficiary's farmer households either at full or half subsidy. In combination with establishment of the Clean Cooking Hubs (CCHs), purchasing directly from suppliers will catalyse private sector investment in ICS by boosting the ICS business of suppliers willing to invest in dissemination of ICS in rural areas (for now the ICS supplier are focusing on urban area while they are neglecting rural households due to the risk of no-payment for their supplied ICS). For ICS suppliers, increasing their sales volumes while securing the payment for a significant quantity of ICS and increasing their opportunity to valorize generated carbon credit could reduce the unit cost of the ICS, which should have a positive impact for farmers. On the other hand, the model for dissemination outlined below will also improve the willingness of households to also invest in ICS as improved income generation opportunities and the availability of financing mechanisms allow.

The tentative model for dissemination will be reconfirmed and improved with all concerned actors during implementation. In summary the tentative model, financial terms and conditions and flow of funds should be as follows:

- First, based on the feasibility study, the project will reassess and select the efficient ICS models (Tiers 2 and above) which are adapted to the rural context (type of fuel accessible, cooking habits) of the Eastern Province and will select related private sector ICS suppliers based on their capacity (financial, technical) and capacity/willingness to supply a high number of ICS and support their dissemination through the Clean Cooking Hubs (CCH) to be established in the Eastern Province.
- Secondly, in collaboration with the selected suppliers and local authorities, the project will support the establishment of CCHs across the EP and will developed their internal rules and functioning modalities, where tasks and commitment from different parties will be detailed. Suppliers will have to collaborate and can share the operating costs of these CCH in the extent of their volume to supply. Local ICS technicians supported by the GoR will work with the CCHs to ensure that sensitization and technical support is provided to households and that the choice of the fuel and ICS technology is adapted to their context (income, type of raw material and access, household size and cooking habits, etc.).
- Based on the ICS preference (among selected efficient fuel/ICS model) expressed by household's (conducted through surveys and collected by CCHs), the project will buy the ICS at the normal market cost (USD 10 to 25 per unit depending of the type of stove). The purchase will be done in bi-annual batches to ensure flexibility an adaptation to household's preferences and fuel supply, supply chain and other factors. These ICS will be made available in CCHs.
- At the CCHs level, these ICS will be disseminated among the households which are involved in project activities (forest growers and farmer's beneficiaries of outputs 1.1 to 1.4) based on their expressed needs, according to following rules:
  - For the 50 % of poorest project beneficiary households (detail definition/condition will be set with local authorities at the starting of the project), the first ICS will be given freely. It must be noted that the use of ICS decreases the financial and economic burden of cooking for households, and that is one of the many major constraints of the up-front costs of investment in ICS by the poorest households.
  - For the 50% of low-income beneficiaries (ceiling to be define), ICS will be provided to the households at a targeted 50% market subsidy. For these beneficiaries, CCHs will have to collect the 50% of the cost taken in charge by the households and ensure the half payment of the related invoices from suppliers (half paid by the project, half paid by the CCHs).
- For household already benefiting of the subsidy for their first ICS acquisition, any other request of ICS (for replacement after 2-3 years) will be at their own cost. Under component 2, the project works with local financial institution, CCHs, ICS suppliers to develop financial facilities (low interest loan, etc) that will help any farmer to access to ICS while securing payment to suppliers thus catalyzing private sector investment in the market.

Sub-activities	Description
Sub-activity 1.5.2.1	Develop and establish subsidy/microcredit scheme and rules with local finance institutions and other economic actors (aligned with activities under output 2.3)
Sub-activity 1.5.2.2	Subsidize dissemination of improved cookstoves for poorest households
Sub-activity 1.5.2.3	Support private sector in biomas fuel / ICS business development.

Activity 1.5.3 Establish "Cooking fuel and technology" hubs in 14 main local markets of TREPA intervention areas.

Households surveyed during project preparation indicate that the high efficiency ICS are not readily available on the local market. This is due to the fact that local ICS producers prefer to target households with sufficient financial resources, most of whom are in urban or peri-urban areas. These high efficiency ICS are not distributed in local markets in rural areas due to lack of perceived demand and insufficient financial resources (subsidy or microcredit). It will be important to support ICS producers/dealers in the establishment of "Cooking fuel and technology" hubs in rural villages, where people can readily access efficient ICS and cooking fuels (pellet, briquette, dry wood). These hubs will be established with the support of TREPA but they will be managed and sustained through contribution/participation of the private companies distributing their ICS/fuel product through these hubs. Many farmers are also suing fresh wood recently harvested for cooking, which is reducing considerably the efficiency due to moisture content. These intended hubs will allow also the exchange of fresh wood with dry wood or pellets.

Survey respondents also mentioned the difficulty of knowing which model of ICS is really efficient and adapted to their situation. Some clay models produced locally at very low cost have a poor efficiency and very low durability and can jeopardize the reputation of all ICS. Therefore, the "Cooking fuel and technology" hubs will have to offer only ICS and fuels that are certified/recognized by the MININFRA energy team. In addition, the hubs will have to deliver to clients advice/training/demonstration service (see Activity 1.5.1) in order to help households identify the model which best suited to their need/capacity.

Sub-activities	Description
Sub-activity 1.5.3.1	Develop the business model and internal rules for the "cooking fuel and technology" hubs
Sub-activity 1.5.3.2	Identify the most strategic market locations for hub establishment
Sub-activity 1.5.3.3	Design the hub architectural plan
Sub-activity 1.5.3.4	Establish 14 Hubs
Sub-activity 1.5.3.5	Train hub staff and establish accounting and financial procedures

Activity 1.5.4: Provide feedback into enabling environment activities supporting the shift from traditional cooking to clean ICS and fuels.

Activity 1.5.4 provides ICS-specific inputs into the enabling environment activities described in Component 3 to support the viability of measures to promote improved cookstoves and fuels. The sub-activities under Activity 1.5.4 will allow regulatory and taxation measures to be grounded in real-world experience and provide rapid feedback on their effectiveness in support of TREPA project objectives.

Sub-activities	Description
Sub-activity 1.5.4.1	Develop standard and minimum performance requirements for ICS that will be disseminated through "Cooking fuel and technology" hubs
Sub-activity 1.5.4.2	Provide input into policies and taxation systems incentivizing adoption and use of high-efficiency stoves

Gender aspects and youth

The project is expected to generate disproportionate benefits for women and children. In rural households of EP, cooking activities are performed almost entirely by women.

According to surveys conducted in 600 rural households in Rwamagana, fuel material is collected predominantly by children (48% to 74%) and by mothers (20% to 33%). The time use per day for collection vary between 1.6 and 2.8 hours, which represents a very high investment in time and loss opportunity of investing in productive or educative activities.

	Collector per type of biomass fuel		
Collector	**Crop Residue**	**Firewood**	**Grass/Small branches**
Child	69%	48%	74%
Domestique	2%	5%	2%
Father	1%	4%	2%
Mother	25%	33%	20%
Other	4%	11%	3%
	Average time of collection per day (hours)		
	Crop Residue	**Firewood**	**Grass/Small branches**
	1,66	2,42	2,84

Given this baseline situation, the TREPA project's ICS dissemination activities (sensitization, training, etc.) should focus on women as the primary beneficiaries. However, it is also important to target men, who are evenly involved in household investment decisions (such as whether to purchase ICS and cleaner fuels) as well in production of biomass fuel on their owned parcels. Therefore, the sensitization and awareness campaign will be carried out through the cooperatives / farmers groups used for landscape restoration activities, with a specific emphasis on the women in charge of cooking in respective households. It is crucial that these organized cooperatives / groups, which will benefit from easier access to microcredits / subsidies, are convinced and are willing to invest in purchasing high efficient ICSs for their member households.

a. Component 2: Climate resilient market development and supply chains incentivize public and private investments in forests, rangelands and agroforestry

Component 2 will improve the enabling environment for Component 1. Outputs under this component will strengthen farmer groups, build climate resilience of selected value chains and enhance access to equitable markets by smallholder farmers. The component will also enhance the long-term sustainability of the interventions under component 1 by linking smallholder farmers operating in climate resilient value chains to financial service providers to invest in the transformation of their current agricultural practices into more client resilient and profitable enterprises. The targeted value chains will include:

1. The value chain with a focus on improved feed available and better storage and marketing facilities for milk.
2. Honey and beeswax value chain since honey and beeswax production is closely link to good forest and trees management.
3. Tree based value chains with a potential focus on fruit trees and nurseries for trees distribution. Furthermore, the program wants to stimulate enterprises that can produce low fuel wood consuming ICS and briquettes.

Chains are selected based on their potential to reinforce climate resilient agro-ecological systems as well as create sustainable income flows for smallholder farmers and other chain actors based on an analysis provided in annex 3. In this component relevant chain actors such as producer organizations and financial service providers will be capacitated to engage in these value chains in a climate resilient, economically viable and sustainable manner. Furthermore, private investment capital will be solicited from local and international sources to invest in the climate resilient value chains. The table below summarizes the outcome and outputs comprising Component 2.

Outcome/Outputs	Description
Outcome 2	Famers, communities and people vulnerable to climate change have capacity and access to resources to restore, benefit from, and maintain climate resilient landscapes
Outputs	**2.1** Farmers' groups strengthened to adopt climate resilient land use practices with access to market and finances
	2.2 Enhanced climate resilience of agricultural value chains and commodities
	2.3 Enhanced financial inclusion and investments in climate resilient value chains

Outcome 2 will result in effectively mainstreamed climate adaptation in relevant value chains that offer prospective economic opportunities for smallholder farmers and other chain actors. It will also offer a market for financial service providers that can finance smallholders and other chain actors in an integrated manner. The financing will be linked with other type of climate resilient education creating long-term and sustainable adaptation of project results and beyond. This will lead to a systematic consideration of climate change risks besides other economic risks in financing smallholder farmers.

Capacity building will be required to strengthen farmers, farmers and producer groups/cooperatives, processors and other supply chain actors level understanding of climate resilient measurements side by side with improving economic perspectives. Also financial service providers need to be supported to develop financial products for actors in the selected value chains while promoting climate resilient methods of cultivation.

Table 24 presents a list of identified capacity gaps that will be addressed by the project activities.

Table 24. List of identified institutional capacity gaps that will be addressed by the project

Baseline	Desired project target	Capacity gaps
Producer organizations have limited understanding of climate resilient production methods and other climate resilient interventions e.g cooking stoves Producer organizations have limited capacity to engage in a business oriented manner in selected value chains	Producer organizations can engage in the respective value chains in an economically viable manner with clear understanding of climate resilient production methods and other relevant interventions amongst their members	Limited knowledge of producer organizations on climate resilient production methods and other relevant interventions Limited capacity of producer organizations to engage in selected value chains in a business oriented manner.
Value chains which could be relevant for climate resilient interventions are poorly developed and currently provide limited business perspectives for small holder farmers and other chain actors.	Relevant value chains include climate resilient methods of production in a cost effective manner	Market linkages in the value chains are poorly developed Chain actors have limited knowledge of climate resilient methods of production and storage

Farmers have limited knowledge on climate resilient production methods as well as understanding of financial products such as savings and credit	Farmers understand climate resilient production methods and are financially included.	Poor knowledge and skills to perform monitoring and evaluation of climate resilient landscape interventions at district, provincial and national levels. Limited awareness of cross-sectoral monitoring and reporting mechanisms.
Financial service providers have limited products that could stimulate climate resilient production in selected value chains	Financial service providers understand climate resilient production methods in agriculture and stimulate this in their agricultural portfolio	Limited knowledge and understanding of climate resilient agricultural production and the growing risks related to climate change among financial service providers
Impact investors will be sensitized to invest in climate resilient production interventions in the respective value chains	Impact investors understand and subscribe to the relevance of promoting climate resilient agricultural production in value chains	Limited financial focus of impact investors on climate resilient agricultural production.

The combined trainings and capacity development activities under component 2 will contribute to resilient supply chains in terms of the following features

a) Ability and capacity to deal with the effects and risks of climate change without much effects on production, processing, distribution and marketing
b) Ability to create new and multiple connections and alternatives to address possible gaps resulting from climate change impacts
c) Ability to produce learning, collaborations, spare capacity and flexibility to deal with stresses and shockers resulting from climate risks and changes

Output 2.1 Farmers' groups strengthened to adopt climate resilient land use practices with access to market and finances

The table below summarises Output 2.1 which will implement and scale-up diversified agricultural packages.

Key aspects	Description
Overview	nder this subcomponent, the project will strengthen the capacity of farmers' organizations (FFPos) so that farmer cooperatives and producer groups are actively creating, participating in and promoting value chains production of products based on climate-resilient land. use. The strengthening of Famers's organizations will increase the efficiency of the service delivery by the FFPOs and provide the opportunity for FFPOs to easily benefit from interventions under Output 2.2 and 2.3 hence leading to increased value chains production of products based on climate-resilient land use , improved access to value addition , and increased income; promote self-financing of the FFPOs movement and reduce reliance to government and donor financial support for the sake of sustainability Output 2.1 will provide the opportunity for FFPOs to ultimately benefit from other project interventions and will largely serve as enabler to smooth and effective implementation of the most project activities. Furthermore, insufficient access to credit by most FFPOs warrants further policy action. With this, under this output, the project will employ Citizen Voice and Action (CVA) social accountability methodology which is an effective way to transform dialogue between communities, government and private service providers in order to influence policy standards monitoring and change for improved services delivery to farmer's organizations.

	The work with Farmer's organization strengthening will be closely linked with value chain development activities under output 2.2 and financial inclusion activities and financial products developed under output 2.3.
Adaptation benefits	• Reduced pressure on the forest ecosystem and drivers of forest degradation and deforestation as a result of the benefit generated contributing to stable ecosystems and prospering societies • Enhanced adaptive capacity of local communities to sustainably operate nature-based enterprises • Enhanced livelihoods of the most vulnerable people through employment creation and boosting income of local communities • Strengthened land use, social accountability and social cohesion • Strengthen business relationships between enterprises, value chain actors and private sector linkages through linkages with interventions result chain under output 2.1 that would lead to linkages with producers, wholesalers, supermarkets and other retailers.
Barriers addressed	• Poor management of farmer's organizations • Lack of linkages between farmers and other actors in selected value chains production of products based on climate-resilient land use • Unsustainable use of natural resources by farmers organizations • Policy related barriers to stronger natural resource management

Description of the intervention

Traditionally farmers have organized themselves in cooperatives, producer groups or other informal groups, with common interests like agriculture production and marketing in order to have better access to farm inputs and other agriculture and financial services.

Despite having a strong legal framework in place, the situation analysis of FFPOs shows gaps in limited organisation of farmers and no clear mapping and categorization of organisations to help development partners to work with, plus a lack of policy guidance with regards to role and potential of FFPOs. Existing farmer producer organizations are very deficient in organizational, administrative and technical capabilities. Capacity constraints among farmer groups and cooperatives are also preventing the successful operation of post-harvest processing, drying and storage infrastructure, and this is contributing to perpetuating post-harvest losses, low produce quality and therefore, low prices and diminished income. Cooperatives also require strong leadership to promote good governance and accountability practices that ensure transparency and good management. Furthermore, as service users, farmer organizations lack the capacity to effectively engage with service providers on issues affecting their growth including; the ability to conduct standards monitoring and community score cards in relation to climate change adaptation and land use policy implementation.

Aligned with the work with farmer groups and cooperatives supported under landscape restoration activities of component 1, Output 2.1 aims to enhance competitiveness of the farmers groups and cooperatives by organising targeted FFPOs and strengthening the capacity of those organizations so that FFPOs are actively involved in decision making at all levels and utilising economies of scale for adopting climate resilience land use management practices, be reachable by extension services, have better access to markets and financial services to increase agricultural growth through participation in value chain production of products based on climate-resilient land use promoted under output 2.2. n. Output 2.1 will achieve this by 1) strengthen cooperatives formation and capacity to function as intended, 2) facilitate cooperatives to adopt practices by-laws and ensure that these are enforced, to ensure the success in tree establishment. The outcomes will be achieved through implementation of the following sequential key steps:

1. Working with target community to scope the local economy, consider gendered roles and barriers to participation in decision making at all levels and utilising economies of scale for adopting climate resilience land use management practices
2. Mobilizing and strengthening farmers groups to work collectively to be reachable by extension services, have better access to markets and financial service
3. Linking farmer's organizations to governance, technical and business development training and coaching to ensure they have the required knowledge, skills and behaviours to respond to high end market requirements;
4. Supporting farmer organization to access savings and finance, extension and business services and both new and existing markets by specifically linking them to interventions result chains under output 2.2 and 2.3 (again considering gendered barriers to accessing technical services and markets), ensuring long-term self-sufficiency. Cooperative strengthening has been actively programmed in 35 countries including Rwanda by World Vision with an estimated direct outreach of over 1,000,000 farming families.

Best Practices and Lessons Learned

This output is designed on best practices developed under WVI's existing work in the country and worldwide on Local Value Chain Development (LVCD) focusing on capacitation of farmer groups more productive and sustainable farming practices and livelihood opportunities that removes the need to depend on external/aid assistance. LVCD is an approach which works directly with farmers to increase production, access to markets and increase their profitability which can be well applied in climate resilient value chains as well. It often involves helping producers and farmers to analyse markets, gain information, build relationships and act collectively to overcome production and market barriers and increase profits.

Description of Activities

Output 2.1 comprises of the following activities and sub-activities:

Activity 2.1.1. Integrate targeted famers into existing FFPOs or where appropriate form new ones

An initial assessment of farmers' cooperatives/ groups in the Eastern Province has been conducted and will inform the final validation of existing groups and formation of new groups to be supported by the TREPA project. The first output of this activity will be an updated list of cooperatives and farmers groups with their characteristics including location, membership and composition, legal status, type of activity/value chains in which they are involved as well as the identification of pertinent issues which prevent the groups from and deliver their function as intended.

Secondly, a gap analysis will be conducted to ascertain (1) FFPOs governance/organizational structures: Existence of cooperative organs and women representation, Performance of cooperative organs, Leadership and managerial skills, Participation in group's governance and management, documentation (2) FFPO's finance and assets: Investment capital, Access to loan facilities, financial management, Assets ownership, Access to market information and networking, Support received by and key stakeholders, Capacity to increase revenue and quantity, (3) FFPO's Business Activities: Most common value chains production of products based on climate resilient land use, capacity to improve quality and value addition for traded commodities, Level of satisfaction of services delivered by RCA, Financial institutions, and other relevant service providers, (4) Knowledge and skills on business regulations and advocacy: Level of knowledge on trading requirements and regulations in Rwanda, Level of knowledge on trading requirements and regulations in EAC and other regional block, Knowledge in conducting effective advocacy, Existence of space of dialogue with authorities and stakeholders, Knowledge on environment protection, (5) Women participation in decision making and control: Participation of women in decision making organs and (6) Priority needs for FFPOs across the seven districts and where there is sufficient demand, support will be provided to farmers to form new cooperatives. Furthermore, detailed analyses of the socio-economic situation of the farmers and detailed studies of the relevant supply chains will be conducted before deciding upon the groups of farmers to organize into groups under this activity.

MINAGRI has been working with farmer cooperatives growing and marketing different crops in the Eastern Province. It will support the assessment of these cooperatives' need and the identification of new ones. The ministry's staff will also facilitate the trainings planned under 2.1.3.

The project will support formalization of potential groups and through training under activity 2.1.3, and support to access finance provided under Output 2.3, will allow groups to create a broader financial base, engage in marketing and branding of their products as a unit and meet required standards for their products.

Sub-activities	Description
Sub-activity 2.1.1.1 Updated analysis of existing cooperatives	Organize meetings in all seven districts to identify their current status and update the cooperative/group information
Sub-activity 2.1.1.2. Analysis and identification of new cooperatives	Detailed analyses of the socio-economic situation of the farmers and detailed studies of the relevant supply chains to identify informal groups or potential groups involved in value chains production of products based on climate resilient land use including those cooperatives/groups engaged in production, processing and marketing.
Sub-activity 2.1.1.3. Formalisation of new groups and cooperatives	Assistance to organize and register new formal cooperatives or farmers/producer groups. Supporting organized groups to become legally registered, i.e. meeting the requirements for them to be dully registered at Rwanda Cooperative Agency (RCA) level. Other groups like producer or processor groups participating or ready to participate in value chains production of products based on climate resilient land use will be supported and taken through a process that would facilitate their graduation into full cooperatives.

Activity 2.1.2. Conduct capacity assessment on organizational and financial management of existing FFPOs and develop a comprehensive strengthening plan

Among other issues, this activity aims at identifying capacity enhancement opportunities and governance, financial and cooperative management issues that hinder competitiveness and the potential to increase productivity and sustainable, climate resilient farming practices (production, processing and marketing). The assessment will inform a capacity enhancement program for cooperatives to deliver livelihood and environment benefits.

Sub-activities	Description

Sub-activity 2.1.2.1 Capacity needs assessment	Carrying out capacity needs assessment of selected farmer groups and cooperatives. The output of this activity will be a detailed report elaborating specific barriers faced by each cooperative or producer group to be addressed including competitiveness, productive and sustainable farming practices and knowledge (production, processing and marketing), livelihood opportunities as well as management oriented organisational, governance and institutional capacity.
Sub-activity 2.1.2.2. Development organizational strengthening plan	Informed by the capacity assessment's recommendations, a comprehensive capacity building plan will be developed to address identified challenges and opportunities for capacity enhancement. The output of this sub activity will serve as a basis for more productive and sustainable farming practices and livelihood opportunities.

Activity 2.1.3 Capacity enhancement programme for farmer groups and cooperatives (FFPOs) This activity will focus on enhancing farmer capacity in cooperative management, financial literacy and value chains production of products based on climate resilient land use. Under this activity members of cooperatives will be guided on the best way to engage and acquire economic benefits from targeted value chains including; Tree-based value chain development, Honey and beeswax value chain development and Fodder value chain development This will be achieved through training, exchange/learning visits and established demonstration sites under TREPA component 1 building on the Farmer Field Schools. MINAGRI's focal staff in each district will assist the project team to develop and deliver training programmes. MINAGRI will also support these trainings and shall support the construction costs associated to the crop value chains promotion though ear marked funds allocated every year to the districts of the Eastern Province.

Sub-activities	Description
2.1.3.1 development of training programme	A training institution will be competitively procured to develop a training programme based on Sub-activity 2.1.2.1 Capacity needs assessment and the training needs identified in Sub-activity 2.1.2.2. Development organizational strengthening plan.
2.1.3.2 Delivery of training programme	Deliver cooperatives training programme specific to Farmer Organizations issues and priorities; (competitiveness, processing and marketing under Output 2.2 and production covered under component 1).
2.1.3.3 Direct provision of	Based on the capacity needs identified under 2.1.2.1 and farmer group capacity building plan under 2.1.2.2, WVI will design and deliver internal management strengthening activities. Working

organisational strengthening	directly with farmer groups and cooperative management teams the project will establish their internal systems including but not limited to: management planning and financial procedures, financial reporting protocols, transparency. General guidelines will be developed/adapted from existing materials or customised based on needs of each group.
2.1.3.4 FFPOs coordinate activities to achieve economies of scale and collective	The project will organize learning visits for farmers to FFPOs demonstrating high standards and best practices for value chains of products based on climate resilient land us to promote practical learning. Similar visits will also be organized for 30 farmers/FFPO's members from each district to visit other small holder farmers of comparable land size who have successfully engaged in value chains of products based on climate resilient. The project will seek to ensure that at least 50% of representatives will be women and farmers will share their experience on land use to their fellow FFPO's members upon return.

Activity 2.1.4: Support smallholder farmers` organizations (Cooperative and Producer Groups) to conduct advocacy around climate change related policies and market reforms to regularize prices and subsidies.

Under this activity, WVR Work with community leaders at sector level to identify and form Citizens Voice Action (CVA) Groups. The activity will a) strengthen the capacity of farmers' organizations to conduct advocacy through CVA (Citizen Voice and Action) Groups, b) conduct community dialogues for monitoring standards and community score cards and c) Monitor the implementation of community scorecard action plans through CVA Quarterly Reflection Meetings which will as well include presentations of advocacy papers. MINAGRI's staff will support the project team to sensitize FFPOs and also form CVA groups. They will facilitate meetings and community dialogues at sector levels and shall assure that necessary actions and solutions to major agricultural issues prioritized by citizens are reported to MINAGRI for additional assistance.

Sub-activities	Description
2.1.4.1 Work with community leaders at sector level to identify and form Citizens Voice Action (CVA) Groups	WVR through its partners implementing CVA will organize Community meetings at sector level to identify and form CVA groups from established FFPOs. At the end of this exercise a list of CVA group members will be generated and shared with the Sector, District and TREPA project PMU as well FFPO's governance committees.
2.1.4.2 Strengthen the capacity of farmers'	Through organized community dialogue between cooperative members and decision makers on climate change related issues the project will build on it to equip cooperative members to

organizations to conduct advocacy through CVA (Citizen Voice and Action) Groups	understand their rights through Citizen Voice and Action (CVA) and other advocacy activities, they can advocate for improve policies both at the local and national levels.
2.1.4.3: Conduct community dialogues for monitoring standards and community score cards.	The project will support CVA groups to organize community dialogues with service providers, Local leaders and community members (service users) for monitoring standards and community scorecards to identify service delivery gaps and make their intentions known and seek support and finally develop action plans.
2.1.4.4. Monitoring the implementation of community scorecard action plans through CVA Quarterly Reflection Meetings	Emphasis will be put on these meetings so that groups feel supported and progress on all action plan points are discussed and the necessary actions are taken and try as much as possible to look for solutions to majority of issues prioritized by the citizens during the action plan development.

Output 2.2 Enhanced climate resilience of agricultural value chains and commodities

The table below summarises Output 2.2 which will implement and scale-up diversified agricultural packages.

Key aspects	Description
Overview	The subcomponent has two key objectives: 1) to reinforce climate resilience in key agricultural and tree crop value chains in the Eastern Province of Rwanda; 2) to strengthen value chain capacities and associated infrastructure in this Province. Findings from the feasibility study show that lack of proper infrastructure, human capacity and access to information remain the biggest challenges for improving the climate resilience of agricultural and tree crop production along the nodes of the associated value chains. Activities in this component will enhance climate resilience in the selected value chains through client-specific capacity building among diverse groups of value chain actors and stakeholders, building on local knowledge and stakeholder networks and boosting the infrastructural capacity for climate and market services.
Adaptation benefits	• Access to climate information enhances adaptive capacity of the local communities and agribusinesses to operate climate-resilient and energy efficient enterprises based on agricultural and tree crops • Strengthened business relationships between farmers, buyers, processors, and traders through enhanced institutional arrangements around climate resilience and energy efficiency • Poverty reduction through generation of employment and income across a portfolio of value chains

	• Reduced pressure on the forest and other wooded ecosystem (less deforestation and forest degradation) through improved production modes and value adding
Barriers addressed	• Poor capacity to engage in climate-resilient and energy-efficient production in value chains of agricultural and tree crops • Lack of supportive infrastructure for wood fuel, honey, beeswax, livestock and tree crop value chains • Limited value adding to agricultural and tree crops due to poor processing facilities, high wastage and limited agribusiness capacity • Lack of structured access to climate information services that enhance the planning for adaptation

Description of the intervention

The projected climate change scenarios in Eastern Province revealed that temperature, precipitation volume and seasonality are going to be critical factors affecting different stages of value chains including production, processing and marketing of the dairy, tree crop, and honeybee value chains (See Annex 3 for further details). Capacities, skills, sustainable business models (with suitable access to attractive finance) across the targeted value chains are not developed such that production would be climate resilient, nor is processing and marketing material and energy efficient. For the agricultural cooperatives to benefit from the project's support, they will be required to meet minimum criteria, such as willingness and readiness to integrate climate-resilient and low carbon technologies within their cooperatives at every stage of the value chain (including renewable energy use). The principal activities in this component comprise:

1. Interventions identification and implementation to improve climate resilience in selected value chains of wood fuel, honey, beeswax, dairy and tree crop.
2. Building local capacity for climate resilience and farm level production energy efficiency in value chains
3. Co-establish climate resilient infrastructure for major agricultural products and commodities
4. Expand Information and Communication Technologies (ICT) to boost information systems and decision support tools for climate resilience and farm level energy efficiency in value chains stated above.

Best Practices and Lessons Learned

World Agroforestry (ICRAF) has longstanding experience (more than 20 years) in strengthening the positioning of smallholders and collective enterprises (incl. cooperatives) in value chains of agri-food and tree crop products around the globe. ICRAF's approach to value chain development takes the organization of smallholders into viable businesses as a point of departure. It is the level of collective enterprises, such as cooperatives and other types of smallholder run small and medium enterprises (SMEs), where the development of business skills has proven to be most impactful. The most effective ways to create and strengthen such business skills have turned out to be customized trainings based on the training of trainers (ToT) approach. In addition, ICRAF has generated ample evidence for the business and technical skills strengthened through the establishment of rural resource centres where face-to-face interaction for specific knowledge and information needs is offered, along with ICT-based information that is accessible to smallholders and cooperative managers through smartphones, tablets and laptops, respectively. Over the past decade, ICRAF has also generated valuable experience in leveraging impact investments and other forms of responsible finance for the development of agricultural and forest product value chains involving smallholders and SMEs. This will be made available to the project at the interface between subcomponents 2.2 and 2.3.

The activities supported under this component have been selected to be complementary with the baseline activities and projects undertaken within and planned for the Eastern Province. While the development of some of the cereals, cassava, banana, Irish beans and dairy value chains are supported by the Government through the MINAGRI, with multilateral funding, this component has been designed to be additional to them through activities 2.2.5 to 2.2.7. Component 2 will also be complementary to the work undertaken under the baseline activities by providing some specific support to value chains that are not considered in the baseline (activities 2.2.1 to 2.2.3 for tree crops, bee product and fodder value chain respectively) but are critical for having a coherent approach, which will lead to the climate resilience of the Province.

Description of Activities

Output 2.2 comprises of the following activities and sub-activities:

Activity 2.2.1: Tree crop value chain development

The project aims to diversify livelihoods as a means of increasing climate resilience through tree crop value chain development and addressing the growing and unmet demand for wood fuel. Appropriate seeds adapted to local soil and changing climatic conditions need to be procured, quality planting material needs to be produced, and adequate distribution channels need to be developed. There is great potential to generate employment and income through raising seedlings and other planting materials such as vegetative propagated plant parts while at the same time ensuring sustainable supply of woody biomass and other products such as building materials, fruits, seeds and nuts derived from trees.
Among the key challenges for restoration and further tree growing in the province is the scarcity of planting materials. The province also lacks any organized tree seed centres that could be providing tested quality seeds for the production of seedlings.

Key to sustainable supply of planting materials is a functioning private sector enterprises and sustainable business models. As such, community-managed tree seed enterprises will be established to secure the continued supply of quality seeds for the production of seedlings in nurseries in support of restoration efforts in the province and beyond. This activity builds on farmer technical capacity developed under component 1 output 1.1, 1.2, 1.3 and 1.4. which support initial forestry and agroforestry seed production and nursery cultivation. The intention is to transfer some of these responsibilities to the private sector after sufficient and effective trainings and other capacity support schemes. The transition to private sector ownership will likewise be supported by output 3.3 which will enhance the national seed and seedling supply system and promote climate adaptation through access to high quality and climate resilient planting material.

In order to ensure sustainable fuelwood and ICS value chain and meet household needs identified in output 1.5, the project will establish a flourishing privately manged woodlot. For the privately managed woodlot contractual farming will be established and linked with the demand generated by the private sector operated cooking fuel hub activities established under output 1.4. Contract farming, if well designed, can be an effective arrangement for providing the start-up capital and other resources required by the communities through the energy enterprises in return for the wood they will be able to source from the woodlots on a sustainable basis. This activity will be supported by the establishment of private woodlots in Component 1.

At least three local seed enterprises and three district level tree nurseries (those established under with viable business plans will be established with focus on quality seeds, seedlings and vegetative propagated planting materials of timber, fruits, nuts and other commercial tree species suitable for the province. The enterprises will be run by youth and women in close collaboration with men from the local communities. MINAGRI's staff working on Fruits and nuts value chains will support the project to develop the nursery enterprises. Champion farmers will be incentivized by receiving improved seedlings and other farm inputs. The Ministry will provide transport to extensionists to reach farmers involved in these value chains.

Sub-activities	Description
2.2.1.1 establishment of seed enterprises	3 seed enterprises trained with viable business plans established and run by youth and women groups
2.2.1.2 establishment of nursery enterprises	Three district-level tree nursery enterprises trained with viable business plans established and producing seedlings required for restoration in the province
2.2.1.3 establishment of contractual wood farming	Establish contractual wood farms in the province which supply raw material for the production of wood pellets for energy use. 50 cooperatives to allocate land areas of 50-70 ha each for

	establishing the contractual farms. This would lead to an area of about 2,500 ha under contractual wood farms.

Activity 2.2.2: Bee product value chain development

Beekeeping is a common livelihood practice in the Eastern Province. The production system is mostly traditional, resulting in relatively low productivity. Over 40% of the beekeepers in the province do not even have basic knowledge of beekeeping compromising their ability to enhance resilience through livelihood diversification and increased resilience of bee product production.[130] The honey produced with such rudimentary practices is perceived to be low quality, due largely to the contaminants originating from inappropriate handling during harvesting and storing. This, in turn, compromises the market value of the honey compared to that of honey produced with improved technologies. Strengthening the capacities of local communities to produce value-added products will increase resilience of farmers diversifying livelihoods and incomes.

An estimated 20 beekeeping cooperatives operate in the Eastern Province or its surroundings. Members of these cooperatives will be trained on improved honey production techniques and value-adding through wax-based products. This involves establishing honey and wax storage stations and associated processing facilities

Cooperatives are also an important vehicle for fostering tree growing for improved bee forage. As the availability of bee forage is characterized by marked seasonality, an important strategy to increase bee forage is to expand the cultivation of agroforestry tree species that provide preferred bee forage also during the off-season.

MINAGRI will support bee product value chains through the Ministry's bee/honey programme. On-ground staff will closely work with the project to train cooperatives in best practices. MINAGRI will also provide transport to the staff to reach 20 bee keeping cooperatives. The project will foster interactions between the cooperatives and private companies through business round tables, trade fairs and similar events around honey and products based on beeswax. Each beekeeping cooperative will have established at least 10 ha of diverse bee fodder species in their localities will lead to the establishment with about 25,000 bee forage trees sourced from the nurseries established under component 1. The project will also introduce improved beehives for at least 50% of the cooperatives and establish the 'Akagera brand' for Eastern Province landscape labelled honey and wax products.

The following interventions will be instrumental in transforming the honey and beeswax value chains through involvement of local producers with strengthened capacities.

Sub-activities	

[130] Mushonga *et al*. 2019, Characterization of the Beekeeping Value Chain: Challenges, Perceptions, Limitations, and Opportunities for Beekeepers in Kayonza District, Rwanda. See: https://www.hindawi.com/journals/aag/2019/5982931/

	Description
2.2.2.1 Strengthening beekeeping cooperatives	At least 10 honey and wax storage stations and associated processing facilities established At least 200 coperative members (at least 40% of which are female) trained in improved honey production techniques and value-adding through wax-based products At least one long-term, equitable business relationship with a wholesale/retail company each among 20 beekeeping cooperatives
2.2.2.2 Improving tree-based bee forage	20 beekeeping cooperatives with at least 10 ha each of diverse bee fodder species, with a total of at least 25,000 bee forage trees (closely coordinated with agro-forestry activities under component 1).
2.2.2.3 Introduction and distribution of modern beehives	At least 10 beekeeping cooperatives provided with improved beehives
2.2.2.4 'Akagera brand' establishment for landscape labelled honey and wax products	Establishment of the Akagera brand for locally produced honey, candles and soaps based on beeswax

Activity 2.2.3: Fodder value chain development.

In general, feed shortage is the single most important challenge for dairy sector development in Eastern Province and Rwanda as a whole.[131] Due to the shrinking size of landholdings and encroachment and the concomitant reduction in grazing lands, feed scarcity has turned into a principal concern for livestock owners in Eastern Province. Development of livestock feed business models and livestock feed enterprises are a principal option to tackle the scarcity of feed supplies, particular during the dry season. Demand livestock feed in Rwanda is already high due to frequent droughts and the resulting readiness of farmers to invest in feed to save their animals. Properly processed and packaged feed can also be transported to Kigali where livestock feed is becoming a serious challenge for households owning livestock.

This activity will focus on the development of sustainable business models and establish livestock feed and fodder landscape restoration enterprises run by trained youth and women

[131] Eugene, M. 2017, Characterization of Cattle Production Systems in Nyagatare District of Eastern Province, Rwanda. See: https://www.omicsonline.org/open-access/characterization-of-cattle-production-systems-in-nyagatare-district-ofeastern-province-rwanda.php?aid=91895

(under activity 2.1.5) to establish and manage such enterprise at district level in groups and cooperatives. The enterprises will harvest livestock feed, which is usually abundant during the rainy season, preserve and package it, and sell it during the dry season.

MINAGRI, through RAB has been piloting different fodder species and will be support this activity and the livestock feed and fodder landscape restoration enterprises through provision of qualified staff and equipment to demonstrate fodder storage technologies, milk collection and cooling technologies as well as best livestock rearing practices such as rotation grazing and grass and fodder farming. The one cow per poor family and veterinary services already on-ground in the Eastern Province will support the project in sensitization and pastoralist mobilization. Restoration enterprises will initially be supported by the project to restore degraded areas to produce feed for livestock, particularly fodder trees, Napier grass, and indigenous high-value grasses by deploying enclosure systems and rotation grazing approaches. The project will also establish large storage areas for livestock feed preservation and drying and packaging. Emphasis will be placed on feeds and methane-reducing feed additives that will lower methane production from ruminant animals.

The project will support interactions between milk producers, their cooperatives and private companies to strengthen district-level milk storing stations and, to the extent possible, co-investments (aligned with activities under Component 2.3). Stations will reduce spoilage while at the same time improving milk quality for processing into dairy products. Part of the added value is expected to flow back to the milk producers through the cooperatives.

The activities in this sub-activity closely align with the interventions and outputs planned in Component 1 subcomponent 3 on silvopastoral systems.

Sub-activities	Description
2.2.3.1 Establishment of livestock feed enterprises and storage areas	At least three livestock feed enterprises and storage areas established that source feed from the silvopastoral systems established (supported by 2.2.1.2).
2.2.3.2 Establishment of restoration enterprises	Seven (one per district) youth-operated restoration enterprises for boosting livestock feed supply through enclosure systems and rotation grazing and grass and fodder tree establishments in degraded areas
2.2.3.3 Proper management of cooling and storage stations	Management recommendations for existing milk cooling and storage stations in the districts is the emphasis here.

Activity 2.2.4 Building local capacity and knowledge for climate resilience in value chains

Climate change and variability pose great challenges to the value chains of agricultural and tree products in the Eastern Province. Building local capacity for climate resilience and energy efficiency in the targeted supply chains will be critical in response to climate change and associated challenges. MINAGRI's agri-business focal points in Eastern Province will support the project in various trainings intended to build the capacity for climate resilience value chains. As such, a short training program will be developed and differ in terms of form and content across the following stakeholder groups: 1) political decision makers, 2) providers of technical, business and financial services, 3) agribusiness and cooperative management (which will be covered under 2.1.3), and 4) farmers. Coordinated with farmer group and cooperative training delivered under activity 2.1.3, the training will be conducted at rural resource centres developed under output 2.2.5

At political and enterprise levels, emphasis will be on sensitization of political and business leaders as regards policy and business options in relation to climate resilience and energy efficiency. At the level of service providers, trainings will be based on a Training of Trainers (ToT) approach to enhance the delivery of climate-relevant technical, business and financial services. At cooperative and farm level, trainings will focus on enhanced capacities for climate-resilient production techniques as well as improving farm level energy-efficiency.

Sub-activities	Description
2.2.4.1 Development of training modules on climate-resilient agribusiness	Training modules will be developed for climate-resilient agribusiness for political decision makers, agribusiness service providers and farmers.
2.2.4.2 Delivery of training modules on climate-resilient agribusiness	At least 300 political decision makers, agribusiness service providers and farmers trained in technologies and techniques that foster climate resilience and energy efficiency in the targeted value chains

Activity 2.2.5. Establish/rehabilitate seven Rural Resource centers and market infrastructures for climate resilient value chains

To support ongoing delivery of extension services, and to share the same site as the largest of the agroforestry/fruit trees nurseries (under activity 1.1.3), the project will establish or rehabilitate seven rural resource centers that will serve as demonstrations/training sites and will create resource and training centers for service provision and to support linkages among technical service providers, agribusinesses and farmers. Adjoining market structures will be developed or rehabilitated. The PMU will work closely with districts offices to identify sites where rural resource centres and market infrastructures will be constructed/rehabilitated. This will follow the district master plan and the strategy position where these centres will be of maximum use. Land will be provided by the Rwandan Government.

Sub-activities	Description
Sub-activity 2.2.5.1 design of construction or rehabilitation works for centres and markets	For seven sites the project will design new centres and outline the rehabilitation necessary for existing centres (training room and adjoining kitchen and toilet facilities). Adjoining market infrastructure will also be constructed or rehabilitated (open air roofed structure with built in market benches).
Sub-activity 2.2.5.2. construction or rehabilitation works for centres and markets	Construction or rehabilitation works for seven rural resources centers and adjoining market infrastructure will be undertaken.

Activity 2.2.6.Trade fairs and business roundtables connecting farmers with other value chains actors for marketing products based on climate-resilient land use

For the enterprises and small business to flourish, access to market and market actors is crucial. Often, smallholder producers and their cooperatives lack such opportunities getting networked with market actors beyond the local level. Similarly, key market actors and buyers also often lack proper connection to the producers and the products that exist in the country. Trade fairs and business roundtables help link market actors and smallholder producers by giving them the opportunity to display their products and objectively discuss a potential business opportunity depending on their production capacity. This project intends to run at least one national trade fair and roundtable at national level and a medium sized ones taking place in each of the districts from year 2-5.

Sub-activities	Description
2.2.6.1 Organize annual trade fairs and business roundtables in Year 2, 3, 4 and 5	Trade fairs organized at national level once every year from year 2 to 5. At local levels, district level trade fairs to link up with local market actors established. Roundtables happen only at national level once a year between year 2 and 5.

Activity 2.2.7 ICT supported climate risk, market information and knowledge products for climate resilience in value chains

The project will leverage Rwanda's fast-growing internet and smart phone penetration projected to reach 60% by 2020 and existing Information and Communication Technologies (ICT) platforms developed by ENACTS and FAO project "Agricultural Services and Digital Inclusion in Rwanda" to promote climate resilience in agricultural and tree crop value chains. Activity 2.2.5 will be linked with output 3.2, providing direct support to farmers to participate in information sharing and use of knowledge platforms and products. Activities will include, but not limited to, mobile phone alerts through short-message services (SMS) and information dissemination through existing mobile applications[132] loaded with the up-to-date climate risk information and market information and data on pertinent value chains, as well as citizen science to effectively engage the users with prompt responses and updates.

Sub-activities	Description
2.2.5.1 Compile and disseminate market information	Compile and disseminate market information on selected value chains via existing platforms in user friendly manner. Deploying the 'citizen science' approach with market dynamics, data and information inputs from farmers, processors and value chain actors.
2.2.5.2 Establish farmer-to-farmer communication	Establish farmer-to-farmer climate and market information communication pathways and identifying 100 community champions (leaders) who will coordinate the process
2.2.5.3 Produce user friendly knowledge products	Production of infographics, policy briefs and scientific publications based on the lessons learnt. This will largely contribute to the learning, replication and scaling-up process targeting a wide range of information users. These will be shared in rural resource centres.

[132] Existing mobile applications will include: "Cure and feed your livestock","eNtrifood","Weather and crop calendar"and "AgriMarketplace"

Output 2.3 Financial inclusion and investments for climate resilient value chains

The table below summarises Output 2.1 which will implement and scale-up diversified agricultural packages.

Key aspects	Description
Overview	Output 2.3 enhances the long-term sustainability and economic viability of the project by linking smallholder farmers (in particular women and youth) operating in climate resilient value chains to financial service providers. Linking to financial service providers can include both savings and credit. Furthermore, it is also envisaged to link downstream value chain actors engaged in processing and trading to respective financial service providers or investors. Financial service providers will be capacitated to develop financial products, including savings, for groups involved in targeted climate resilient activities described in 1.5 as well as develop specific financial products in the climate resilient niche value chains for honey/tree-based product, and fodder value chains for smallholder farmers and other chain actors. Financial service providers will also receive capacity building support to enhance their capacities both at branch levels and at headquarters to analyze climate resilient methods of agricultural production in mainstream crops and include indicators for measuring and awarding such methods of production. Furthermore, this component will support enterprises that produce ICS and briquette making units for cooking. These enterprises can be especially interesting for youth and young entrepreneurs and will require specific financial products tailored to their needs.

	Product design and development will be based on assessment of demand for financial products and services, detailed screening and adaptation of internal procedures of financial institutions, and pilot testing and evaluation of financial products for the selected value chains. Financial products will be interconnected with climate resilience education for chain actors under outputs 2.1 and 2.2. and for mainstream crops techniques will be developed to analyze and score climate resilient agricultural production techniques.
Adaptation benefits	• Increase farmers' access to finance for climate resilient production in agriculture and specific niche value chains. • Enhance financial inclusion of rural poor households and women and youth, to improve climate resilient livelihood strategies • Effect of activities will be a reduction of farmer production losses because of climate adaptation in land-use planning, weather and disease monitoring in production processes • Effect of activities will be a reduction of farmer's losses in storage and post-harvest handling of produce. • Effect of activities will be an enhancement of overall participation of women in climate smart handling of crops and post-harvest handling. • Reduce long term credit risks related to financing smallholder farmers by creating a sustainable business perspective with climate resilient production technology. • Evaluate the potential for youth who develop climate mitigation small projects like cook stoves to enter into financed businesses.

	• Create an environment for impact investors interested in climate resilient impact
Barriers addressed	• Farmers have limited knowledge on climate resilient production methods as well as understanding of financial products such as savings and credit. • Financial service providers have limited products that could stimulate climate resilient production in selected value chains • Lack of access to finance for rural population especially women and youth • Limited financial education among smallholders • Lack of participation of women in access to finance for climate resilient production methods in the respective value chains. • Lack of jobs for youth in climate resilient economic activities. • Limited loan fund capital in the side of Financial Institutions • Impact investors and banks are not sensitized to invest in climate resilient production interventions in the respective value chains • Agri-insurance services to smallholders as a way of transferring risks is still new with limited coverage.

Description of the intervention

The relevance of financial services to mitigate risks of climate change and to stimulate climate resilient production methods is envisaged through the following aspects:

1. Enhance climate resilience and livelihood at household level by stimulating savings groups, particularly for women
2. Reduce the risks of the effects of sudden changes in climate such as drought or flooding by linking agricultural credit risk assessment tool scoring to indicators on improved erosion control and land management practices and to early warning

messages on drought and rainfall, also for loan officers who are in regular contacts with clients.

3. Encourage farmers to use climate resilient production methods through enabling better access to credit and by reducing credit barriers for repeat loans when climate resilient production methods are successfully implemented. (erosion control, water harvesting and gradual reduction of the use of pesticides for example) It is envisaged that the smallholder farmers and cooperatives that are trained on climate resilient production processes under component 2.2 are first eligible for access to finance from the respective financial service providers. Indicators to assess this properly will be included in loan assessment and monitoring systems. These clients will have access to these products during the piloting and scaling of the products developed.
4. Improve pre-and post-harvest losses through better handling and storage of produce e.g. honey ,fruit trees and fodder products. This will have an immediate positive effect on farmers' income as well as a long-term effect on climate resilient through drastic reduction of wastage.
5. Facilitate widespread usage of improved cooking stoves and alternative energy sources (solar power, biogas) by providing financial services for such equipment's side by side with productive investment loans and looking at youth as potential clients.

Table 25 below summarises some of the selected and supported value chain actors, the baseline commercial financial products available to them, prevailing commercial interest rates and loan conditions (if these products do exist). The table also presents potential financial products that will be developed for the project, targeted interest rates and loan conditions. Figure 15 of the value chain shows various value chains, actors across those value chains and the financial products across those value chains the project will support to develop.

Target group	Baseline	Year 1	Year 4
Vulnerable rural groups involved in cooking stoves woodlots production	No access to formal finance, very limited informal finance, low financial literacy	Financial literacy, Savings linked to FSPs First group guarantee loans for woodlots, group loans assessed by group coherence tool	Access to savings and loans of FSP, including digital transfer options Bigger group guarantee loans small enterprise loans for groups in fodder production
Farm households	Limited access to timely and seasonal agri-loans, single commodity loans based on high physical collateral, limited financial literacy. Prevailing commercial interest rates for similar financial products for single crop product interest rates vary above 18%, require collateral and have short tenor of only 6-12 months	Access to agroforestry loan on mixed term conditions (1-5 years) incentivizes engagement in agroforestry practices and reduces collateral needs, financial and climate resilience education.	Agroforestry loan on mixed term conditions (A-CAT plus) (1-5 years) incentivizes, crop and tree monitoring as alternative collateral (geo data). Reducing the rate 15% and the collateral conditions become flexible and linked to agro-forestry monitoring.
SMEs processing agroforestry products	No access, no specific products for niche SMEs processing agroforestry products or producing cookstoves. Prevailing interest rates for similar financial products which are only provided in urban areas are around 18% and require significant collateral and tenor of only 6-12 months	Access to prototype loan for investments in machinery and equipment (processing of agroforestry products and cookstove production), credit risk assessment tools developed.	Access to improved loans for SME investments linked to processing of agroforestry products and service units for a number of SMEs. Reduced interest rates to 15% or lower and tenor increased to 5 years.
Financial service providers	Limited knowledge and understanding of climate impact on target groups, no tailored financial products limited loan capital, no tools to fair appraise agriculture loans, lack of risk management tools	Assessment based agroforestry and prototype loans for niche SMEs, linking products for savings groups, risk management knowledge on climate impacts improved. Improved or developed tools to assess risk.	All types of new loans tested, adjusted and rolled out including digital and geodata monitoring of plots, roll out to all areas (future: nationwide roll out and other MFIs)

Table 25 TREPA Financial instruments and baseline situation

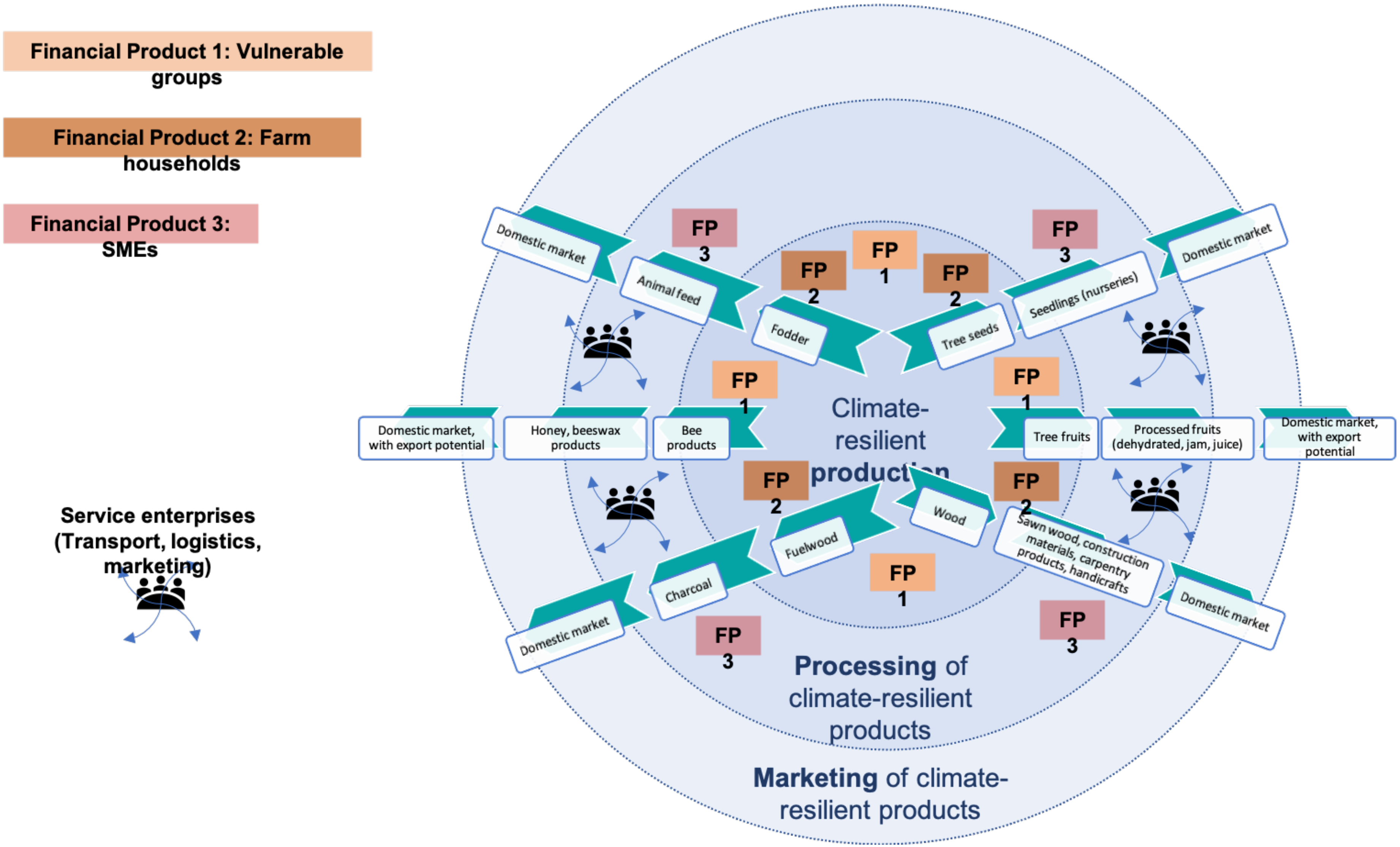

Financial Product 1: Vulnerable groups
Financial Product 2: Farm households
Financial Product 3: SMEs
Service enterprises (Transport, logistics, marketing)
Climate-resilient production
Processing of climate-resilient products
Marketing of climate-resilient products
Domestic market
Animal feed
Fodder
Tree seeds
Seedlings (nurseries)
Domestic market
Domestic market, with export potential
Honey, beeswax products
Bee products
Tree fruits
Processed fruits (dehydrated, jam, juice)
Domestic market, with export potential
Fuelwood
Charcoal
Domestic market
Wood
Sawn wood, construction materials, carpentry products, handicrafts
Domestic market
FP 1
FP 2
FP 3

Figure 15 Financial products across a portfolio of value chains in Eastern Province, Rwanda

Key activities include:

1. Ensure inclusion of women and youths in groups organized around restoration activities (in 1.5) by stimulating savings for income generating activities including equipment acquisition, and financial education and linking them to financial service providers.
2. Stimulate improved land management and erosion control measures in mainstream agriculture by including indicators to value these improvements in current loan products and incentivize farmers to use such practices through faster and easier access to loans for stable crops.
3. Ensure value chain finance products closely linked and connected to the producer organizations and value chain development activities as stipulated in 2.1 and 2.2. which are honey, fruit trees and fodder.
4. Detailed and comprehensive scoping of financial service potential in the respective value chains, as input for detailed product design and development
5. Create climate awareness and sensitivity for financial service providers and investors (farmers and value chain actor's collaboration is already foreseen in 2.1 and 2.2)
6. In collaboration with financial service providers, design and pilot testing of financial products for the respective value chains,
7. Evaluate and adapt the financial products based on client satisfaction, organizational sustainability and relevance for climate resilient production methodologies.
8. Implement the roll out and upscaling plan of financial products developed
9. Facilitate impact investors to engage in investment for SME's in the relevant value chains
10. Support the mobilization of loan fund for microfinance institutions participating in the project
11. Connect financial service providers to insurance programs.
12. Co-organize learning events to stimulate wider use of financial products and practices developed.

Best Practices and Lessons Learned

Output 2.3 is informed by the long-term experience of ICCO-cooperation, an international NGO in access to finance for smallholder farmers and other actors in the context of value chains and experience with multi-stakeholder platforms for program implementation. Output 2.3 combines climate resilient strategies with general best practices in agricultural and value chain finance. The approach recognises that short-term economic benefits for farmers, cooperatives and other stakeholders have to be balanced by longer term financial and climate resilience objectives to create long-term sustainability in production processes. Recognising the need for sustainable finance, ICCO has a longstanding relationship with financial service providers in Rwanda and builds internal capacity of these organizations to deliver financial services to smallholder farmers and in particular to women. ICCO also supports the institutions to link to international impact investors to grow their portfolio. Furthermore, ICCO has experience in SME financing through its international investment funds. ICCO's research on brief background on financial inclusion in Rwanda is included in

Annex 4. In order to ensure successful linkage of financial services to farmers and cooperatives, two tried and tested tools will be used (1) a specialized-Agricultural-Credit Assessment Tool (A-CAT) which will be used to assist the assessment of credit applications including improved climate resilient production techniques (See Annex 5), and (2)the "Group solidarity system in producer organisations" model developed by ICCO in collaboration with WFP to establish successful savings groups (see Annex 6). Activity 2.3.1, 2.3.2, 2.3.3, 2.3.4 and 2.3.5 will be run in parallel to develop and support implementation of financial products, services and savings groups.

While activities under component 2 are specific to some value chains that are critical for increasing the resilience of the livelihoods and the Province overall, in complementarity with the work undertaken and planned on other value chains, the activities under this component will be cross-cutting and supportive of all related agriculture value chains in the Province. This is the same approach used in component 1, which will benefit all value chains and activities happening in the Province and leading to climate resilience.

Description of Activities

Output 2.3 comprises of the following activities and sub-activities:

Activity 2.3.1: Financial education and savings mobilization for groups involved in restoration activities linking with MFIs

This activity will provide financial education and savings mobilization for farmers and FFPOs involved in activities under 1.1-1.5 and 2.2. The activity will focus on individuals and groups, with particular focus on vulnerable rural populations including youth and woman. These include groups/FFPOs developed under output 2.1, involved in restoration activities (woodlots restoration, agroforestry / fruit tree planting, clean cooking fuel & improved technology, and water harvesting systems).

Activities will include financial education and saving promotion strategies for the groups as well as linking to financial service providers to open up accounts. This will eventually assist groups to access other types of financial services such as loans and matching loans. Once the groups begin maturing, acquire equipment or need additional capital for maintenance, a mechanism to group/co-finance critical equipment and maintenance for climate resilience will be developed in collaboration with the financial service providers (this will be linked where possible to financial products developed under activity 2.3.4). This mechanism will include partial subsidy for the equipment, contribution from the groups' savings and/or loans provided by an MFI. This mechanism is relatively new to financial service providers, so it needs to be tested and evaluated. It would go together with careful guidance and coaching of the groups on savings and loan management to reduce the risk of non-repayment of the loans as partial subsidy was given.

MINAGRI has also been working on supporting farmers to access small loans from micro-finance banks. MINAGRI's staff will join the project team in training FFPOs. Travels associated to this support will be provided by the Ministry. In addition, the presence of MINAGRI's staff in this activity will provide lesson learning to inform potential steps needed to be made by the Ministry for the replication at national scale

Sub-activities	Description
2.3.1.1 financial education and introduction to financial services	Educate groups on the importance of savings, relevance of account opening and keep savings with financial service providers. Educate groups on other products of financial service providers
2.3.1.2 Savings mobilization and linking to MFIs	Design financial products in line with internal policies and procedures of selected financial service providers, that can allow for matching loans linked to partially subsidized equipment.
2.3.1.3 Develop group loan products for cost sharing to acquire envisaged equipment, for example ICS access for targeted households.	Guide the financial service providers and groups through a process of testing the new matching facility for viability and scalability
2.3.1.4 Evaluation of mechanism and potentially develop product under 2.3.	Evaluate the product on its relevance for the groups and the financial and operational feasibility for the financial services provider. If the product is seen as relevant and appropriate, it can be replicated at national scale in other working areas and branches of the financial services provider.

Activity 2.3.2: Promote and upscale agri-finance products of MFIs (to support maize, beans and rice production) including water collection, planting of trees, soil erosion mitigation

This activity is particularly focused on financing and stimulating scaling up of the better land management and erosion control practices developed under component 1 as well as supporting better water harvesting techniques for farmers who are engaged in the main agricultural food crop production (maize, rice and beans) in Rwanda's eastern province. Participating financial service providers already finance these crops, and some already use the Agri-Credit Assessment Tool (A-CAT) to analyse loan requirements for these crops. The activity focuses on integrating indicator tools within assessment methodology of financial service providers to assess improved methods of land management farmers are undertake alongside production. As a result, this activity addresses risk assessment barriers which prevent financial services providers understanding the risk profile of loan applications for financing better land management and erosion control measures. Thus, the activity supports the development of products to be developed under activity 2.3.3.

Envisaged activities include: (1) Awareness raising of MFIs on the relevant climate resilient practices in agriculture undertaken by the project under component 1. Based on the climate resilient methodologies employed under component 1, (2) develop and include indicators to assess climate resilient agricultural practices in credit assessment methodologies. (3) Establish systems to monitor practices throughout the loan period and test the relevant assessment tools and monitoring practices before mainstreaming in all loan assessments. The activity would also include eventually digitization of the loan and assessment tools digital A-CAT connected to geospatial information (linked with output 3.1.7). After the first testing year (second year of the project) the tool will be evaluated before mainstreaming and upscaling.

MINAGRI will support the development of indicators of climate resilient production methods that ICCO will be developing for MFIs. The Ministry will also support all farmer efforts targeting farmers growing maize, beans and rice to access loans for agricultural inputs, post-harvest handling/processing and marketing.

Sub-activities	Description
2.3.2.1 Training MFIs staff	Train financial services providers to understand relevance of climate resilient production methods and possible indicators to include in credit assessment for preferential lending to those who meet the criteria.
2.3.2.2 Include indicators in credit assessment	Integrate indicators, developed along with consortium members, for assessing climate resilient measurement in agriculture for farmers in current loan products for maize, beans and rice, and design systems to monitor these indicators.
2.3.2.3 Establish monitoring system to verify indicators	Support the MFI to develop a monitoring system that will verify the indicators in credit assessment from 2.3.2.2
2.3.2.4. Test revised products	Guide and coach the financial service providers through a testing phase and evaluate the new procedures on applicability for farmers and accuracy to measure climate impact from year 2 of the project implementation.
2.3.2.5 Evaluate revised products for mainstreaming	Revised products and services will be revised based on lessons learned during pilot phase. The products will then be made available and promoted by MFI for scaling up throughout branches/offices in other provinces of Rwanda under 2.3.5.

Activity 2.3.3: Detailed and comprehensive scoping of financial service potential in the respective value chain for detailed product design and development

This activity aims to support the financial product development process to tailor financial products to the needs of farmers and other chain actors. It will look at accurate quantifiable client needs, internal procedures of the financial service providers and at possible linkage with advisory services on climate resilient production of the selected value chains under output 2.2.

Activities related to financial product development are described per value chain and related to the Micro Finance Institutions (MFI) that can eventually work in these value chains, including the general stimulation of savings groups especially for women and youth. It is envisaged that respective MFIs work on different products for different value chains and when the product is tested and validated it can be replicated to other MFIs and financial service providers in the area.

In order to establish successful development of savings groups within cooperatives and to ensure successful linkage of financial services to the cooperatives, a "Group solidarity system in producer organisations" model developed by ICCO in collaboration with WFP will be introduced (see Annex 6). The system provides a manual and will guide the establishment of savings groups, while also ensuring good participation of women in the cooperative.

Activities related to financial product development described per value chain below.

Overview of financial services development activities for tree crop value chain

Stimulation of marketable tree crop production can be an attractive investment for the smallholder farmers while at the same time stimulates the production of woody biomass which is relevant for improved ecosystems and better conservation of forest areas. To stimulate the proposed economic activities of tree value chains, the following financial products and services are envisaged:

1. Financial products and services to support establishment of community managed tree seed enterprises to secure the continued supply of quality seeds for the production of seedlings in nurseries.

2. Financial products and services to support tree nursery enterprises especially for relevant marketable tree crops such as macadamia nuts, mango and avocado.

3. Financial products and services to contractual wood farming to stimulate contract farming arrangements for farmers to engage profitably in maintenance of woodlots

Financial products tailored to the development of these enterprises will be developed in collaboration initially with two micro-finance institutions (MFI) namely Duterimbere and RIM. A third Microfinance institution will join at a later stage.

In addition to these products it is also envisaged to stimulate a financial product for the actual production of tree–crops at farmer level. Tree crop production is a multi-annual process and financial products of especially microfinance institutions are usually short term (1-3 years), therefore the financial product for tree crops will be a product combining tree –crop production with other agricultural products, preferably crops that can be intercropped with the trees for some time. A specialized agricultural credit assessment tool -Agricultural-Credit Assessment Tool (A-CAT) will be used to assess credit applications (See Annex 5).

Overview of financial services development activities for bee value chain

Beekeeping as an income generating activity is very common in the Eastern Province of Rwanda. While it is a relevant product to preserve the ecosystem in the area, production is low due to traditional production methods, which are also not always very conducive to the environment. The value chain development activities suggested in 2.2 in the bees' value chain focus on strengthening beekeeping cooperatives and interactions and market linkages for the marketing of honey, establishing bee fodder species and beehives. As the focus is very much on cooperatives, the financial services providers in the bees' value chain will be connected to both individual small holders and cooperatives in particular with two selected MFI - RIM and Copedu. Financial services/products will be designed to support:

1. Financial products and services that will enable strengthening of beekeeping cooperatives and their interactions for the marketing of honey.

2. Financial products that will support the cooperatives to establish bee fodder species

3. Financial products that will support introduction of modern beehives through cooperatives

4. Financing to support the market linkages for the honey and beeswax value chain especially linked to Akagera park and also hotels and supermarkets in the area.

The development of savings groups in the beekeeping cooperatives will facilitate access to loans for improved beehives, while also building up internal capital and savings at the group and cooperative level.

Furthermore, financial services will be developed for the cooperatives to jointly manage the bee forage area with different species of bee forage. The system requires close collaboration between the MFI and the cooperatives and will follow the guidelines of organization as established by ICCO

In addition to the facilitation of financial services to cooperatives and savings groups, ICCO will explore with the MFIs if there are other relevant financial services needed in the bees value chain, such as for example finance for equipment, packaging, trading and storage of honey and bees wax, as well as for transportation to markets in the park area.

Overview of financial services development activities for fodder value chain

The fodder value chain is very new in Rwanda and its economic viability has yet to be proven however lack of good fodder is becoming a critical factor in the area for farmers engaged in cattle keeping. One of the critical factors is scarcity of feed supplies, particularly during dry seasons. The program proposes to establish animal feed production enterprises. It is envisaged that financial service providers can provide loans to such feed production centres once they have engaged in structural production of fodder and have an identified market outlet. (this will be stimulated under 2.2) it is foreseen that this can happen in the third year of program implementation. Financial services will focus on

1. Financial services for women and youth who will be encouraged to establish livestock feed enterprises, that focus on production, processing and packaging of animal feeds. Some groups will focus on restoration of degraded areas to produce feeds.

Specific financial products for the fodder value chain will be developed with Duterimbere and Copedu, and RIM The program will be engaged in a detailed product development process as foreseen in the other value chains.

The combined activities related to financial product development in the tree crop, bee and dairy value chains in collaboration local and multilateral financial institutions listed include:

Sub-activities	Description
2.3.3.1 Screening products and services	Screening the most current and potential financial product requirements per value chain
2.3.3.2 Design products and services	Design financial products in line with internal policies and procedures of selected financial service providers.
2.3.3.3 Facilitate linkages between chain actors and financial service providers	Facilitate linkages between financial service providers and chain actors as well as service providers in climate resilient production methodologies

Activity 2.3.4: In collaboration with MFI - design and pilot testing of financial products for the respective value chains

This activity aims to design and test the financial product in collaboration with the financial service providers to see if the product is relevant and useful to the smallholder farmers or other chain actors. It also serves to see if the product can be handled and managed by the financial service provider in a cost-effective manner. The envisaged products in the bees' value chain focus on linking with producer cooperatives in this value chain.
MINAGRI staff will support the selection and mobilization of Cooperatives to be initiated into saving groups and those that will be trained on financial products offered by MFIs (developed in 2.3.3).

Sub-activities	Description
2.3.4.1 Approval of products and services	Approval of financial products and services in collaboration with financial service providers and other stakeholders
2.3.4.2 Mobilization and education of savings groups	Select relevant cooperatives for mobilization and education of savings groups in the cooperatives

2.3.4.3 Sensitization and financial education of saving groups, already trained on climate impact, to find fund facilities to implement their solutions	Sensitization and **financial** education of cooperatives members on savings groups, already trained on climate impact, to find fund facilities to implement their solutions
2.3.4.4 Training of staff and clients	Training of staff and clients, cooperative members on the new product, financial and climate resilient education to MFIs and clients
2.3.4.5 Pilot testing and monitoring products	Pilot testing and monitoring of the financial product in collaboration with the MFI and other stakeholders
2.3.4.6 Capacity building of 3 financial institutions in key areas: risk management, portfolio management and social performance	Capacity building of 3 financial institutions in key areas: risk management, portfolio.

Activity 2.3.5: Evaluate the financial products

This activity aims at confirming the relevance of financial products for the farmers, savings groups and cooperatives as well as the financial sustainability of the product for financial service providers. After the pilot tests, the products are reviewed on: (1) Client satisfaction with the products terms and conditions, (2) relevance for climate resilient methods and impact on climate resilience, (3) internal capacity of MFI to incorporate the products in a sustainable manner, and (4) identifying upscaling possibilities. In support of the evaluation process, the Ministry of Finance and Economic Planning and MINAGRI will document lessons learned for upscaling with a particular focus on identifying legal and legislative barriers.

Sub-activities	Description
2.3.5.1 Evaluate financial product	Evaluate client and stakeholder satisfaction on the financial product, especially with the cooperative management
2.3.5.2 Assess and adapt financial	Assess the financial sustainability and the operational sustainability of the product with the financial service providers and adapt the product as needed

sustainability of product	
2.3.5.3 Confirm products for upscaling at MFI level	Confirm the product and prepare a detailed plan for upscaling of the product

Activity 2.3.6: Implement the roll out and upscaling plan of financial products developed

This activity aims at mainstreaming the financial products throughout the relevant branches and build in-house capacity of the financial service providers to replicate the product, with other producer organizations and in other areas of operation. MFIs will be guided to mainstream the products in their operations based on the evaluation reports. The Government of Rwanda through the Ministry of Finance and Economic Planning and MINAGRI will support the scaling up of the financial products nationally. Organizational mainstreaming of products includes the following activities.

Sub-activities	Description
2.3.6.1 Adapt product for mainstreaming at branch and national level	Adapt internal procedures and systems to mainstream the product in relevant areas
2.3.6.2 Develop each MFI capacity to replicate product	Build in house capacity to replicate the product to other branches
2.3.6.3 Digitalization of tools and systems to support the financial products	Financial service providers will be supported to digitize the loan assessment procedures including systems to monitor changes in agricultural production processes to support the scaled up financial products

Activity 2.3.7: Facilitate impact investors to engage in investment for SMEs in the relevant value chains

This activity includes scoping of prospective investors, identifying and developing attractive business propositions for both financial service providers and SME's as well as guide investors through the process of due diligence resulting in conclusive funding contracts. This activity will be mostly undertaken with banks such as Kenya Commercial Bank or Urwego and will entail some support in developing bankable business proposals as well as brokering for successful linkages with banks and investors. Financial service providers will also be connected to appropriate insurance programs.

Sub-activities	Description

2.3.7.1 Business proposals development	Develop prospective business proposals with SME's for interested impact investors
2.3.7.2 Identification of investors and Due diligence	Engage in a business financing process, including facilitation of visits and due diligence analysis
2.3.7.3 Financing contracts	Support financing contracts and facilitate monitoring
2.3.7.4 Linkage with agri-insurance scheme	Connect financial service providers to insurance programs and create awareness raising on insurance. Resulting in at least one workable modality to agri-insurance with MFIs.

Activity 2.3.8: Learning and sharing with chain stakeholders and financial sector

A very important component of the program is the strong collaboration of all stakeholders involved in the development and use of new financial products and services. This activity links the development of knowledge and awareness and learnings from the development of financial products and services with the training under component 1 and knowledge and leaning under component 3. This activity will ensure learning both horizontally across and vertically within the financial services sector to ensure informed analysis, learning and improvement of interventions. Furthermore, the ICCO team will share lessons learned on finance service product development trajectories and participate in the projects other learning events to replicate financial products and services in the agricultural sector.

Sub-activities	Description
2.3.8.1 Regular collaboration with all program stakeholders and chain actors to tune up all implementation activities.	Participation in learning on climate resilient methods for agricultural production related to finance
2.3.8.2 Organize learning events on relevant financial products	Organise awareness raising events (or combine with other events held by the project) with all project stakeholders and chain actors to raise awareness of financial products and services
2.3.8.3 Introduce financial service perspectives in regular program reporting and planning	Prepare and share lessons from the financial services sector with other stakeholders of the project to promote climate resilient agricultural finance and understanding of products and services during other awareness, reporting and planning activities under component 1, 2 and 3.

2.3.8.4 Organize financial sectors seminars to share lessons learned and solicit interest of other financial sector actors	Hold tailored seminars for the financial sector to learn from the other activities of the project including the trainings to farmers from component 1 and the knowledge and awareness from component 3.

Component 3: Strengthening of national and local institutional capacity and cross sectoral coordination to mainstream climate resilience in land management and planning

Component 3 aims at strengthening the capacity of the national and local institutions and enable them to effectively mainstream climate adaptation in land planning and management to ensure climate resilient landscape governance. The table below summarises the outcome and outputs comprising Component 3.

Outcome/ Outputs	Description
Outcome	**National and local institutions are empowered to effectively mainstream climate adaptation in land planning and management**
Outputs	3.1 Mainstreamed gender-responsive climate resilience for coordination cross-sectoral planning & community landscape restoration plans developed
	3.2 Enhanced and coordinated knowledge and information systems for decision support
	3.3 Seed and seedling supply systems enhanced
	3.4 Evidence from best practices generated through applied research and co-learning

Outcome 3 will result in effectively mainstreamed climate adaptation in national and sectoral strategies creating an enabling environment for long-term and sustainable adaptation project results and beyond. The mainstreaming strategy adopted by the project consists of using a climate lens to screen current policies and strategies and integrate climate resilience metrics for improved monitoring and reporting.

By including resilience metrics, these policies will provide the opportunity to build-in appropriate climate proofing measures and include projects and activities than can reduce climate vulnerability. This will lead to a systematic consideration of climate change risks and adaptation in policy planning that will be sustained beyond the project duration.

To be effective, climate adaptation solutions are cross-sectoral and need to be mainstreamed across all sectors while achieving greater policy coherence is essential. Therefore, there is a need for strengthened cross-sectoral collaboration among the agricultural, forestry and land-use sectors.

Capacity building at all governance levels is central for achieving this objective and should be targeted to address the specific capacity gaps. Table 26 presents a list of identified capacity gaps that will be addressed by the project activities.

Table 26. List of identified institutional capacity gaps that will be addressed by the project

Baseline	Desired project target	Capacity gaps
National agencies responsible for agriculture and agroforestry activities rarely collaborate and share information, which results in uncoordinated and often overlapping interventions, which compromises sustainability of results and scalability of best practices.	Effective collaboration between institutions in charge of agriculture and agroforestry (i.e. MINAGRI, RAB and RFA) to ensure synergies between climate resilience interventions in the country, through active information sharing and communication.	Limited knowledge on climate resilient restoration measures with cross-sectoral benefits. Lack of mechanisms for institutional collaboration on climate resilient strategies.
Land-use management is fragmented and does not consider climate risks, which leads to high expose and sensitivity of populations and agricultural areas to climate hazards such as floods and soil erosion.	Scaling-up of integrated and climate risk-informed landscape management through trained administration agents in the East Province who promote the approach and provide technical advice in the project area and other provinces.	At Province level poor knowledge and skills on integrated landscape management approach. At Province level lack of knowledge on climate risks and how to integrate them in landscape planning and management. Lack of financial investment in capacity building for staff and equipment.
Current monitoring and evaluation systems are inadequate for reporting on climate resilient landscape solutions and not coordinated among sectors and governance levels. This hinders the generation of lessons learned and reporting on the effectiveness of adaptation interventions.	Harmonized cross-sectoral and multi-level monitoring and reporting mechanisms that document best practices for climate resilient landscape strategies, inform policy making and contribute reporting for national and international commitments (e.g. NDC).	Poor knowledge and skills to perform monitoring and evaluation of climate resilient landscape interventions at district, provincial and national levels. Limited awareness of cross-sectoral monitoring and reporting mechanisms.

Output 3.1 Mainstreamed gender-responsive climate resilience for coordinated cross-sectoral planning & community landscape restoration plans developed

The table below summarises Output 3.1 which will develop cross-sectoral planning & community landscape restoration plans for climate resilience.

Key aspects	Description
Description	Strengthen the collaboration and capacities of institutions at national, provincial and district levels to effectively mainstream climate resilience in a coherent and gender-responsive manner in sectoral and community restoration planning. Mainstreaming will comprise of integrating climate resilience metrics into district development strategies and annual performance contracts and harmonizing cross-sectoral monitoring and reporting mechanisms. This will establish an enabling environment and proper incentives for actors at local, district and provincial levels to integrate adaptation considerations within their activities and contribute to coherent reporting at all governance levels. Particular consideration will be given to incentives for participation of men and women and marginalised groups. This will be operationalized at local scale with the design and implementation of climate risk-informed landscape restoration plans in 7 Districts/Sites via participatory approach coupled with geo-spatial analysis in landscape Restoration Opportunity Assessment Methodology (ROAM) makes it robust and likely to generate implementable restoration plans.
Adaptation benefits	1. Create incentives for the consideration of climate adaptation in development and land-use planning processes

	2. Facilitate adaptation actions, monitoring and reporting across different government levels and cross-sectoral 3. Create an enabling environment for scaling up of climate resilient landscape solutions
Barriers addressed	1. Limited ability to design and enforce robust monitoring and reporting mechanism for cross-sectoral and to measure impact 2. The institutional capacity and coordination to implement climate-risk informed landscape management strategies is weak 3. There is a need to develop gender responsive and inclusive adaptation solutions

Best Practices and Lessons Learned

This output is informed by the outcomes from an international workshop (Kigali, 2015) on Forest and Landscape Restoration and Sustainable Food and Agriculture. One of the key recommendations made was to set up an inter-sectoral working group to foster improved coordination on cross-cutting issues related to agriculture and natural resources. The inter-sectoral working group was to serve as a platform for dialogue on issues that are cross-cutting to agriculture and natural resources, with a particular focus on agroforestry development. In this context, a cross-sectoral taskforce (CSTF) was set up with the aim to support the functioning of the Agriculture, Environment and Natural Resources Sector Working Groups in implementing the National Strategy for Economic Transformation (NST1) priorities as well as to support the domestication of Sustainable Development Goals (SDGs) and their linkage to the high-level dialogue on green growth to promote forest landscape restoration, sustainable agriculture and livelihoods improvement (IUCN/RFA/ARCOS, 2018). The CSTF is coordinated by the Rwanda Forestry Authority (RFA) in collaboration with FAO, IUCN and other partners. Since its creation, the Cross-Sectoral Task Force has been meeting regularly to exchange and promote peer learning between actors, but without a clear scope of work to enable policy influence and efficient collaboration. In a recent study, IUCN/RFA/ARCOS (2018) noted that the CSTF suffers from a number of weaknesses including:

(i) Lack of official mandate for the CSTF to formally carry out its activities;

(ii) Irregular attendance of CSTF members to different meetings especially from government due to other commitments as most of them are senior officials;

(iii) Lack of clear and regular funding to facilitating CSTF meeting and other required activities which hinder frequent convening of CSTF meetings; and

(iv) Lack of clear follow up and inconsistency in reporting on different measures taken by the CSTF.

The activities below outline how the TREPA project will aim to overcome these barriers to mainstream climate resilience interventions and catalyze their effective coordination.

Description of Activities

Output 3.1 comprises of the following activities and sub-activities:

Activity 3.1.1: Organize and facilitate 10 multi-stakeholder workshops to identify and integrate climate resilience metrics into 35 (7 district*5years) annual district development strategies and performance contracts.

This activity aims at supporting the integration of climate resilience metrics[133] into district development strategies and annual performance contracts. This could be achieved by facilitating organization of joint planning workshops of interventions and performance targets with clear climate resilience indicators.

Sub-activities	Description
Sub-activity 3.1.1.1	Organise and facilitate annual planning of restoration interventions
Sub-activity 3.1.1.2	Organise and facilitate annual evaluation and setting up of performance targets (Performance contracts)

Activity 3.1.2: Hold monthly round tables to facilitate the collaboration for adaptation actions between institutions in charge of agriculture and agroforestry

This activity aims to strengthen collaborative efforts, in particular between institutions in charge of agriculture and agroforestry (i.e. MINAGRI, RAB and RFA) to encourage synergies and avoid overlapping mandates and redundancy in different climate resilience interventions. The involved staff at both national and local levels shall be empowered to readily share information and activity plans through regular (e.g. monthly exchange) communication.

[133] Climate resilience indicators include: - Number of farmers adopting climate resilient technologies such as agroforestry and soil conservation measures; - Number of farmers using improved and climate resilient crop and tree species; - Staff trained in climate resilient technologies; - Number of people adopting green energy sources (e.g. solar, improved cooking stoves, wood pellets, LPG, etc.)

Sub-activities	Description
Sub-activity 3.1.2.1	Hold monthly round tables with both national and district administrations in Eastern Province.
Sub-activity 3.1.2.2	Facilitate discussions and provide technical support in decision-making for cross-sectoral collaborative efforts at landscape scale.

Activity 3.1.3: Deliver 5 training sessions at central and district level, to enhance capacities for funding mobilization, planning, and delivery of climate adaptation actions

This activity aims at training of technical staff including agriculture, livestock and forestry extension agents and planners on climate risks and their implications for cross-sectoral aspects. District level planners will also be better equipped to access funding for adaptation actions from FONERWA and other sources.

Sub-activities	Description
Sub-activity 3.1.3.1	Develop curricula and training materials on climate risks for the sectors agriculture and forestry and adaptation solutions with cross-sectoral implications.
Sub-activity 3.1.3.2	Deliver in collaboration with other partners 10 training sessions for 35 people.

Activity 3.1.4: Provide technical assistance for the design and implementation of a cross-sectoral monitoring and reporting mechanism for climate resilient actions

Since TREPA is a cross-sectoral project, coordinating monitoring and reporting of interventions is critical to avoid duplication at least on the project intervention areas particularly where the same households benefit from guidance from agriculture, livestock and forestry extension agents. Joint field visit between RFA and RAB will enable a better use of transport, allow a better coordination of activities and a more productive consultation with rural households. In addition, cross-sectoral appraisal and knowledge sharing will likely result in better design and cost-effective implementation. Such cross-sectoral field visits will also play a pivotal role in scaling up interventions.

Sub-activities	Description
Sub-activity 3.1.4.1	Organize and facilitate cross sectoral annual monitoring and reporting workshops
Sub-activity 3.1.4.2	Support joint annual knowledge sharing events (forum) for technicians, decision-makers, planners, policy-makers and landscape restoration managers

Sub-activity 3.1.4.3	Carry out joint 40 (2 times per quarter) field interventions by mixed teams of development agents, in particular RFA and RAB

Activity 3.1.5: Identify and train cross-sectoral teams of technicians to become landscape restoration planners and managers in collaboration with communities

This activity aims at strengthening the capacity of the administration staff in the East Province not only to perform their work in the project intervention area but also to deliver their expert services elsewhere in the country. This is an important aspect of the paradigm shift for the project to achieve its goals. It is anticipated that scaling up will happen as a critical number of technicians and extensionists are to be properly trained and equipped. The set of skills to improve will revolve around integrated landscape management focusing on degraded areas.

Sub-activities	Description
Sub-activity 3.1.5.1	Identify cross-sectoral teams of technicians to be trained and become landscape restoration planners and managers
Sub-activity 3.1.5.2	Organize training materials on planning and implementation of integrated landscape restoration
Sub-activity 3.1.5.3	Undertake training of selected teams of technicians on integrated landscape restoration

Activity 3.1.6: Collaborate with communities to define priority criteria and select primary target intervention areas to restore ecological functionality (specific maps)

During ROAM study for Rwanda in 2014, spatial analyses have revealed areas suitable for different landscape restoration interventions. The pilot sites will serve as reference to help decision-makers and planners to upscale or replicate interventions in other parts of the country by other donors, government budget and even the private sector. The targeted areas will be updated during project inception, depending on conditions and needs to be assessed during an updated ROAM study or other such analysis if deemed necessary.

Sub-activities	Description
Sub-activity 3.1.6.1	Identify and assess actors in community restoration plans
Sub-activity 3.1.6.2	Update primary target intervention areas on maps
Sub-activity 3.1.6.3	Refine in collaboration with communities, priority criteria for landscape restoration

Activity 3.1.7: Train 28 staff in the district authorities and provide technical assistance for the preparation of 7 landscape restoration plans with climate resilience protocols / technical packages at the district level.

This activity aims to lead the target districts authorities to prepare 7 landscape restoration plans (one per district). This will involve not only training but also provide technical assistance, logistics, acquisition of satellite imagery, GIS system and other surveying means, and guidance in terms of technical analyses as well as economic and financial assessment. In order to monitor, report and verify improvements in institutional and regulatory conditions, IUCN will develop a scorecard matrix which establishes a number of objective criteria to evaluate Cross-Sectoral Planning and Community Landscape Restoration Plans. During project inception, the scorecard and baseline will be established. Metrics include: 1) degree of integrating climate resilience metrics, 2) presence of annual performance contracts, 3) degree of harmonizing cross-sectoral monitoring and reporting mechanisms, 4) established and functioning incentives for actors at local, district and provincial levels to integrate adaptation considerations within their activities. Particular consideration will be given to incentives for participation of men and women and marginalized groups, and 4) contribute to coherent reporting at all governance level

Sub-activities	Description
Sub-activity 3.1.7.1	Facilitate logistics and acquisition of satellite imagery, GIS system and other surveying equipment
Sub-activity 3.1.7.2	Organize and facilitate training of 28 district staff (4 per district) in operating acquired technical tools and systems
Sub-activity 3.1.7.3	Provide guidance in terms of technical analyses as well as economic and financial assessment

Output 3.2 Enhanced and coordinated knowledge and information systems for decision support

The table below summarises Output 3.2 which will enhance and coordinate knowledge and information systems for decision making to increase climate resilience.

Key aspects	Description
Overview	Appraise and improve existing knowledge and information systems at national and provincial level to ensure the integration of climate-related data to contribute to climate-informed decision-making, monitoring and reporting for different sectors and at all levels in order to inform a scale-up of project results. This will enhance monitoring of climate information and relevant climate-related indicators at landscape level in order to guide decision-making-processes. Improved decision-making capabilities will inform the scaling-up of initiatives within the Eastern Province and the rest of Rwanda. This will be accompanied with training of trainers' sessions for technical staff responsible for the information systems. The TREPA project will support units in charge of information systems such as the FLR monitoring system and the climate early warning system, with targeted training, equipment and other financial and technical assistance. In this regard, the TREPA project will design low-maintenance solutions that will be affordable after the project. It is anticipated that the establishment of user-friendly information systems will enable monitoring of climate information and relevant climate-related indicators at landscape level in order to guide decision-making-processes, particularly in terms of scaling-up initiatives within the Eastern Province and the rest of Rwanda.

Adaptation benefits	1. Document best practices to generate evidence of the effectiveness of adaptation actions in agriculture and forestry.
Barriers addressed	1. National level institutions lack a comprehensive system for sharing climate knowledge

Best Practices and Lessons Learned

The services of the National Meteorological Agency (Meteo-Rwanda) have been recently improved as it shares daily and often hourly updates on weather predictions throughout the country using various media including public broadcasting stations and social media. In the field of agriculture, the on-going Rwanda Climate Services for Agriculture project (2016-2019) seeks to transform Rwanda's rural farming communities and national economy through improved climate risk information management. The aim of this output is to improve agricultural planning and food security management in the face of a variable and changing climate at both local and government levels. Specifically, the project aims to improve the supply, communication and use of climate-related information in a balanced manner using products co-developed by both providers and users. The project staff works directly with technical officers, policy and decision makers within the Government of Rwanda, as well as with farmers and other key stakeholders in the agriculture sector.

The Rwanda Climate Services for Agriculture project benefits from years of applied research on climate services for agriculture by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) and its partners in Africa and beyond. For instance, the project has adopted the Enhancing National Climate Services (ENACTS) approach, already piloted in eight countries in Africa, including Rwanda. ENACTS focuses on the creation of reliable climate information suitable for national and local decision making. Under this initiative, the National Meteorological Agency (Meteo-Rwanda) has merged satellite data with its station observations to fill gaps in both space and time and can now provide a range of high-resolution climate information products tailored to agricultural user needs through web-based "maprooms".

The project has started helping farmers to use Participatory Integrated Climate Services for Agriculture (PICSA) information via their phones to make key farming decisions. The system is backed by Meteo-Rwanda in ensuring that smallholder farmers access real-time climate-related information as part of broader efforts to build resilience to climate change. Through the project, farmers will be trained and empowered on how to manage risk and adapt to changing climate by interpreting and making sense of weather information. TREPA has considered lessons from the project and integrated these into its design. As such, TREPA will establish a robust information system that would inform both farmers and decision makers for climate vulnerability and risk management.

In terms of FLR monitoring system, most districts in the country have developed their district forest management plans (DFMPs). However, most DFMPs are not being properly implemented due to a number of constraints including complexity of the DFMP documents, lack of skilled human resource and limited financial resources. In order to ease the design and allow the right implementation and monitoring of DFMPs by field officers (including use of GPS mapping tools), a user friendly database software is currently being developed by the RFA with the support of Forest Management and Biomass Energy (FMBE) project implemented by ENABEL. Once the software is operational, all required information and function for updating, monitoring and reporting on DFMPs will be made accessible to districts and sector officers and to forest managers of private FMUs. The software and its application will enable easy monitoring and evaluation of FLR interventions. The TREPA project will enforce the right use of the system, and during project implementation, improve/upgrade the software to ensure integration of new or revised functions based on feedback from users.

Description of Activities

Output 3.2 comprises of the following activities and sub-activities:

Activity 3.2.1: Improve existing knowledge and information systems to ensure effective integration of climate risk related data to support climate informed decision making.

The project will support the revival and establishment information systems that will enable easy access to knowledge and information by project beneficiaries and stakeholders. Such information systems may include FLR monitoring systems, Climate early warning systems and Knowledge/information exchange systems. The project will first conduct an updated gap analysis on the status of knowledge and information systems on climate resilience in the Eastern Province and then determine the needs in terms of technical and financial assistance to update and improve the knowledge and information systems in the Eastern Province to support climate resilience activities. The project will further improve, and where necessary, establish new communication channels between the existing information platforms. The established information systems will be user friendly. It is anticipated that the establishment of user-friendly information systems will enable to monitor climate information and relevant climate-related indicators at landscape level in order to guide decision-making-processes, and scaling-up initiatives within the Eastern Province and the rest of the country.

Sub-activities	Description
Sub-activity 3.2.1.1	Conduct an updated gap analysis on the status of knowledge and information systems on climate resilience in the Eastern Province
Sub-activity 3.2.1.2	Determine the needs in terms of technical and financial assistance to update and improve the knowledge and information systems in the Eastern Province to support climate resilience activities
Sub-activity 3.2.1.3	Improve, and where necessary, establish new communication channels between the existing information platforms

Activity 3.2.2: Organize 4 trainings for 36 technical staff (28 from districts, 2 from RAB, 2 from RFA, 2 from RLMUA and 2 from Meteo-Rwanda) on managing information systems and integrating climate-related aspects.

The staff in charge of using and maintaining the information and monitoring systems must have adequate skills and means to perform their services over the lifespan of the TREPA Project and even beyond. Training will be undertaken by project staff assisted by both international and national trainers. Training exercises may include training need assessment, a series of training sessions and training efficiency analysis. Emphasis will be put on training local trainers in order to make the staff independent from external training assistance.

Sub-activities	Description
Sub-activity 3.2.2.1	Carry out training needs assessment for different information systems
Sub-activity 3.2.2.2	Organize and facilitate training of staff operating the knowledge and information systems in Eastern Province
Sub-activity 3.2.2.3	Follow up performance of trained staff and support maintenance of established or revived information systems

Output 3.3 Seed and seedling supply systems enhanced to provide diverse climate adapted species and varieties.

The table below summarises Output 3.3 which will enhance and coordinate knowledge and information systems for decision making to increase climate resilience.

Key aspects	Description
Overview	The overall objective is to design and establish a national-level program to improve the seed and seedling supply system and promote climate adaptation through access to high quality and climate resilient planting material. In order to enable this, the project will mainstream climate change aspects in sector-specific policies and legal frameworks, generate maps and recommendations for the identification of habitat suitability for the

	climate resilient seeds and enhance capacities of key national actors in the Eastern region. This output will improve the ability of local entities to supply native and resilient wood tree species germplasm from local sources and increase the diversity of fruit germplasm such as avocado, mango, tree tomato, macadamia, pawpaw, guava suited to agroecological zones in eastern province. Engagement with the private sector will be encouraged through the creation of collaboration platforms for state and non- state actors such as the District NGO coordination board and Joint Sector Working Groups. The project will develop incentives for local fruit nursery accreditation systems to produce the 'right materials for the right place' and avoid pest and disease problems.
Adaptation benefits	1) Farmer capacity to adapt to climate change will be strengthened by improved access to plant varietal diversity. Such strengthened capacity will reinforce the benefits of activities in Component 1 and contribute to greater food availability throughout the year, the production of more nutritious and healthy food sources, and income generation (CCAFS 2016, McMullin et al. 2019). 2) Technical support and climate education will help state and non-state actors to design and support local institutional infrastructure, providing access and use of climate resilient plant genetic resources beyond the project boundary and timeframe (CCAFS 2016, Dawson et al. 2012).
Barriers addressed	1) Lack of climate-resilient planting materials for agroforestry, forestry and

	horticulture due to limited knowledge and access. 2) Limited consideration of farmer local knowledge on local tree diversity in combination with scientific knowledge results in wide adoption of few exotic timber forestry species such as Eucalyptus which undermining the resilience of the ecosystem. 3) Limited institutional knowledge and capacity for management of climate resilient planting material. 4) Inadequate funding for the seed sector to innovate and promote resilient planting material. 5) Limited integration of climate change into the policy and legal framework for the seed sector.

<u>**Description of the intervention**</u>

This output is a prerequisite for the effective implementation of the restoration strategy outlined in Component 1 and to support farmers scale suited agroforestry packages and cooperatives and other farmer groups being assisted under Component 2. The adaptation measures in Output 3.3 contribute to project outcomes by promoting diversified planting material sources for agriculture and silvo-pastoral activities to increase productivity and help reduce risks of pest and disease outbreaks associated with poor genetic resources that are excessively sensitive to climate variability. In addition to providing planting materials, activities in this output will fill key information gaps by evaluating for usefulness and usability, decision support tools involving crop and tree suitability for current and future climate conditions in Eastern Province . The primary focus is to achieve a large scale impact adopting an extension strategy that yields the following results: 1) the Eastern Province to be closely associated with the national tree germplasm programme promoting climate resilient seeds and seedlings; 2) technical national staff at all levels receive knowledge and capabilities on climate change and implications for planting material and resilience; and 3) relevant technologies and capabilities in appropriate tree seed procurement are imparted to target beneficiaries through training, information, marketing and extension.

The project will develop and test species and provide recommendations, combining the expertise of national and international tree seed and research centres, high-resolution present and future climate data sets, species distribution records and new approaches for habitat distribution mapping, recently developed by the partners involved in the project.

This will help make recommendations on current traditional cropping systems and its adaptation to changing seasonal needs.

The activities comprising this output will be informed by locally relevant tools such as the Resilient Seed Systems Resource Box[134] and the Tree Seeds for Farmers Tool Box (Kindt et al. 2006), which will be used to enhance the access and use of crop diversity to adapt to climate change. Additionally, a potential natural vegetation map of Rwanda is available (www.vegetationmap4africa.org), entitled '*Atlas and tree species composition for Rwanda; Potential Natural Vegetation of Eastern Africa*'(Kindt et al. 2014). The project will create an enhanced 'higher resolution' map, which will provide the possibility to model potential natural distribution of species in the landscapes and thus to identify the baseline of the species considered and their future climate suitability. This will make possible to assess the status of the intraspecific variation of a much larger number of species than would otherwise be considered realistic. The book on '*Useful Trees and Shrubs for Agricultural and Pastoral Communities of Rwanda*' (Ruffo et al. 2009) describes useful tree species, but guidelines for their use and sourcing of propagation material is virtually non-existent. The map will be relevant for several project activities:

(i) indicate the position of transitions between areas with significantly different environmental conditions, linked with the distributions of all useful and ecologically important tree species across environmental gradients

(ii) provide a tool for ecosystem restoration, park management, and community conservation in different areas like surrounding hill sides, river banks and wetlands

(iii) provide a tool for forecasting the effects of climate change on ecosystems (distribution, composition, invasive problems, and state shifts),

(iv) provide a tool for recommendation domains of indigenous and exotic species for use in productive smallholder agroforestry

For the highest-ranking priority tree species, the project will refine and test provenance maps using genomic tools and through early-screening trials across environmental gradients. The application of genomics to advance breeding programmes will be done in collaboration with the African Orphan Crops Consortium (AOCC) based at ICRAF in Nairobi, where genome sequencing of promising but underutilized African crops have been initiated in parallel with a programme to educate African plant breeders (African Plant Breeding Academy). Results will guide the conversion of early-screening into applied breeding seed orchards providing effective mobilisation of selected, diverse gene pools for wise use in planting programmes across the region (cf. Activity 3.3.3). The component will enhance the national capacity of governmental and private partners to develop tree seed input supply systems that enable the delivery of superior tree planting materials to smallholder farmers, and forest landscape restoration projects.

[134] For more information on the Resilient Seed Systems Resource Box, see: http://www.seedsresourcebox.org

Seed production and distribution may become more successful by preparing an investment strategy that takes into account the constraints and opportunities of all the actors and their roles and the potential commercial as well as livelihood benefits. Investments should be based on an overall analysis of the sector, its different functions (seed sources, procurement and distribution), supply channels, and institutions, as well as estimates of the effects of investments on productivity and quality of tree products on incomes (for agroforestry, woodlots, etc.) and sustainability of plantings (for restoration). In many places the supply of tree seed in forestry has been dominated by the public sector but often restricted to forest plantations. With tree planting increasingly taking place on farm and for environmental protection with involvement of local communities and small-scale farmers, more informal seed distribution has become dominant and resulted in losses.

The involvement of the private sector (commercial business, farmer cooperatives) and the public-private partnership are considered of significant importance for sustainability in the longer term. Marketing and sales of tree seed and seedlings is an important component of the programme. The marketing approach of the programme will be based on the view that the tree planter is looking at trees as an investment. Marketing is then a question of making tree planters able to recognize the advantages in using better seeds for tree planting through extension. The incentive schemes should be seen within the context of the large investment portfolio of forest landscape restoration activities planned by the Government partly based on international funding sources and will therefore be designed and implemented in close collaboration with this investment portfolio under the auspices of the Ministry of Environment (MoE) through Rwanda Forestry Authority (RFA).

The establishment and management of a decentralized tree seed programmes with public and private partners covering many species and large environmental variation is a specialized and knowledge-intensive and -dependent field of work. The project will engage specialised international technical assistance from the ICRAF Genebank in Nairobi and from the international tree seed unit at University of Copenhagen. The tree gene bank of ICRAF in Nairobi currently handles more than 5000 accessions of about 200 species; and thirty-six field gene bank hubs (similar to the tree seed orchards proposed for Rwanda) with stands of 44 species are operated in 16 other countries.

International Technical Assistance will further be delivered by ICRAF in collaboration with the University of Copenhagen (UCPH), where the former Danida Forest Seed Centre (DFSC) is embedded. The experience of UCPH/DFSC draws on hands-on work with tree seed programmes in more than 20 tropical countries since the early 1960s and in collaboration with ICRAF since 1991. The proposal builds on the lessons learned from this large body of work. Local Technical Assistance (LTA) will be engaged and developed as part of the exit strategy.

Best Practices and Lessons Learned

Sharing of best practices and lessons learned is crucial in advancing understanding and uptake of climate adaptation activity. There is no one-size fits all adaptation, but there are similarities in approaches across regions and sectors. Sharing best practices, learning by doing, and iterative and collaborative processes including stakeholder involvement, will be used to support progress. Both "bottom up" community planning and "top down" national strategies are needed to help regions deal with impacts such as increases in drought, heat stress, and floods. . Such a mix of approaches requires state and local agencies to coordinate as they incorporate climate risks and adaptation planning into their programs. Cross-cutting efforts at the national and local levels, as well as initiatives in the corporate and non-governmental sectors, that builds resilience to climate change while also highlighting barriers and the research, development, and deployment needs can help stakeholders scale up adaptation activities.

Uncertainty, about the future climate, as well as about population growth, economic development, response strategies and other social and demographic issues, can inform climate adaptation activity (McCollum et al. 2011; Moore et al. 2012; Staudinger et al 2012). Through iterative processes stakeholders can regularly evaluate appropriateness of planned and implemented activities and revise them as new information becomes available (EPA 2011; NPS 2010; NRC, 2010a). Key best practice and lessons to consider:

(i) This intervention will seek to promote co-learning measures that promote adaptation to climate change built into existing institutions, networks and agencies, rather than creating a brand-new set of institutions.

(ii) Facilitating and encouraging networking will be instrumental in ensuring that lessons learned, and best practices are shared in a manner that will foster the scaling up of climate adaptation activity.

(iii) Since adaptation is inherently place- and time-specific, detailed understanding of institutional inter-workings and dynamics is critical to moving adaptation strategies forward. Information gathered from areas outside of the traditional climate studies can be researched for relevance to various adaptation processes (Dovers and Hezri 2010; Skaggs et al. 2012).

(iv) Improve coordination among government agencies through local mechanisms such as the Joint Sector Working Group

(v) Develop a climate adaptation framework that fosters a collaborative and iterative approach to provide information and resources to smallholder farmers, forest owners, researchers and managers across a variety of private and public organizations to assess the vulnerability of ecosystems based on verified information and experience in order to plan adaptation actions that meet management goals.

(vi) Conduct on-the-ground implementation with increased focus on demonstrations, monitoring, and evaluation to inform implementation of current and future adaptation efforts

(vii) Conduct assessments and document learning to better understand how certain underrepresented and highly vulnerable groups (e.g., tribes, rural communities) can be supported by reducing vulnerability and building adaptive capacity.

One of the challenges to adaptation often cited by decision-makers is the lack of clear information about the rate and magnitude of climate change. Assessment on the types of information users want and the creation of appropriate delivery mechanisms are needed.

To be usable, scientific information must be relevant to users (Lemos and Rood 2010). To best understand the needs and context of decision-makers, researchers will need to involve and engage decision-makers in clarifying how decision-making processes unfold and how scientific and other information to support, enable, and empower decision-making is used in these process (Hulme and Dessai 2008).

Given that selected adaptation options will have both short- and long-term consequences, and may affect sectors and regions differently, it is important to develop evaluation criteria to measure outcomes and learn to characterize successful adaptation. As the adaptation process itself must be adaptive, continued evaluation and revision of adaptive strategies will be needed (National Climate Adaptation Summit Committee 2010; PCAST President's Council of Advisors on Science and Technology 2011).

Additionally, ICRAF experience with large land restoration and food security programs (TFSP) in east and west parts of the country via Rural Resource Centres (RRCs), has revealed that key strategies to bring about change involves (i) technical backstopping (ii) partners support (iii) peer co-learning and linkages and (iv) paradigm shift in the policy institutional focus. The strategies and their impact pathways are shown in Figure 16.

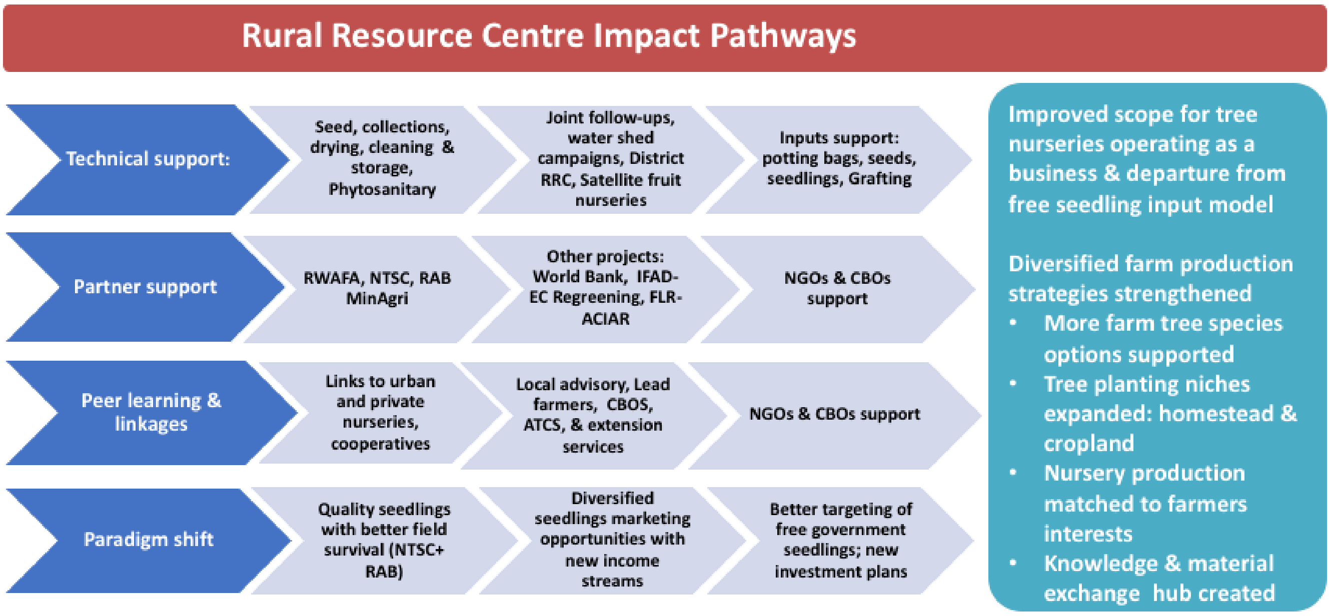


Figure 16. Key impact pathways to influence climate resilient planting material delivery via RRCs in Rwanda

<u>Description of Activities</u>

Output 3.3 comprises of the following activities and sub-activities:

Activity 3.3.1: Integrate climate change aspects in policies and strategies for the seed sector and develop business models to promote climate resilient varieties

This activity aims to enhance the enabling conditions for strengthening the seed sector and promoting climate resilient seed and seedling varieties. This will be achieved by conducting an assessment is to analyse the needs and opportunities for the growth of the sector, the actors, and influential factors in the agribusiness system. The project will identify appropriate business models for seed supply in order to develop business development services to promote climate resilient seeds and seedlings. In parallel the following policies and strategies identified by ICRAF Regreening Africa Rwanda project (see Annex 1) will be assessed to identify entry point for integrating climate change related aspects in order to enable opportunities for intervention and points of leverage among public and private actors:

- Rwanda National Forest Policy 2017- targets to attain 30% forest cover by 2020
- Rwanda Agroforestry Strategy and Action Plan 2018-2027
- Rwanda National Seed Policy 2007
- Draft Law governing seeds and plant varieties in Rwanda, 2016
- National Strategy for Transformation (NST) 1
- Strategic Plan for Agriculture Transformation 4 (PSTA 4). 2017 -2022
- International commitment on land restoration such as the Bonn challenge and AFR 100
- The Green Growth and Climate Resilience National Strategy for Climate Change and Low Carbon Development (2011)

MINAGRI will support the development and promulgation of policies and strategies that promote reproductive materials for fruit trees and nuts that are more climate resilient as compared to the currently used in the EP. MINAGRI will also support establishment of public-private collaboration platforms. The Ministry will provide staff, facilities, workshop and travel costs associated to this support.

Sub-activities	Description
Sub-activity 3.3.1.1	Conduct situational assessment on the seed and seedling sector to identify opportunities for promoting climate resilient varieties and development of climate proof business models.
Sub-activity 3.3.1.2	Assess sector policies and legal framework to identify entry points and integrate climate change aspects to promote climate resilient seed and seedling varieties.
Sub-activity 3.3.1.3	Support establishment of public-private collaboration platforms based on demand-supply scenarios developed for tree species priority groups, based on which location and size of seed sources to be established can be determined, and quality material promoted through the most appropriate channels of supply, including possible seed marketing associations/networks.

Activity 3.3.2: Prepare climate informed maps and information portal for habitat suitability for up to 100 climate resilient tree and crop species in Rwanda

This activity will provide the knowledge and information required to establish a national modality for conservation, improvement and utilization of tree genetic resources, leading to establishment of improved seed sources *cum* conservation areas, as well as delivery of germplasm of the priority climate resilient tree species in Rwanda. The generation of the maps will be based on climate suitability modelling, and knowledge of genetic differentiation from field trials and genomic studies.

The specific models and maps for the priority tree species of Rwanda will be developed under the inception phase of the project and will inform project activities in Outcome 1 and Outcome 2 as well other national and sub-national initiatives. All activities of outcome 1 and 2 involving tree planting, agroforestry practices, and tree nurseries and therefore choice of species and planting material will benefit directly from the activity.

MINAGRI will provide support suitability mapping of fruit trees and nuts, as well as crop suitability as it builds on MINAGRI's support to districts in mapping soil fertility and agricultural inputs recommendations. MINAGRI and RAB breeding, and climate change staff will contribute to this activity through trainings and workshops organization and all travels associated to this cost will be covered by the Ministry. Where end users are unable to access this information via smartphone (due to limited penetration), alternative approaches will be supported, for example by developing SMS services linked to the portal.

Sub-activities	Description
Sub-activity 3.3.2.1	Prepare high resolution maps for habitat suitability and recommendation domains for up to 100 priority tree and crop species in Rwanda.
Sub-activity 3.3.2.2	Document important patterns of genetic differentiation of selected indigenous species to identify climate resilience characteristics and potential for climate adaptation
Sub-activity 3.3.2.3	Develop and introduce a user-friendly decision support system and interactive information portal ("what to plant where"), allowing stakeholders to make informed choices regarding the best-suited tree species and their seed sources location for all relevant sites and functions. Identify appropriate SMS alternatives where users are unable to access smartphones.

Activity 3.3.3 Design and establish a national-level breeding programme for up to 25 climate resilient priority species of fruit, food, fodder and timber species

This activity will review stakeholder planting material demand and local and external supply options (cf. also 3.3.1). Farmers, extension services and nursery operators will be beneficiaries of diverse, more productive, climate resilient and disease-free certified planting materials sourced following phytosanitary standards especially for priority fruit cultivars. Commercially important fruit varieties of avocado, mango, tree tomato, and macadamia will be sourced following international best practices for farmer orchard establishment in home gardens and to set up mother blocks to help in multiplication of materials by nursery operators. The project will conduct trainings and education modules for national and grassroot actors on climate resilient seeds, germplasm handling, phytosanitary regulations to raise awareness and improve on material sourcing, storage, need for documentation and management of invasive species. Technical backstopping will be offered to nursery operators on proper planting material handling to reduce pest and disease problems at the nursery stage and mix up of varieties for different ecological settings.

The activity will further identify existing- and establish new seed production *cum* conservation areas of the priority tree species in Rwanda with focus on the Eastern Region. The project will design a breeding programme for up to 25 priority species, including identification of distribution and deployment zones - considering climate change; and including design, establishment, management and use of breeding seedling orchards (BSOs) for selected model species. Deployment zones will include mapping and delineation of areas for intensification with improved fruit cultivars of avocado, mango, tree tomato and macadamia and site identification for fruit scion banks and orchard establishments; conducting discussion and developing agreements with district and local authorities on allocation of land for fruit scion banks and orchard establishment.

The programme will be based on diversity and designed to provide for climate change adaptation and resilience of the species to be used in current and future climates. The new seed production areas will be established as breeding trials and at the same time serving as seed production areas producing genetically high-quality and climate resilient seeds. The aim is to make at any time best quality climate resilient seeds available for tree planting activities in Rwanda, while at the same time continuously improve the quality of the seeds and seedlings.

MINAGRI will support this activity through provision of qualified breeders from RAB, providing equipment, and supporting trainings and travels associated to this support. The current MINAGRI's Crop Breeding Programme will support the project team to enhance the resilience component. RAB Research Stations under MINAGRI in the EP will be open to host the planned mother blocks and BSOs in relevant deployment zones that will be used in breeding.

Sub-activities	Description
Sub-activity 3.3.3.1	Design a breeding programme for up to 25 priority species, including identification of distribution and deployment zones based on climate information
Sub-activity 3.3.3.2	Range wide acquisition of priority species from their distribution area, including procurement of superior fruit planting materials and develop germplasm exchange protocols/agreements with regional and international research and development bodies; and range wide collections of plus tree families (from natural

	stands as well as possible landraces) complementing existing collections.
Sub-activity 3.3.3.3	Design and establish mother blocks and BSOs in relevant deployment zones.
Sub-activity 3.3.3.4	Assess, manage and use the mother blocks and BSOs for breeding, acquisition of vegetative propagules and seed procurement.

Activity 3.3.4: Conduct 12 trainings for six multi-agency working groups on seed-seedlings and climate adaptation

This activity will sensitize and conduct trainings for district and national sectoral working groups and district level NGO coordination board on matters concerning diverse quality seed and climate resilience. Trainings may include (i) short course on developing climate resilient seed and seedling systems for national and local institutions conducted covering decision support tools on climate adaptation and plant varietal suitability mapping, (ii) trainings of trainers on germplasm handling, phytosanitary regulations, and (iii) development of 'nursery hygiene' best practices to manage pest and disease problems, depending on the needs identified.

MINAGRI will provide staff and support training on fruit and nut reproductive materials adapted to climate change. Associated costs of equipment, travels, and professional contractual services will be supported.

Sub-activities	Description
Sub-activity 3.3.4.1	Conduct training needs assessment for key stakeholders to develop climate resilient seed and seedlings supply systems with the establishment of a tree seed network of local and national stakeholders; and assess the need for introduction of climate proof standards in existing tree germplasm facilities
Sub-activity 3.3.4.2	Conduct 12 trainings for 6 multi-agency working groups in relevant methods and relevant technologies in climate proof tree seed procurement, nursery development and business operation as well as extension of knowledge to target beneficiaries.
Sub-activity 3.3.4.3	Prepare, publish and distribute training, extension and information material in all aspects of the program.

Output 3.4 Evidence from best practices generated through applied research and co-learning

The table below summarises Output 3.4 which will enhance and coordinate knowledge and information systems for decision making to increase climate resilience.

Key aspects	Description
Overview	Good practices and scaling up of climate resilient strategies need to be built on robust evidence regarding their effectiveness to address climate risks. The output aims to improve the knowledge on the role of agroforestry systems and practices to contribute to restoration of degraded agricultural land and build climate resilience. The activities under this output will address knowledge gaps on agroforestry systems (e.g. ecological and socio-economic perspective, value chains development, sustainable use of biomass energy) via applied research and evidence generation to inform good practices for climate resilience in the country. The results from the applied research will guide both public and private development partners to disseminate appropriate agroforestry-based restoration options, profitable and nutritious value chains, improved cookstoves (ICS) to enhance the resilience of social and ecological systems. and suitable institutional options that foster adoption at scale of agroforestry-based landscape restoration and sustainable use of biomass energy in the Eastern Province.
Barriers addressed	1) Little understanding of direct beneficiary farmers to better understand their changing needs and constraints in participating the recommended agroforestry packages 2) Insufficient links and collaboration between research agencies with extension services and useful research of beneficiary farmers to understand needs, which are leading to low adoption by farmers of proposed innovative agroforestry methods.

Description of the intervention

In the context of EU initiative on Climate-relevant Innovation through Research in Agriculture (and food systems) in developing countries –DeSIRA (2018 Call for proposals), ENABEL and IUCN co-jointly submit a project proposal which has been approved end of 2018. This project is under formulation and implementation should start beginning 2020 for a 5-year period. This EUR 4 million EU initiative, called "Improving resilience of farmers' livelihoods to climate change through innovative, research proven climate-smart agroforestry and efficient use of tree resources in the Eastern Province" will be implemented by ENABEL and IUCN, in collaboration with research institutions (ICRAF, University of Leuven, University of Genk, University of Rwanda) and RFA/RAB extensions services. The DeSIRA project is fully complementary to outcomes 1 and 2 of the TREPA program and has the same intervention area (Eastern province). Thus, DeSIRA project contributes to the TREPA Output 3.4 with research excellence and co-financing by the EU. Only the main DeSIRA investment to be made from 2021 to 2024, which will be directly linked to specific activities of the GCF project, is accounted for as co-funding for the GCF project. ICRAF has already developed knowledge and tools for agroforestry in Rwanda and in the region and will act as a key partner in the implementation of this Output 3.4.

Output 3.4 focuses on adopting participatory action research methods for the design and monitoring of the agroforestry systems in order to test and refine current practices. The research will engage 1500 farmers' households in the Eastern Province. This output will generate robust evidence on agroforestry systems and cooking technologies to address knowledge gaps and inform good practices for climate resilience building.

It is evident that the future development of agroforestry –based landscape restoration will achieve greater impact if it targets and strategically incorporate the production of high nutritious agroforestry products (especially fruit). Therefore, this output will generate insights and complementary proven knowledge (adapted species/variety and good practices) in value chains of climate resilient, high nutrition value chains from agroforestry landscapes of the Eastern province.

Research topics were identified and approved during a participatory workshop held in May 2019 with key partners (RFA, MINAGRI, MININFRA, ICRAF, UR, UICN, ENABEL, University of Leuven). These partners have in mind the intended TREPA activities, and thus selected priority research/knowledge generation that should help TREPA implementation at field level, avoiding too much fundamental research. Priority topics in the research agenda have been identified and approved during a participatory workshop held in May 2019 with key partners (RFA, MINAGRI, MININFRA, ICRAF, UR, UICN, ENABEL, University of Leuven). Research topics include:

1) Agroforestry systems:

- Through practical experience, identify agroforestry system models with highest potential for achieving climate resilience at a landscape scale
- Assess the effects on water balance in semi-arid ecosystems the impact of incorporating different trees (and management options) on water dynamics will be quantified and simulated and then integrated with farm and landscape level models

to explore trade-offs and synergies amongst impacts of changing tree cover management on ground water dynamics at landscape scale.
- Assess carbon sequestration potential by different agroforestry systems
- Identify the most important socio-economic barriers to restoration and adoption of agroforestry practices
- Test and disseminate incentive mechanisms for supporting adoption of agroforestry-based landscape restoration by farming households in the Eastern Province.
- Assess the socio-economic benefits from agroforestry and how they contribute to reducing the vulnerability of smallholder farmers
- Determine the effect of agroforestry trees on biodiversity richness
- Develop methodologies and tools for agroforestry monitoring in the context of the climate scenarios.
-

2) Improved cookstoves (ICS):

- Document evidence on the role of ICS in achieving sustainable forest management
- Generate locally tested expertise and knowledge on highly efficient, durable, affordable and user-friendly ICS
- Test, improve and standardise ICS
- Document information on available and accessible biomass fuels

The output will seek to support the development of mechanisms and platforms for communicating research findings and building the capacity of extension staff in the implementation of best practices. Training will be provided for four PhD national candidates that will conduct research under the supervision of professor from the University of Rwanda and interdisciplinary and interuniversity research platform (e.g. Universities of Genk and Leuven, Belgium).

The project will use an evidence-based approach to generate knowledge and a more diverse portfolio of agroforestry-based landscape restoration options that will suit different sites and farmer circumstances in Eastern province. An understanding of the socioeconomic circumstances of the farmers and barriers to adoption of agroforestry will build the foundation for addressing economic, ecological and behavioural constraints to adoption of agroforestry. The project will increase uptake of innovative agroforestry options by the farmers by fostering greater resilience through economic and ecological diversification, higher farm productivity and biodiversity securing food and income, and higher profitability through capturing more value from high commercial and nutritious agroforestry products. The farmers and private entrepreneurs are expected to benefit through capacity building in value chains development and nutritious agroforestry products related business opportunities, especially for women and the young people. This will be achieved by explicit gender transformative processes, understanding and prioritizing agroforestry-based landscape restoration options that women and young people can benefit from.

The investments will mainly aim at generating knowledge and skills and translating these into practices and policy recommendations for increased adoption and scaling out.

Description of Activities

Output 3.4 comprises of the following activities and sub-activities:

Activity 3.4.1: Produce 6 research publications on the role of agroforestry systems for building climate resilience in semi-arid landscapes

This activity aims to document research results on a specific set of research questions related to the role of agroforestry for increasing resilience of semi-arid landscapes. While the initial phases of activities have been selected under Outcome 1, the outcomes from this research will be used to inform ongoing on-the-ground activities under Outcome 1 to improve the projects impact over time as well as to inform policy revision and formulation under Outcome 3. The research will focus on assessment of the current agroforestry systems and their productivity characteristics, potential for carbon sequestration, contribution to microclimate and water balance regulation. It will come in support of the output 1.1. A review of the existing spatial and socio-economic agroforestry data will be made to complement the findings from field surveys. The profitability of each agroforestry system will be assessed on the basis of cost–benefit analysis, net present value, internal rate of return, and annualized income. The activity will result in a series of knowledge materials and research publications to inform decision-makers and practitioners in the application of best practices.

Sub-activities	Description
Sub-activity 3.4.1.1	Conduct a field research and survey to assess the different agroforestry practices in the Eastern Province
Sub-activity 3.4.1.2	Assess the productivity characteristics of the identified types of agroforestry systems and develop a framework for evaluation
Sub-activity 3.4.1.3	Determine the effect of agroforestry trees on biodiversity richness
Sub-activity 3.4.1.4	Estimate the carbon sequestration potential by different agroforestry systems via dendrometry, tree ring analysis and tree growth studies
Sub-activity 3.4.1.5	Assess the available knowledge about the effect of trees on water balance in semi-arid landscape to provide baseline information
Sub-activity 3.4.1.6	Assess the role of agroforestry systems for the dynamics of the microclimate
Sub-activity 3.4.1.7	Conduct scenarios to determine trade-offs of agroforestry systems

Activity 3.4.2: Produce 2 publications on the role of agroforestry systems for food security and building socio-economic resilience of local communities.

Analyse the value chains in selected landscapes of the Eastern Province and identify the different financing options for high nutritious agroforestry products, identifying the various organizational and institutional arrangements which support value chain development as well as assessing and profiling the associated business opportunities. The initially considered commodities for the value chains include fruit, nuts.

Sub-activities	Description
Sub-activity 3.4.2.1	Identify high nutritious (fruits/nuts/fodder) value chains and characterise at least 4 with high potential for building resilience to the local population
Sub-activity 3.4.2.2	Market analysis for selected potential value chains analysed

Activity 3.4.3: Locally test user-friendly improved cooking stoves (ICS) and produce 4 knowledge materials to train 6 local producers and 12 national/district staff and inform best practices

This activity will focus on producing inventory of available ICS technologies in the project area and documentation of stove characteristics, including efficiency, fuel consumption, health effects, cooking behaviours, and user acceptability will be assessed through in-depth interviews and focus groups. Project experts will carry out laboratory testing of the most promising ICS efficiency focusing on gas emission and acceptability by farmers. Efficient and low gas emission selected models of ICS will further be tested in kitchen participatory testing at households' level and compared to traditional cook stoves (3 stones stove). Finally, financial analysis and cost-benefit simulations for assessing the net benefits of changes in ICS technologies will be conducted to demonstrate how the economic case for ICS is contextual, pointing to the households' choice among ICS. A training will support local artisans and small-scale business entrepreneurs, composed of youth and women, in design and adaptation of their models based on user's feedback Provide small start-up advance to the local ICS producers for equipment purchase to design and adapt ICS models based on user's feedback.

Sub-activities	Description
Sub-activity 3.4.3.1	Conduct baseline studies on availability and accessibility of biomass fuel in the Eastern Province
Sub-activity 3.4.3.2	Prepare inventory on the efficient ICS best adapted to raw material availability and user appreciation in the Eastern Province
Sub-activity 3.4.3.3	Train 6 local producers in design and technology development for ICS

Activity 3.4.4: Produce 4 knowledge and research materials on the socio-economic barriers to adoption of climate resilient practices for land restoration and identified opportunities for economic incentives.

This activity will focus on producing studies on (i) barriers for low adoption of agroforestry and (ii) socio-economic benefits from agroforestry to inform future actions and policies. The project will establish a large-scale experiment in participatory development that emphasises local technology based on farmer-led testing of agroforestry options, where farmers themselves select agroforestry technologies, implement the field tests and assume responsibility for disseminating the results locally. An evaluation the on-farm agroforestry plots will provide useful supplementary information for the design of improved agroforestry systems.

Sub-activities	**Description**
Sub-activity 3.4.4.1	Assess the barriers/causes to low adoption of agroforestry for building resilience in semi-arid landscapes
Sub-activity 3.4.4.2	Assess socio-economic benefits from agroforestry systems and identify incentive mechanisms for farmers
Sub-activity 3.4.4.3	Test different kind of extension mechanisms as one of the barriers, and analyse answer from farmer to each system

Activity 3.4.5: Conduct 8 capacity building sessions for x and develop 8 knowledge sharing tools to foster scaling-up of agroforestry systems for climate resilient landscapes and promote sustainable use of biomass energy.

This activity will focus on improving the monitoring system and capacity for the agroforestry activities. The project experts will review and test the existing M&E system to understand the gaps and weaknesses that need to be improved. Indicators for agroforestry monitoring will developed with active participation of key actors, stakeholders and beneficiaries' groups. The right tools and methods to measure indicators will be selected in a participatory manner to ensure common understanding and responsibility among agroforestry stakeholders. Policy support tools for agroforestry monitoring and evaluation will be developed to ensure that agroforestry M&E system is integrated into the overall planning of land use.

Sub-activities	**Description**
Sub-activity 3.4.5.1.	Agroforestry monitoring capacity enhanced
Sub-activity 3.4.5.2:	Develop 8 of knowledge sharing tools to improve up-take of research for policy and practice

Sub-activity 3.4.5.3:	Conduct 8 training sessions for extension services and other relevant actors on incentive mechanisms in agroforestry sector
Sub-activity 3.4.5.4:	*National capacity in ICS testing and standardisation improved.*
Sub-activity 3.4.5.5:	Train four PhD students on applying research methodologies for agroforestry systems to strengthen national research capacity and excellence in the field

Implementing modalities

Output 3.4 will be entirely funded by the EU DeSira project and implemented jointly by Enabel and IUCN in coordination with ICRAF, RAB and UR.

Activity 3.4.1 and 3.4.2 will be coordinated by IUCN while activities 3.4.3 and 3.4.5 will be coordinated by ENABEL. Activity 3.4.5 will be jointly managed by ENABEL and UICN. All the activities will be implemented with the support and in collaboration with the University of Rwanda, the University of Gent, the University of Leuven and ICRAF. Applied research activities will be conducted in farmer's parcels and households through 4 Rwandese PHDs and around 20 Masters supervised by lecturers and researches of above-mentioned institutions. University students will be trained and used as surveyors where relevant. Expert specialist, such as engineer in ICS design, will be outsourced through service contract. Officer from RAB, RFA, MINIFRA and from District will be involved in field and transfer of knowledge activities.

A technical/scientific committee involving above mention research institutions will be established to coordinate and supervise the overall research actions (approval of protocol, review and approval of research report, review of publication, of policy brief, etc.) (Table 27).

Table 27. Implementing partners and stakeholders

Actors	Roles and responsibilities
Implementing partners	
IUCN and ENABEL	Project manager coordinating the Project Management Unit of this component, implement direct project activities, provide technical advice, and manage relationships with and advise key partner institutions
National stakeholders	

MINAGRI/RAB	Support in integrating agroforestry practices in farming systems and collaboration in strengthening agroforestry extension services including technical assistance in farmer trials, demonstration sites and farmer field schools (FFS) trainers and facilitators to develop, implement and transfer climate – smart agroforestry practices
University of Rwanda	Co- supervision of PhD students and MSc internees across R1 and 2 of the intervention
MININFRA	Involved in every activities regarding ICS
Ministry of Environment/RFA	Participate in planning and monitoring, particularly in areas of agroforestry and biomass energy Provide political support on the planning, preparation, implementation and evaluation of project processes to ensure its integration in the overarching strategies and programs of Rwanda
International stakeholders	
Ghent University	Teaching and supervision of PhD, MSc students undertaking research on agroforestry systems and components and agroforestry value chains.
World Agroforestry Centre (ICRAF)	On the basis of MoU between ICRAF and Enabel on one hand, ICRAF and IUCN on the other, ICRAF will be in charge with the implementation of specific adaptive research and capacity building activities relevant to results 1 and 2 .
Local Authorities	
Districts and Sectors' offices in the Eastern Province and peri-urban Kigali	Political support in mobilizing the population for undertaking agroforestry-based landscape restoration research and development activities in the District
Farmers and farmers' cooperatives	
Beneficiary farmers and farmers' cooperatives in the EP and peri-urban areas of Kigali City	Beneficiaries of the project who participate also in on-farm experimentation (set-up and management of participatory trials)
NGOs and Civil society	

NGOs and civil society platforms operating in the districts of EP and Peri-urban Kigali	Provide orientation to the implementation of adaptive research Support mobilization of the private sector community to engage in adaptive research activities. Support piloting of investment packages through its strategic priority of promoting high nutritious value chains

14. Section 8. Overall sustainability of the project

Section 8 presents an overall description of the mechanisms that will be adopted throughout the project components to ensure the sustainability of the proposed interventions.

Overview

The overall goal of this project is to achieve lasting transformative change within the drought-degraded Eastern Province transforming it into restored, productive and climate-resilient ecosystems and communities. The project addresses barriers to achieving transformative change by establishing the right mix of enabling environment conditions necessary for business and social participation and reducing climate related risks for investments. Establishing enabling conditions for investments for land restoration, forestry and agro-forestry sets the basis for climate resilient and adaptive economic development in the Eastern Province, which will in turn further enhance revenue generation and attract investments. Beyond establishing enabling conditions, empowering national and local stakeholders and institutions to maintain these measures beyond the scope of the project is an essential element to the project exit strategy.

Investments in component 1, which restore landscapes will support climate resilient agro-ecological systems and livelihoods. In turn, the reinforcement of agricultural markets and value chains, under component 2, will further strengthen and support climate resilient ago-ecological systems. Lastly, the empowerment of national and local institutions to effectively mainstream climate adaptation in land planning and management under component 3 will enable faster recovery in the aftermath of droughts, reduced loss of GDP during, and sustained growth. By monitoring these impacts, the project will make the case to the private sector and national government for continued investment to build on the project outcomes.

The project will ensure that the sustainability of the interventions is feasible beyond the GCF resources through the following transformative actions:

Biophysical sustainability

The basis for sustainable transformative change rests upon the project's overall transformation of the biophysical conditions of the drought-degraded Eastern province into restored, productive and climate-resilient ecosystems and communities through a shift towards best forestry, silvopastoral and agroforestry practices. As a result of the project, in the longterm, the projects interventions will contribute to the resilience of ecosystems to climate changes by supporting water and soil protection while contributing to biodiversity conservation and woody biomass supply.

Forestry, agroforestry and silvopastural measures will provide multiple benefits including the reduction of soil loss, increase of wood biomass, plant and soil carbon sequestration, soil nutrients, provision of essential resources such as a livestock fodder, fruits, and fuel wood for cooking energy and construction materials. The project will support the establishment of and maintenance of systems of land use rights and the signing of agreements between landowners and district governments in order to prevent over exploitation of resources will be established during the project that will be maintained by various stakeholders following project closure. Increased knowledge on biophysically sustainable practices mean stakeholders can maintain protection of land and resources.

Maintenance of river/lake shore, national park buffer zones and road side plantation: The main management objective for both river/lake shore, national park buffer zones and road side plantation are to scale up restorative activities and increase the knowledge and capacity of stakeholders to protect these areas from grazing, overuse of woody biomass and activities that contribute to runoff and soil degradation. Long term economic modelling demonstrates a significant positive effect of protection of river/lake shore, national park buffer zones and road side protection. Beyond the scope of the project the cost for these activities will be ensured by the government at central and local level: as the targeted areas restored by TREPA are contracted by private operators responsible for the overall maintenance and management activities of river/lake shore, national park buffer zones and road side plantation.

Sustainable forestry management: Models estimate that in the median and long term view, the Project will impact very positively the balance supply/demand of wood, reducing over the years the so high pressure on resources, which is jeopardizing their sustainable management The project supports the development, revision and maintenance of District Forestry Management Plans (including, public forest cadastre mapping, forest inventory, silviculture planning, public FMU design) that will support the change to sustainable and productive forest management, for the support of landscape restoration and the increase of the resilience to climate change

<u>**Policy, regulatory and institutional capacity:**</u>

The key to maintaining the transformative change in the project is the development of the institutional capacity of stakeholders and institutions. Transformational change is maintained by addressing weak institutional capacity and coordination to implement climate-risk informed landscape management strategies.

Strengthening coordination and national capacity for land planning and management: Strengthening the capacity of the national and local institutions and enables them to effectively mainstream climate adaptation in land planning and management. Component 3 in particular will seek the following outcomes:

- To promote co-learning measures that promote adaptation to climate change built into existing institutions, networks and agencies, rather than creating a brand-new set of institutions.
- Facilitating and encouraging networking will be instrumental in ensuring that lessons learned, and best practices are shared in a manner that will foster the scaling up of climate adaptation activity
- Improve coordination among government agencies through local mechanisms such as the Joint Sector Working Group
- Conduct on-the-ground implementation with increased focus on demonstrations, monitoring, and evaluation to inform implementation of current and future adaptation efforts

Capacity building: Training of technical staff including agriculture, livestock and forestry extension agents and planners on climate risks and their implications for cross-sectoral aspects. Will better equip actors to access funding for adaptation actions from FONERWA and other sources. Furthermore, strengthening the capacity of the administration agents in the East Province not only to perform their work in the project intervention area but also to deliver their expert services elsewhere in the country beyond the project scope. This is an important aspect of the paradigm shift for the project to achieve its goals. It is anticipated that scaling up will happen as a critical number of technicians and extensionists are to be properly trained and equipped.

The project will work through district administration structures to build their capacity and strengthen their asset base (including capacities). The concerning power of local government structures will be supported to provide policy and strategic support for restoration activities, particularly for district owned assets and investments in resilience. Supporting this will be an enhanced planning and decision-making systems reinforced by improved climate information.

Mainstreaming climate change adaptation metrics: The project will integrate climate resilience metrics into district development strategies and annual performance contracts and harmonize cross-sectoral monitoring and reporting mechanisms. The mainstreaming strategy adopted by the project consists of using a climate lens to screen current policies and strategies and integrate climate resilience metrics for improved monitoring and reporting. By including resilience metrics, these policies will provide the opportunity to build-in appropriate climate proofing measures and include projects and activities than can reduce climate vulnerability. This will lead to a systematic consideration of climate change risks and adaptation in policy planning that will be sustained beyond the project duration through increased capacity of stakeholders. Mainstreaming these metrics will: create incentives for the consideration of climate adaptation in development and land-use planning processes; facilitate adaptation actions, monitoring and reporting across different government levels and cross-sectoral, and; create an enabling environment for scaling up of climate resilient landscape solutions.

Integration of climate-related data to contribute to climate-informed decision-making will enhance monitoring of climate information and relevant climate-related indicators at landscape level in order to guide decision-making-processes and inform the scaling-up of initiatives within the Eastern Province and the rest of Rwanda. Training of trainers' sessions for technical staff responsible for the information systems will allow the transfer of knowledge beyond the lifetime of the project.

Establishing long term legal structures to ensure adaptation measures are sustained: MoUs or farming contracts between local authorities and supported farmer groups and FFS will be signed and legally binding to stipulate the long and short term modalities of support and collaboration of each involved party (farmers, local authorities, sector extensionists and researcher support) to ensure investments are sustained. In exchange, local authorities will continue to support farmer groups with agro forestry extension services through national budget lines established through the support of the project

Supporting this at the local authority level will be an enhanced district planning and decision-making system supported by improved climate information and an information dashboard. Local authority officials will be enabled to use this information in making improved climate change adaption decisions and to allocate resources more effectively

Technical and knowledge sustainability:

The project achieves a transformation shift in technical capacity and knowledge to address the compounding barriers of a) limited knowledge and awareness of climate change risks, impacts, and adaptation solutions related to land restoration, b) Inadequate technical capacity on designing and applying climate resilient management practices, c) national level institutions lack a comprehensive system for sharing climate knowledge

Developing the technical and knowledge capacity of smallholder farmers: The project supports ongoing country efforts to enhance the food security and incomes of smallholder farmers, especially women, through targeted activities at the food system, cooperative, and individual farmer levels. Component 2 in particular will contribute to strengthening smallholder farmers' institutions, increasing their marketable surplus through climate resilient solutions, including improved access to inputs and extension services, improving quality climate commodities harvest, reducing post-harvest losses, and enhancing access to finance and predictable markets, capacity building in quality control and marketing, contracts negotiations with off-takers. Developing the technical and managerial capacity of farmers will lead to greater participation in agricultural markets that will be maintained by increased capacity and income generation overtime.

Developing technical knowledge through applied research: Component 3 focuses developing technical knowledge that is based on existing experience on the ground and will feed directly back into the projects interventions. The activities are informed by locally relevant tools such as the Resilient Seed Systems Resource Box. Based on existing tools the project will develop and test species and provide recommendations, combining the expertise of national and international tree seed and research centres, high-resolution present and future climate data sets, species distribution records and new approaches for habitat distribution mapping, recently developed by the partners involved in the project. This will help make recommendations on current traditional cropping systems and its adaptation to changing seasonal needs. Increasing the adaptive capacity overtime. Following project closure the research will remain in knowledge products of the project as well as capacity developed of researchers and other experts such as agro-ecological technicians extensionists. Furthermore, regular learning exchange meeting between farmer's groups and reward champions will be held during the project and maintained after project closure by forestry boards.

Transforming the technical and financial sustainability of ICS market and fuel supply solutions: The TREPA ICS intervention will focus on conventional high efficient woody biomass improved stove, leaving the dissemination of ICS to specialised actors (NGOs such as VSF, local company) which are providing specifically designed microfinance scheme and long term maintenance services.The projects support to ICS market transformation for efficient cook stoves will be ensured via close collaboration and involvement of all value chain market actors: local communities (demand), manufacturers (supply), and financial intermediaries (MFIs). It is the aspiration of the project to create such business model that market will continue growing without further grant support. This is based on the following assumptions:

1. Demand for improved cook stoves will sustain due to implementation of SFM regime in pilot communities;
2. Supply of affordable cook stove will be provided by local manufacturers; and
3. Financing will be made available at affordable terms by partner MFIs.

<u>Financial and business sustainability:</u>

The project will strengthen investment in value chains and in restoration enterprises that will function beyond the life of the project and will be critical to maintaining ecosystem management. Value chain actors as farmers and end users will be not only be trained and equipped with technical knowledge and skills but will be well-endowed with basic financial and business and accounting literacy in order to maintain financially viable MSMEs.

Marketing of Agroforestry Products and Development of their Value Chains is an important pillar to ensure the long term financial sustainability/increased profitability of agroforestry systems. Private investors are directly engaged under component 2 to develop financial products are crucial to ensure the long term viability of actions under this project. Enables the provision of climate-smart and eco-credit by financial institutions and companies to their farming clients With access to start up and working capital through the 'last mile' competitive financial products and services. ICCO financial services metrics products will integrate with lenders' core banking systems to make sure land-related climate risk factors can be easily incorporated into existing credit processes in order to maintain lending beyond the scope of the project. Access to micro-credit /saving system specifically designed for rainfed, agro-forestry and silvopastoral systems investment is crucial. For example, technology that will continue to support beneficiaries beyond project lifetime, such as rainwater harvesting technology investments for off-season small-scale irrigation.

Establishing systems in order to maintain sustainable forestry management through profitable business models, cooperatives and long term contracting: The project will establish both the technical and managerial capacity of stakeholders to manage under high regime forest through SFMPs under DFMP intending to optimise the sustainable long term production. State owned forests will be contracted to private investors based on successful models operating in the country and regionally. Supporting long term contracting and concessions for restored state and district forest in line with forestry management plans will ensure the sustainable long term production of timber woods and poles, while using residue for production of clean fuel wood product such as pellets, and thus maximise the additional value per ha of forests. The economic profitability of this PPP is the guaranteed by the sustainable management of these forests, ensuring their full contribution to ecosystem services and to climate change resilience. Furthermore, new innovative financial mechanism for the private FMU middle/long term forest business case development will be supported by the project and developed with local finance institutions.

Considering the very low investment capacity of small-holders, restoration of forest supported by TREPA provide a long term growing capital to the cooperative, increasing their capacity to access to finance, to developed their business and sustain their forests. The project will support small-holders in private FMU cooperatives establishment. Following project closure these activities will be maintained by state (national and district governments supported by MINIRENA) and private (microfinance institutions) actors. Furthermore, the directly supported FMUs will serve also as example that should lead neighbouring small-holders to initiate their owned FMUs and proceed restoration with microfinance facilities that will be established by the project and maintained following project closure.

Ultimately, through restoration, and forest capital that can support access to finance, the organisation of the small-holders into FMUs will ease the linkages between raw wood producers and the wood products markets, allowing the establishment of more professional and profitable value chains.

Strengthened value chains: Output 2.1 and 2.3 specifically aims to enhance the inclusivity and competitiveness of climate resilient commodities market systems in Rwanda to ensure longterm business sustainability through; strengthening business linkages for efficient value chain performance; increase the productivity and profitability of smallholder farmers with the aim of alleviating poverty and reducing the number of those experiencing food insecurity, while increasing the number of those readily accessing markets through Push and Pull approach.

Increased profitability of smallholder farmers through training, awareness campaign, study tours and establishing meaningful public private partnerships to attract more investors in their respective value chains. Increasing the lasting capacity of vulnerable producers and farmers to analyse markets, gain information, build relationships and act collectively to overcome production and market barriers and increase profits will lead to sustainable businesses in the long term. This will also involve linking farmers with buyers or buyers’ agents in this space by developing a preferred-buyers network in each of the districts and a business platform model that link buyers and farmers to build trust and transparency

Furthermore, Vision Fund, a microfinance subsidiary, will continue to offer loans following project closure to support the continued strengthening of value chains and Rwandan climate resilient commodities traders will have the opportunity to seek capital from these sources beyond the traditional microfinance limits.

Social sustainability:

The projects interventions will directly enhance the climate resilience of communities and thus leaving lasting transformative change. Private sector resources will be leveraged to partake and invest in long term gender responsive CRA, SFM and ICS through inclusive value chain and market-based approaches. Training (including training of trainers) and capacity development will have a lasting effect on communities’ ability to maintain the following benefits beyond the project scope:

Development and maintenance of ecosystem services: Through inclusive CRA, SFM and ICS value chain and market based approaches, value chain actors (including women, youth and disadvantaged groups and micro, small and medium enterprises) will be trained, empowered, rewarded and incentivized to protect and improve their productive assets (land, soil, water, forest, rivers, marine) whilst generating ecosystem services for the local community and reduce local pollution and GHG emissions.

Empowerment of local custodians: The strong social capital, social cohesions and cooperative and field farmer school movements in Rwanda will be further strengthened to be the custodians in sustaining the interventions promoted beyond the GCF resources.

Capacity development leading to increased job opportunities: The projects targeted training and participatory interventions will provide enhanced jobs opportunities, especially for women, youth and marginalised groups. These activities will increase income and labour force participation opportunities beyond the project scope. Specific activities include:

Ownership/demarcation and conflict resolution: The project will directly support state forest stand ownership/demarcation conflict cases solving and management plan updating in order to ensure social cohesion and consensus over natural resources necessary for continued sustainable development. Improvements will be made to the processes under which land claims judgements are made and submitted and processed hby the land authority with final decisions updated in the Land Administration and Information System database.

- Targeted training along the value chain. For example, training on value-addition in traditional activities will enhance income generation that can be maintained in the long term
- Training on maintenance and repair of all introduced technologies

Gender balanced and mainstreamed project implementation: Working with target community to scope the local economy, consider gendered roles and barriers to participation in production, and identify high-potential products in a participatory Local Value Chain Analysis;

To achieve broader impact, IUCN will undertake the following initiatives to ensure that women and men benefit equally from the project:

a) Recruit gender balanced field staff that will be responsible for direct project implementation.

b) The project will ensure equal participation of both men and women at all levels of the implementation right from the mapping of value chains actors and market analysis, production, processing, marketing, selling the produce and decision making on investment options and utilization of the earned income.

c) The project will advocate for more women participation in farmers groups/cooperatives leadership positions, and

d) Negotiate for women friendly financial services and use women role models in agribusiness to encourage other women through coaching and mentorship.

Sustainable Social accountability: World Visions (WV) Citizen Voice and Action (CVA) social accountability methodology is an effective way to transform dialogue between communities and government in order to improve services and will be maintained by WV beyond the scope of the project. CVA employs targeted civic education; participatory community service scorecards and social audits of services, where comparisons are made between government standards, such as extension agents per head of population or student-teacher-ratios with the reality of service provision. CVA equips communities with simple tools, so they can engage in non-confrontational dialogue with their government and agree on ways of improving services. The three phases of CVA are improved: 1) Enabling citizen engagement, 2) Engagement via community gathering, and 3) Improving services and influencing policy. CVA will continue to operate beyond project closure to ensure sustained social participation and allowing direct engagement of citizens with government to improve services and policy

15. Annex 1. List of selected tree and shrub species per intervention and their preference by men and women

Tree/shrub species	Agroforestry	Silvopastoral / Akagera buffr	Woodlot	Treeplantation	Roadside	Riv/lake	Potential uses	Women	Men	Both	Comment
											Indigenous species
Acacia polyacantha		x				X	Shade in pasture, firewood, Nitrogene fixation				
Acacia sieberiana		x			x						

Albizia gummifera	x	x					Shade in pasture, firewood, Nitrogene fixation, stakes for climbed bean		x		It makes durable charcoal and men prefer it because they mainly dominate and reap the monetary benefits of charcoal production.
Albizia lebbeck	x	x					Shade in pasture, firewood, Nitrogene fixation, stakes for climbed bean			x	It is preferred by both men and women. Its uses include environmental management, forage, medicine and wood.
Bersama abyssinica		x					Timber, firewood			x	The wood is used for poles in house building, as firewood and for making charcoal. Branches are used in living fences. *Bersama abyssinica* is further valued as an ornamental shade tree, for bee forage and in agroforestry. Women use seeds as a substitute for preparing soap for both women and men to use.
Erythrina abyssinica		x			x		Cultural interest (protection), ornemental, beekeeping, handcraft			x	This species is preferred by both men and women because they use it in farm demarcation, making living fences and protecting their houses against wind effects. It also has cultural value (protection).
Maesa lanceolata		x					Endengereus species, parfums			x	Firewood, medicine against Tapeworm (fruit), live fence
Markhamia lutea,	x				x		Timber, Firewood. Handceaft		x		Markhamia is preferred by men because it provides good timbers and men are the ones who invest in wood sawing.The tree is considered to be an effective treatment for skin-affection.
Prunus africana		x					Medicinal product			x	The species is used as an ornamental tree in large gardens and for avenues,timber, wind breakers
Pterygota mildbraedii,	x						Timber, Firewood. tree shade coffee				

Terminalia superba		x	x	x			Timber				
Verononia amigdalena	x						Fodder, medecine, stakes for climb beans				
Exotic species											
Acacia angustissima	x						Fodder, nitrogene fixation, firewood, stake, beekeeping	x			This species is very good in soil conservation and it also provides fodder like Calliandra and Leucaena. It is easy to manage and it grows quickly. In Gicumbi, *Acacia angustissima* is being encouraged because of its high biomass production and coppicing ability.
Bambusa vulgaris						x	handcraft,firewood, stabilizing river	x			Ornamental materials (art crafts)
Calliandra calothyrsus	x						Fodder,Green manure, firewood, stakes for climbing	x			Idem
Casuarina equisetifolia					x		Timber, Firewood. Windbreak			x	Casuarina is frequently planted in town gardens. It is good in making fences, and it is said to make excellent hot-burning firewood.
Cedrela serrata	x		x		x		Timber		x		Most of women are criticizing this specie saying it smells bad. But men like it because of its timber
Eucalyptus spp			x	x			Timber, poles, firewood, beekeeping.			x	The Eucalyptus is preferred by both men and women because of different products it provides to livelihood- Fuelwood, timber ,charcoal, poles, money
Grevillea robusta	x		x		x		Timber, Firewood. Mulch for vofffee , tree shade coffee			x	Men and women like Grevillea because it provides stakes for beans (women preference women) and other wood products (poles and sawn wood)

Leucaena diversifolia	x						Fodder, green manure, firewood and stales for climbing beans	x			Women are the best friends of this specie because it is easy to plant –due to its dispersal abilities and ease to harvest (its management is easy)/ it provides fodder and stakes.
Leuceana tricandra	x	x					Fodder,Green manure, firewood, stakes for climbing				
Leuceana palida	x	x					Fodder,Green manure, firewood, stakes for climbing				
Maesopsis eminii		x	x	x	x		Timber, Firewood. tree shade coffee			x	Men prefer this because it is used in wood carving. But women also can be attracted by its flowers and smells.
Pinus keysia				x			Timber, firewood.		x		It is appreciated because of its timbers and tolerates poor and rocky soils.
Pinus caribea				x			Timber, firewood.				
Morus alba	x		x				Fodder, sericulture	x			Easy propagation (cuttings) and can be used in sericulture (silk worm rearing).This species can be promoted in tea plantations along secondary and /or tertiary drains.
Senna spectabilis	x				x		Green manure, Firewood, Stakes for climbing, beekeeping, ornemental				
Azadirachta indica,					x		medicine tree , shade				
Sesbania sesban,	x				x	x	Green manure, firewood, stakes for climbing beans				
Tephrosia vogelii	x						Green manure				

Fruiting species											
Annona cherimola								x			Fruits + other products and services
Carica papaya	x						Nutrition and income generation			x	Fruits + other products and services
Passiflora f.edulis (Passion fruit)	x							x			Passion fruit should be promoted to stimulate women and men to plant *Ficus thonningii* as they positively and intimately interact.
Persea americana	x									x	The avocado tree is preferred by both women and men because of its fruits. It can also help in soil conservation and provides other many wood products
Psidium guajava	x						Nutrition and income generation			x	Fruits + other products and services
mangifera indica	x						Nutrition and income generation			x	Fruits + other products and services

16. Annex 2 – Methodology for modelling of the Moisture Index for the Eastern Province in Rwanda

Methodology for the estimation of the Soil Moisture Index

Monthly moisture index (the product of P PET-1 where P is precipitation and PET potential evapotranspiration; this index is also known as the aridity index) were obtained after calculating 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 extraterrestrial solar radiation was obtained from the CGIAR CSI. 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, a medium emissions scenario and the scenario for which most (i.e. 19) future General Circulation Model data sets were available from WorldClim.

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 case that at least 66% of models showed the same trend and as **unlikely** in case that at most 33% of models showed the same trend.

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 area of Eastern Province (9,813 km2) with the area covered by the grid cells (10,114.96 km2)

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 as for the month of May.

Processing and mapping of geospatial data sets were done with *R 3.5.1*.

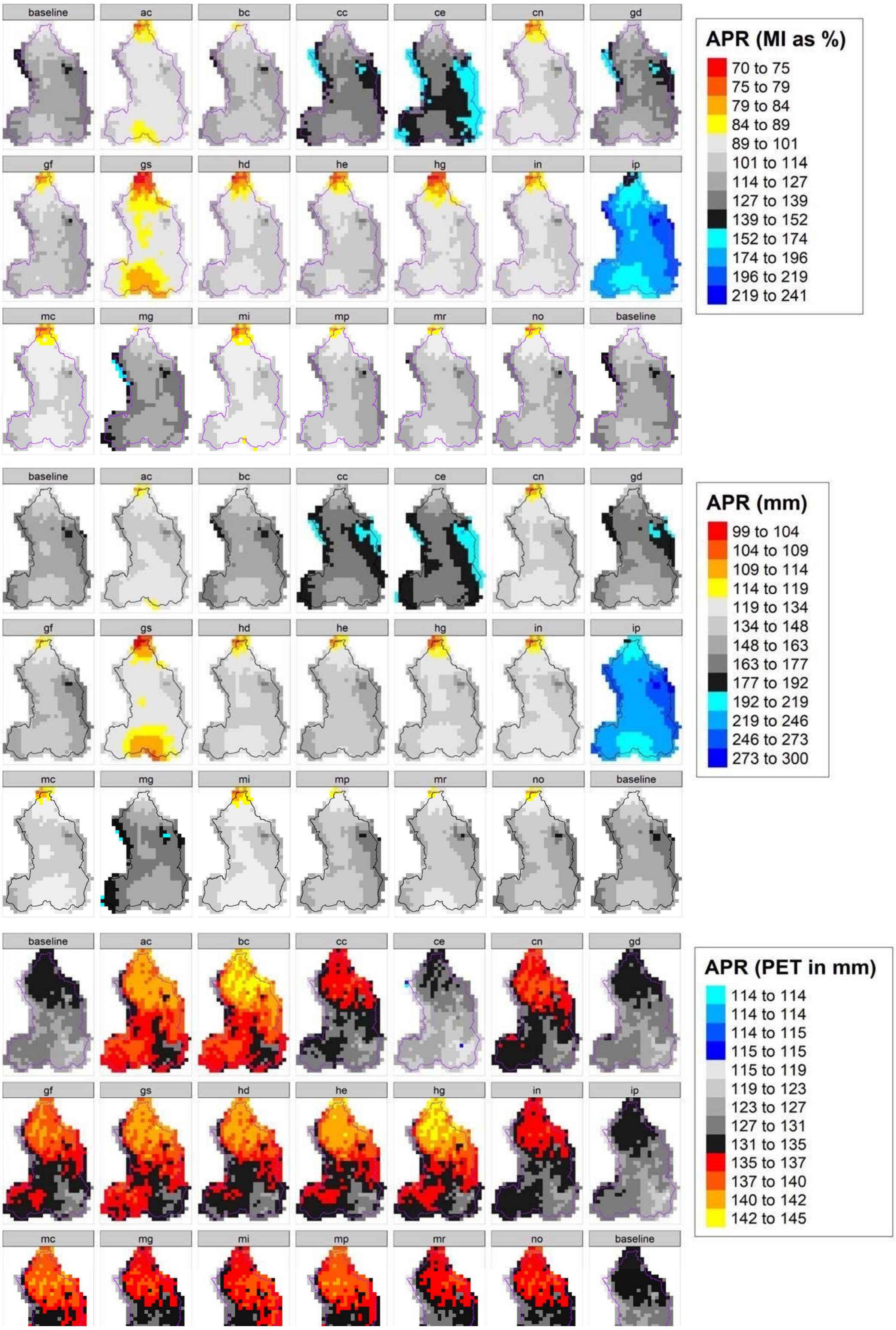


Figure 1. Projected mid-21st century changes (RCP4.5) for the project area in April in moisture index (top), precipitation (middle) and PET (bottom)

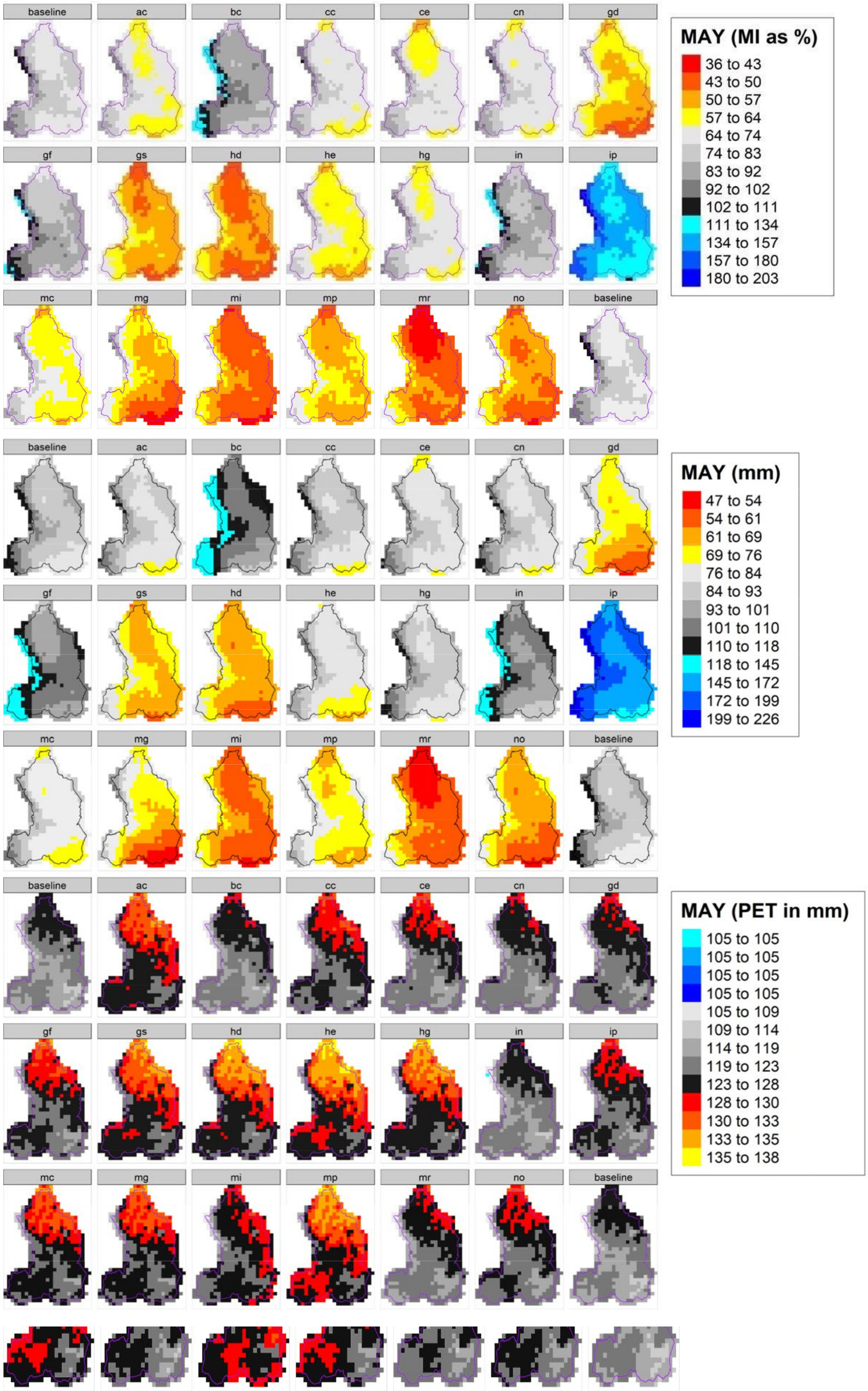


Figure 2. Projected mid-21st century changes (RCP4.5) for the project area in May in moisture index (top), precipitation (middle) and PET (bottom)

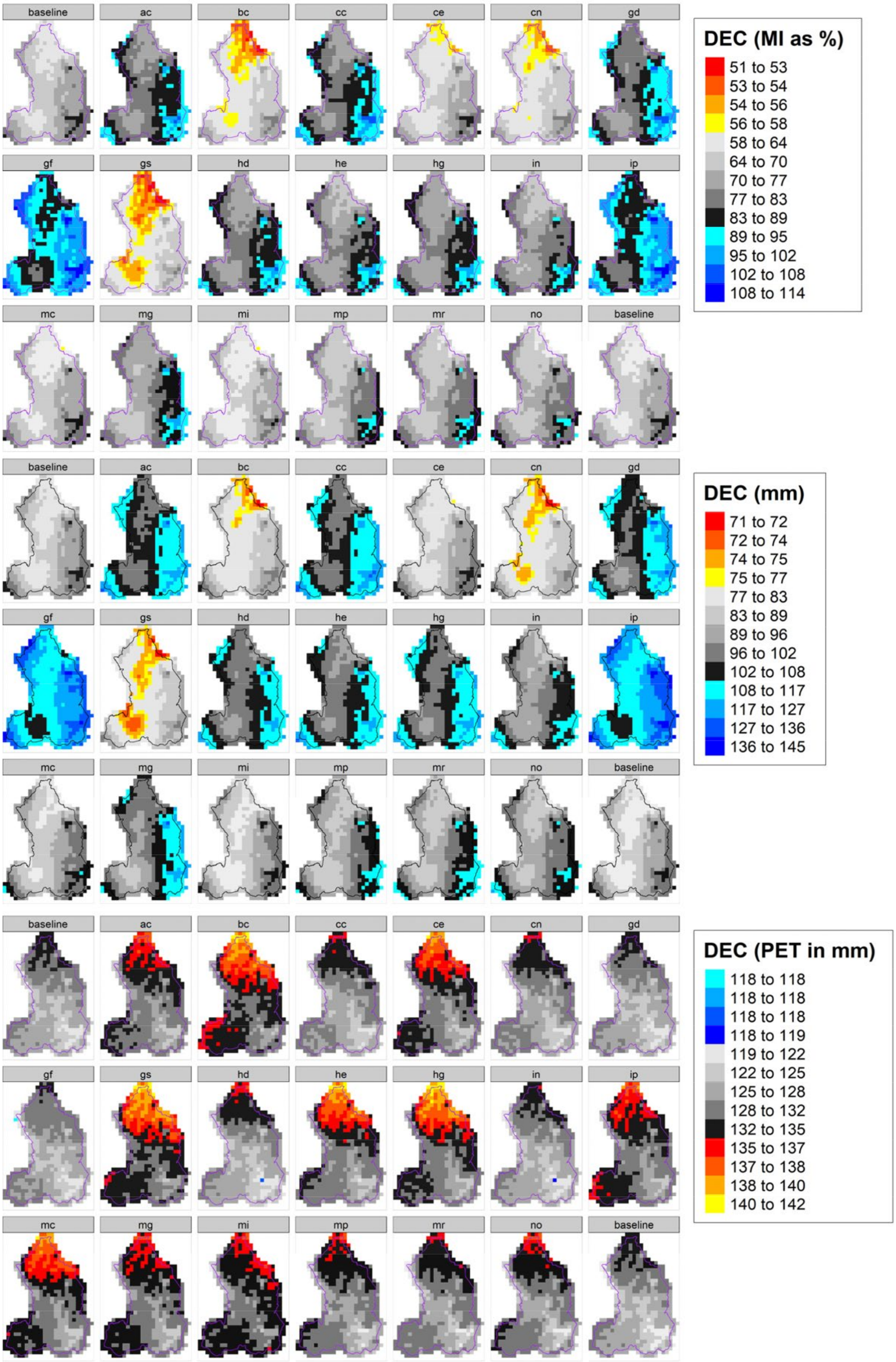


Figure 3. Projected mid-21st century changes (RCP4.5) for the project area in December in moisture index (top), precipitation (middle) and PET (bottom)

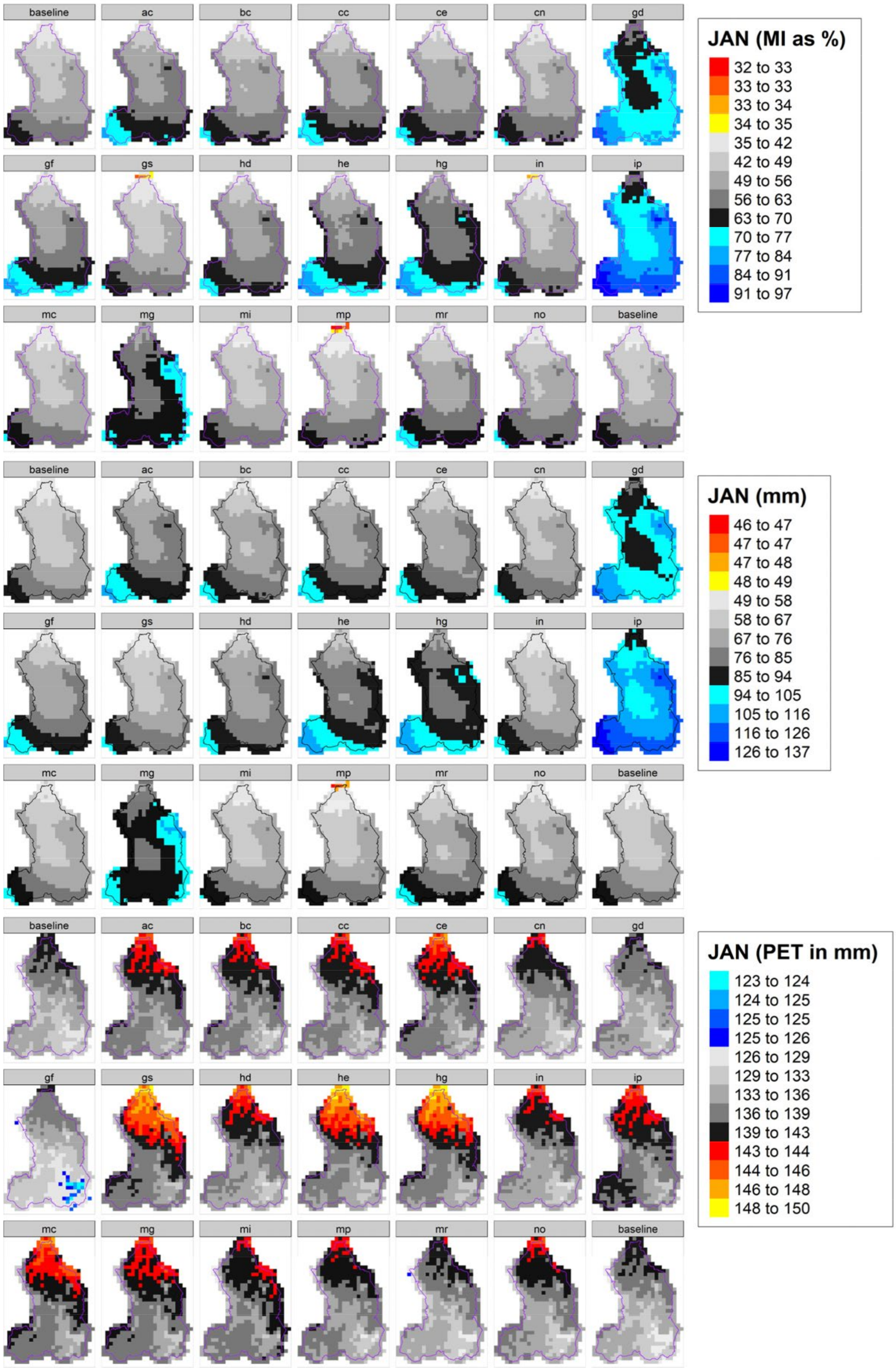


Figure 4. Projected mid-21st century changes (RCP4.5) for the project area in January in moisture index (top), precipitation (middle) and PET (bottom)

17. Annex 3. Value chain analysis and implications of the climate risks for the targeted value chains under Component 2

The projected climate change scenarios in Eastern Province revealed that temperature, precipitation volume and seasonality are going to be critical factors affecting the various value chains chosen in this project. The impact of precipitation volume changes affects the different value chains differently. The following section describes the impacts of climate change on the various elements of the value chains.

The observed patterns of climate change and variability affect the targeted value chains in several ways. Table 1-4 summarizes the impacts of climate change and variability on the different stages of the value chains, namely production, processing and marketing.

The value chains emphasized in this project include dairy, tree based products including, fruits and nuts, timber and wood pellets and honey and beeswax. They were selected due to their relevance to the local context of the proposed project area.

Dairy value chain

Rwanda has currently about 1.4 million heads of cattle, 2.9 million goats and 0.7 million sheep. 40 percent of these animals are found in the Eastern Province of Rwanda. The contribution of the livestock sector to Rwanda's economy has increased recently – standing at 4.6 percent of national GDP and 14% of agricultural GDP in 2015. This increase has largely been attributed to investments by the government in the livestock sector. For example, among the flagship programmes is the GIRINKA ("One cow for one poor family") which played a crucial role in improving the supply of nutritious food for the family members.

Dairy farming in Rwanda is largely practiced by smallholders whose production systems are often constrained in terms of the size of landholdings, soil and climatic conditions, and the lack of investment. Reports from the Rwanda Governance Board reveal that, in 2017, the Eastern Province received a bit more than 100,000 cows which were distributed to as many poor households. District-level distribution figures reveal that the districts in the Eastern Province received the highest number of cows – Gatsibo 20 650, Bugasera 18 853, Nyagatare 15 178, Kirehe 13 459, Rwamanga 13 177, Kayonza 11 602 and Ngoma 8260. With this additional cattle heads given to smallholders, it will be critical to ensure appropriate feed supply through agroforestry and silvopastoral techniques.

In general, feed shortage is the single most important challenge for dairy sector development in Eastern Province and Rwanda as a whole (Eugene 2017). Due to the shrinking size of landholdings and encroachment and the concomitant reduction in grazing lands, feed scarcity has turned into a principal concern in these areas. Zero grazing is becoming a prominent practice, given that more than 60% of households with livestock cultivate less than 0.7 ha. In zero grazing schemes, cattle is kept in the shade and fed through a cut-and-carry system. Districts like Nyagatare are already exceeding their livestock carrying capacity. Climate change and variability, among other factors, are exacerbating the intensity and frequency of dry spells which compromise livestock productivity. Boosting livestock feed supply mechanisms through climate-smart interventions such as growing of drought tolerant tree and grass species and feed management based on it is therefore critical.

Table 1. Impacts of climate attributes on the dairy value chain

	Production	**Processing**	**Marketing**
Increasing temperature	- Milk and meat yields reduced due to feed shortage for livestock, and heat stress affecting animals	Investments in cooling facilities for storage needed to avoid temperature-induced losses	Investments in cooling facilities for transporting and marketing needed to avoid temperature-induced losses
Decreasing rainfall during rainy season	Milk and meat yields reduced due to feed shortage for livestock	Installed capacity underutilized due to lower availability of milk and meat, with adverse effects on employment and income	Lower availability of dairy products and meat, with adverse effects on nutrition, consumer prices, employment and income
Increasing precipitation during dry seasons	Milk and meat yields may increase due to higher feed availability	Dairy products need better packaging and storage facilities. Road networks may be less passable, compromising transport of raw materials	Road networks may be less passable, compromising transport of dairy and meat products
Erratic rainfall: late onset of rains	-Drought may lead to feed shortage resulting in poor milk and meat yield; -Production costs could be higher due to the increase in price of feed.	Dairy products need better packaging and storage facilities.	Low operational efficiency of processing equipment due to marketing costs associated with low volume.

Erratic rainfall: heavy rainfall in short period	-Flooding could hamper animal movement; disease and pest outbreak; feed toxicity could also happen due to mould formation in fodder.	Dairy products need better processing facilities that can reduce the risk of floods and rainwater seepage.	Flooding may destroy road networks and communication channels

Bee product value chains

Beekeeping is a common livelihood practice in the Eastern Province. The production system is mostly traditional, resulting in relatively low productivity. Evidence from the province, particularly the Kayonza area, revealed that 80% of the communities use traditional beehives and they smoke the bees during honey harvesting without any use of proper equipment.

Damage to the bee colonies during honey harvesting is high largely due to the adverse effects of smoking of the hives to chase away the bees. The honey produced with such rudimentary practices is perceived of low quality, due largely to the contaminants originating from inappropriate handling during harvesting and storing. This, in turn, compromises the market value of the honey compared to that of honey produced with improved technologies.

Value addition is also minimal as products derived from beekeeping are largely confined to honey, foregoing income that could be derived from additional products, such as beeswax as raw material for candles, soaps and other products. The beekeepers operate based on experience rather than skills acquired through formal training. Over 40% of the beekeepers in the province not even have basic knowledge of beekeeping (Mushonga et al., 2019). At the same time, the authors highlight the large number of bee colonies in the area and suggest that apiary enterprises could make significant economic and environmental sense. Strengthening the capacities of local communities to produce value-added products will therefore increase their esteem of beekeeping and the care taken of the bees.

Table 2. Impacts of climate attributes on honey and beeswax value chains

	Production	Processing	Marketing
Increasing temperature	-Low honey and wax production due to water stress resulting from increased temperature; -reduces availability of pollen and nectar due to effects on flowering time; -affects colony stability due to feed shortage, water supply and habitat suitability.	Installed capacity underutilized, with adverse effects on employment and income Changing harvest schedules due to shifts in forage supply	

Decreasing rainfall during rainy season	-Low honey and wax production due to water stress resulting from increased temperature -Drought affects pollen and nectar availability	Low operational efficiency resulting from low production and changing harvest schedules affected by forage supply.	Marketing volume may be low and hence low employment and income.
Increasing precipitation during dry seasons	-This may improve the bee activity and hence more honey and wax though it depends on the attributes of the bee forage species.	Better use of installed capacity, with positive effects on employment and income	Road networks may be less passable, compromising transport of honey and beeswax
Erratic rainfall: late onset of rains	-Shortage of forage due to changes in flowering patterns of plants -Water stress for bees due to poor access to water	Low operational efficiency resulting from low production and changing harvest schedules affected by forage supply.	This may not influence any marketing attribute.
Erratic rainfall: heavy rainfall in short period	-Physical damage to the beehives and the colony; -Damage to the forage plants e.g. breaking of flowing branches, or at smaller effect damage to the flower buds; -Inhibits bee movement and communication leading to dysfunctional colony	Low operational efficiency resulting from low production. Investments needed to protect processing facilities against heavy downpours and flooding	Flooding may destroy road networks and communication channels hence affecting marketing.

Tree crop value chains

Over less than two decades, Rwanda's population has increased by about 50%, from around 8 million people in 2000 to roughly 12 million in 2016. Most of the communities (>85%) rely on biomass, both for construction and energy (cooking and heating). The extraction and production of woody biomass is often associated with significant losses of wood due to rudimentary techniques for producing and utilizing energy materials. For example, it is estimated that producing 1 kg of charcoal requires 9 kg of wood - far beyond the 3 kg of air-dried fuel wood needed for producing 1 kg of charcoal with appropriate production modes.

The rising demand for wood for energy and construction due to the significant increase in population, along with the wastage associated with wood processing and utilization, has induced an alarming shrinkage of wood supplies available on-farm, in forests, and in other woodland areas. Combined, these factors have also led to a significant decrease in forest areas, with the associated reduction in ecosystem services that human societies and animal populations rely on and which they require to adapt to changing climatic conditions.

In Rwanda, including the Eastern Province, wider distribution of improved cookstoves is believed to contribute to reduced demand for wood as these consume 67% less wood compared with traditional cooking methods (Rasoulkhani et al., 2018). Despite lacking data on their adoption rate and continuity of their use, uptake may be limited due to the way the wood supply system is shaped. Inyenyeri, the most widely known brand of improved cooking stoves, relies on wood pellets for which communities source raw materials from woodland remnants. This practice may encourage people to harvest wood irrespective of the species most appropriate for wood pellets. When communities cannot meet associated wood supply needs, they are likely to revert to traditional cooking practices reliant on firewood and charcoal.

Both at national and provincial levels, there is a strong need to boost the supply of woody biomass to avert any further degradation of local forest resources. This requires investing in growing trees on farm and in degraded areas under communal management which are not commonly used for other purposes. In addition, the national government promotes the integration of fruit trees into farming systems to enhance nutrition at household level. Suggested species include avocado, mango, tree tomato for home consumption and commercialization. Some common species like tamarind are also promoted as fruit trees, particularly as off-season fruit available during the dry season. Commercialization of selected tree species such as macadamia is also gaining strong attention in response to the growing world market for nuts. A principal limitation of such efforts is the low availability of quality planting material. Efforts to improve availability, such as those of NGOs like One Acre Fund, imply the provision of seedlings on a credit basis and are yet to be rolled out at larger scale.

Table 3. Impacts of climate attributes on tree-based value chains

	Production	Processing	Marketing
Increasing temperature	Increasing temperature leads to low biomass yield; It may also lead to wilting and subsequent drying of the trees which supply wood. Slower growth of timber trees	Wood drying may require less energy. Lower volumes available for processing, but positive effects on physical properties (wood density, caloric value) due to reduced tree ring growth	Reduced volumes may be compensated through increased value due to better physical properties
Decreasing rainfall amount during rainy	-Drought leads to low biomass yield due to high evaporative losses	Low operational efficiency of processing equipment and personnel leading to low employment and income as a result.	Marketing volume may be low and hence low employment and income.

season (Drought)			
Increasing precipitation during dry seasons	-Improved biomass yield with some caution on potential insect attack depending on the species	Better use of installed capacity due to higher volumes available, with positive effects on employment and income	This in effect does not influence any marketing attribute for wood except on transportation.
Erratic rainfall: late onset of rains	-Planting material supply could be in short supply if rain delays and hence new field establishment may be delayed.	-Low survival rate and low biomass production of planted trees.	This in effect does not influence any marketing attribute for wood.
Erratic rainfall: heavy rainfall in short period	-Heavy downpour may damage survival of young saplings and branches of the trees thus causing stress on the plants leading to low biomass production.	Heavy rains may damage seedlings, sapling, tees and hence damaging the sources of the raw materials for processing. Investments needed to protect processing facilities against heavy downpours and flooding	Road networks may be less passable, compromising transport of timber and wood pellets

Annex 4: Brief background on financial inclusion in Rwanda.

Overall, financial inclusion is relatively high in Rwanda as compared to other African countries, with an estimated 92% women being financially included compared with 93% men. The rural-urban distribution in Rwanda is 98% of urban to 91% of rural. Informal financial services play an important role for rural smallholders including women; 41% use non-bank financial institutions. Key challenges in access to finance for rural smallholders are limited education, financial education and access to information, limited access to inputs and markets, and limited collateral. Appropriate financial products for different categories of the rural population including women and youth are still a problem, and rural financial services are generally seen to be risky and costly, especially by the formal financial institutions such as banks. Agricultural finance is considered a higher risk by financial institutions especially given the impact of climate change bringing drought and/or flood to different parts of the country and notably in the eastern province.

Figure 1: Rural -urban inclusion (Finscope 2020)

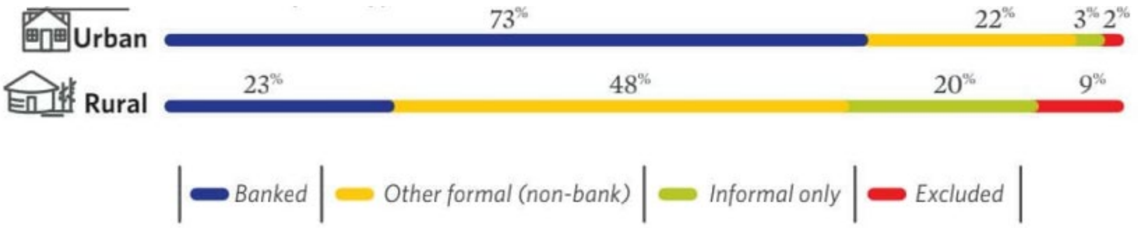
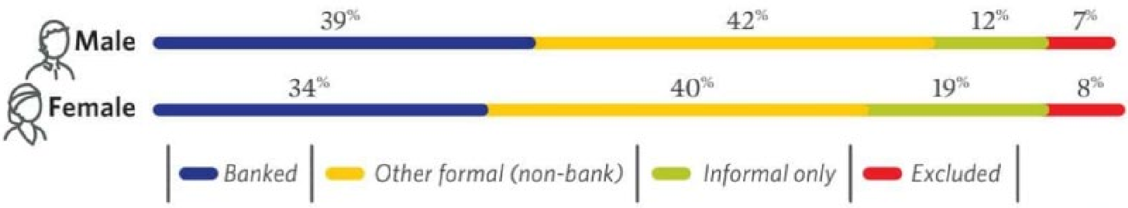


Figure 2: Male-female inclusion(Finscope 2020)



The informal sector, and especially savings and credit groups, are of key importance to smallholders, especially for women in rural areas. Women use financial services primarily as a risk-management strategy to address household cash flow constraints and food security needs at household level, while men use financial services to invest and grow their businesses. Women are very appreciative of savings products alongside loans. Other financial services, such as insurance and remittances, are less used, especially by women.

The use of mobile money has notably increased in Rwanda. In 2020, about 25% of banked adults use digital financial tools up from 6% in 2016. However most of the use of mobile money is for money transfers from branch to head office accounts and sometimes for savings. The recent FINSCOPE shows that access to mobile phone service is 87% of adults in Rwanda. Issues of transparency and client protection still need to be addressed in the use of these digital services, however, mobile money could help improve accessibility while reducing costs of services to the rural population, once these services are streamlined, marketed and controlled.

Recently, the government has embarked on a new draft financial inclusion strategy (2019–2024) [135]. In this strategy, mobile money is seen to be promising for reaching out to the traditionally unbanked including women. Furthermore, the new strategy highlights the following actions:

- Deepening the usage of financial services for the rural population in terms of usage of a variety of products including loans, savings, insurance, etc.
- Increasing access to finance for farmers also by linking savings groups to more formalized financial institutions.
- Developing appropriate financial products for the rural population and for SMEs, especially in the context of a value chain.
- Enhancing financial education and client protection principles, as stated in the governmental programs for leaving no one behind.
- Further digitalization into a national payment system, aiming to become a cashless economy and with 80% of the adult population using mobile and or smart card systems.
- Addressing institutional gaps and enforcing public–private partnerships (PPP).

In summary, even though Rwanda does relatively well in terms of access to finance, access to agricultural finance is still low for smallholder farmers, especially for rural women.

The informal sector, and especially savings and credit groups, are of key importance to smallholders, especially for women in rural areas. Women use financial services primarily as a risk-management strategy to manage household cash flow constraints and food security at household level while men use financial services to invest and grow their businesses. Women are very appreciative of savings products alongside loans. Other financial services, such as insurance and remittances, are less used, especially by women.

The use of mobile money has notably increased in Rwanda. In 2016, around 2.3 million adults in Rwanda used mobile money, but mostly for money transfers from branch to head office accounts and sometimes for savings. The recent study on client voices [136]shows that mobile phone use in rural areas is close to 50%, and almost similar for men and women. Issues of transparency and client protection still need to be addressed in the use of these digital services, however, mobile money could help improve accessibility while reducing costs of services to the rural population, once the services are streamlined, marketed and controlled.

Recently, the government has embarked on a new draft financial inclusion strategy, draft in process (2019–2024) [137]. In this strategy, mobile money is seen to be promising for reaching out to the traditionally unbanked including women. Furthermore, the new strategy highlights the following actions:

[135] Draft document under consultation, initiated by AFR: financial inclusion strategy for Rwanda 2019–2024.

[136] Smart campaign, Mastercard foundation and Laterite (2019) Client voices: Rwandans speak on digital financial services

[137] Draft document under consultation, initiated by AFR: financial inclusion strategy for Rwanda 2019–2024.

- Deepening the usage of financial services for the rural population in terms of usage of a variety of products including loans, savings, insurance, etc.
- Increasing access to finance for farmers also by linking savings groups to more formalized financial institutions.
- Developing appropriate financial products for the rural population and for SMEs, especially in the context of a value chain.
- Enhancing financial education and client protection principles, as stated in the governmental programs for leaving no one behind.
- Further digitalization into a national payment system, aiming to become a cashless economy and with 80% of the adult population using mobile and or smart card systems.
- Addressing institutional gaps and enforcing public–private partnerships (PPP).

In summary, even though Rwanda does relatively well in terms of access to finance, access to agricultural finance is still low for smallholder farmers, especially for rural women.

Annex 5 Overview: Agricultural Credit Assessment Tool (A-CAT)

This annex provides a short overview of the Agricultural Credit Assessment Tool (A-CAT) that will be added to the general client assessment procedures of selected financial service providers under Output 2.3.

Introduction and relevance of smallholder finance.

Smallholder farmers are increasingly important to address the growing demand for food crops. Smallholders are under pressure to increase agricultural production and for this they need access to appropriate finance. The current available financial products in Rwanda are not always well-aligned with smallholders' needs..

Traditionally financial institutions have perceived financing in agriculture as high risk because of:

- High risks due to dependency on weather, seasonality of produce, changing climate conditions, unreliable input sources and fluctuating output markets especially in developing countries.
- High costs, since clients are often scattered in rural areas and need small loans provided at the doorstep. Servicing and monitoring such small loans can be costly especially in remote rural areas.
- Capital and liquidity constraints, due to peak seasonal demands of credit for all farmers who cultivate the same crops in a given area. Timely supply of credit is critical to avoid diversion of loans and thus risk low repayment. However, when demands for loans come at the same time, liquidity management becomes a problem especially for smaller rural based financial service providers.
- Lack of understanding of agriculture as a business and appreciating how to work with smallholder farmers is a challenge. Financial service providers have limited information on cost and yield of specific crops and no proper records on production estimates are available at farmers' level.

Banks often avoid agri-finance, while microfinance institutions have used group loan systems for smallholder farmers. For subsistence farmers, small group loans are suitable but for emerging farmers who produce for the market, the loan amounts are often insufficient. In Africa and Asia there is a growing cohort of smallholder farmers that produce for the market, and who require financial products tuned to the production cycles of specific marketable crops. With such loans, farmers can improve their yield by using better and more inputs such as certified seeds, fertilizer and pesticides, and improved harvesting techniques to serve the demands of the markets.

Tailored individual agri-credit, using the Agricultural Credit Assessment Tool (A-CAT).

ICCO has developed a simple analysis tool to facilitate the provision of tailored loans to smallholder farmers. It is a tool that can be added to the general client assessment procedures of a financial service provider.

The Agricultural Credit Assessment Tool (the A-CAT) combines basic crop specific input information and production costs with estimated yield projections and relevant client data for individual farmers. The tool is relatively simple and makes basic agri-references available in an easy to use format at the level of the loan officer. The package includes:

- A technical reference card for the crop, based on expert agricultural extension information and used for agricultural training as well as to develop the excels sheet. It provides basic information on:
- Specific crops including specific input needs and basic conditions for production, such as location and soil type, potential productivity, length of production cycle, resistance to drought or sicknesses, and production risks and possible mitigation strategies. Advice on the cultivation process such as use of inputs and fertilizer, timing and production calendar.
- An excel based tool providing crop specific information on inputs and costs and other crop specific data according to the expert agricultural information. A reference estimation is provided on total production costs, cash flow of the production process and potential yield estimates. The sheet is used as an annex to the regular loan appraisal procedures and provides detailed information for crop specific loans.

The tool is used at the start of the loan application. The loan amounts, disbursements and repayment dates can be determined based on this analysis. The actual realized yields of an individual farmer are filled at the end of the season so that comparison can be done on the initial estimates for the season versus the actual realized production and income. The farmer and MFI thus gradually build up historical data which can be used for future loan assessments. If a farmer performs according to expectations, the financial service provider can decide to lower the guarantee requirement accordingly.

Samples of use of A-CAT from ICCO –Terrafina portfolio.

Rwanda: One of the organizations that is currently using the A-CAT for all its agricultural products is Duterimbere. In 2016 Duterimbere started the introduction of the A-CAT on a pilot test base for potato’s in the north of Rwanda. After this initial experience, they decided to introduce the A-CAT for all its individual agricultural loans and trained all branch staff and loan officers on the use of the tool. It is now compulsory for loan officers to use the tool for any individual agricultural loan assessment. Duterimbere is in discussion with ICCO Terrafina to digitalize the tool. Duterimbere has 32 loan officers in 18 branches in Rwanda. It has a total of over 50,000 clients.

Senegal: UIMCEC is a cooperative finance institution that has introduced A-CAT for each crop it used to provide loans to. During the pilot phase, UIMCEC launched with the use of ACAT specific crop finance for potatoes and onions. Recently, UIMCEC launched an ACAT especially designed for husbandry. It has trained all its 92 loan officers, and now A-CAT is obligatory in every agricultural credit file. UIMCEC has 163,572 members. Now UIMCEC is setting up an internal agriculture centre that will be able to provide annual training to loan officers, but also to actualise ACAT-reference data or even to develop ACAT-references for new crops.

Both organizations appreciate the A-CAT since it makes loan officers more confident to estimate the real finance needs for the crop. They noted that credit files using A-CAT contain more accurate production data and yield estimates, and thus the loan provided is more useful to the farmer.

Digitalization of the tool

In the course of 2017 and 2018, a digital version of the A-CAT has been developed in Ethiopia. This digital version is relevant for several MFIs that have introduced the excel-based version of the tool. The tool was digitized in collaboration with an Ethiopian-Kenyan based ICT company.

The recent development is the partnership between ICCO and Simbuka, with support of the Rabofoundation, that resulted in the integration of A-CAT into Simbuka's loan origination software. Loan officers can then do loan assessments in an app. This eases the efforts for the farmers, for loan officers and gives the MFIs better insight in the credit worthiness of their rural clients.

The multi-tenancy SaaS (Software-As-A-Service) architecture of Simbuka enables low-cost deployment, greatly decreasing the cost of supporting the install base. These cost savings are passed onto the three MFIs in Rwanda where the enhanced Simbuka system will be first deployed, and then to all future customers.

The digital version compiles a prototype per crop and feeds the information per clients in the digital application. It speeds up the assessment process per client since required data are fed into the app, allowing for fast processing of a large number of clients cultivating similar crops in an area. The prototype can be developed for several crops simultaneously and client data are filled in easily, using the standardized format. Furthermore, the digital version allows to store historical data per client that are captured regularly which makes monitoring easier and analysis and disbursement of follow up loans faster.

The digital version of the A-CAT tool is tuned to the requirements of a specific MFI and integrated into the core banking system of that MFI, thus integrating general client data with crop specific loan products. Data are fed into a database at the MFI level and then used for different stages in the credit analysis and approval process, e.g. the loan officer, credit committee and branch manager have different levels of access to approve the loan. Eventually data can be analyzed for management decisions on branch opening and branch level monitoring.

Figure 17 Image of the digital version of the A-CAT tool


Requirement Gathering & Scoping
Research &
Usability Engineering
Prototyping
Development
Testing & QA
Deployment
Training &
Sales Support
Maintenance &
Technical Support
Product Development
Life Cycle

Annex 6: Savings group solidarity system in producer organisations

In order to optimally function, cooperatives need a strong link with their members to meet their supply chain obligations to the market in quantities and in quality as well as to support their members' capacity to attain economic development.

An important objective of the organization of savings groups in cooperatives is to boost the cohesion and ownership of the members and to strengthen member's savings and access to financial services. The focus on members' savings in the groups assists to increase the liquidity and capital position within the cooperatives as well as their negotiation positions.

ICCO with Farm to Market Alliance (FtMA) developed and tested a new approach to stimulate group savings as well as to enhance access to input loans by producer organizations. The new model organizes smallholder farmers in solidarity groups to promote savings. In turn, new approaches to improve the access to finance for producer organizations were developed, which link solidarity groups to micro-finance institution and Savings and Credit Cooperation Organisations (SACCOs).

The organization of savings groups in cooperatives has helped to build the trust of financial institutions in the cooperative and its members since the MFI can link directly with cooperative members for savings mobilization and input loans. It can ultimately promote stronger and sustainable relationships between producer organizations and financial institutions. In figure1 below a systematic picture of the system is provided.

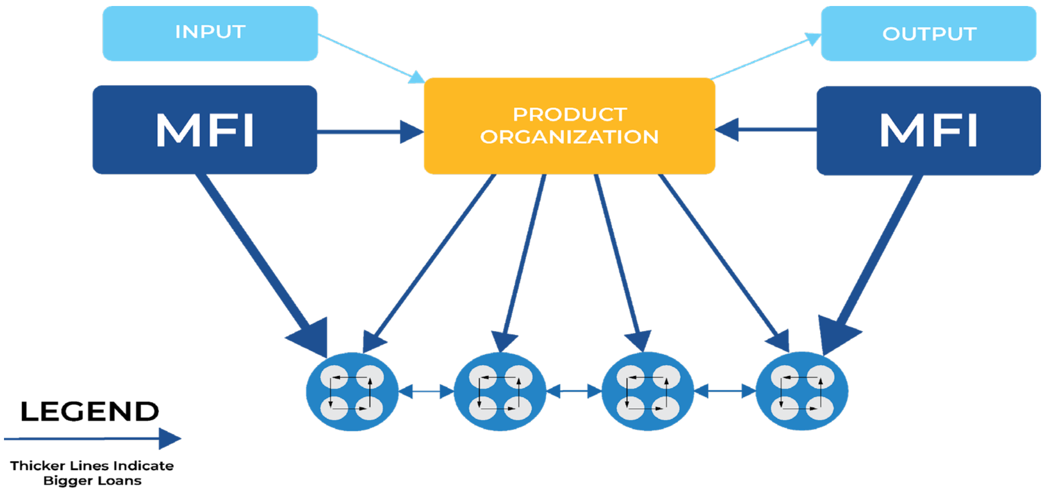


Figure 1. Diagram of the proposed system.

Key actors in the system are:

1. The saving groups within the producer organizations

2. The producer organizations

3. The Microfinance Institutions

4. Input suppliers and off-takers

This system allows for financial education and membership mobilization as well as access to finance within the cooperatives that operate in a value chain.

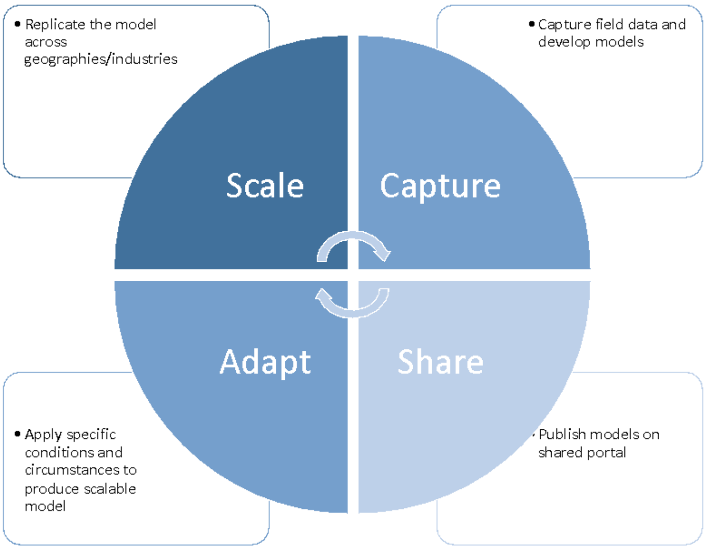
In this system the farmer-members will have access to 1) internal loans in the groups from group member’s savings, 2) input loans obtained by the cooperative and divided over the savings groups, and 3) loans from MFIs directly to the groups. The system can assist the cooperatives to get loans for aggregation and marketing, based on better internal capitalization of the cooperatives through the internal group savings, which strengthens the capital base in the groups and in the cooperatives.

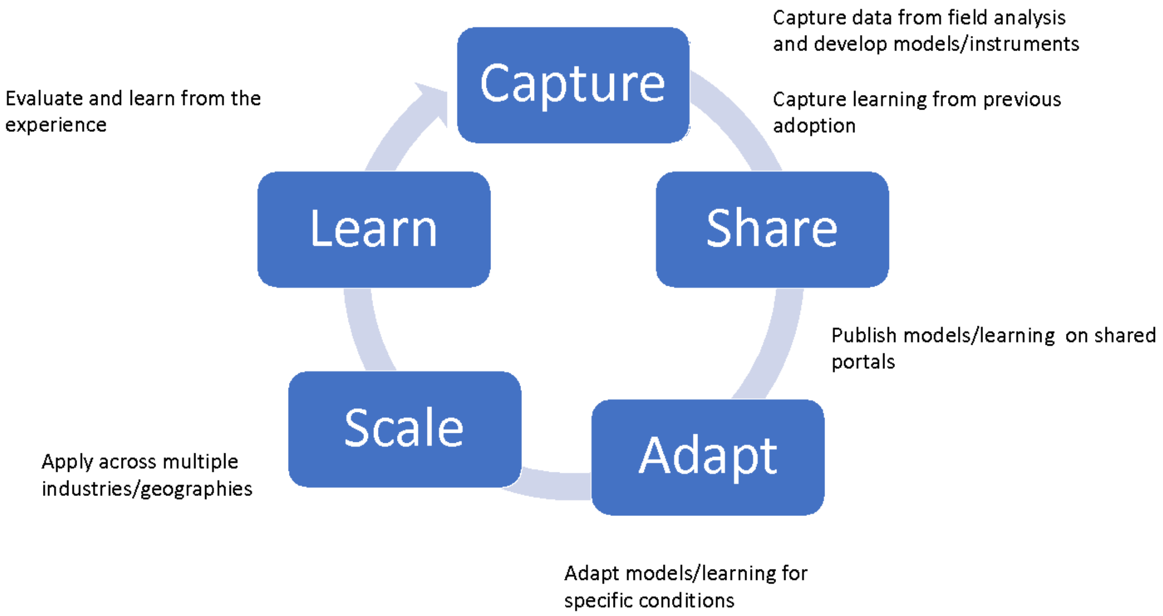
Sustainable collaboration between all actors involved is needed, thus ensuring fluid communication between the key actors, which are the MFIs, PO’s, and SG. It can create a strong working link between cooperatives POs and MFIs. The ICCO program staff will provide coordination among actors. Financial education is an integral part for all stakeholders in the system. Financial service providers are also supported to develop special financial products and procedures to engage in this system.

Annex 7 TREPA-Rep Model

The projects knowledge management activities fall under the TREPA-Rep model for scale up and replication. The model provides a framework approach for constant monitoring and evaluation, adaptive learning and management and knowledge collection, creation and peer to peer learning. Following project closure TREPA-Rep will be maintained by Rwanda Forestry and Water Authority (RFWA).

The TREPA-Rep model is outlined in the diagram below:





Roles under the TREPA-Rep model are outlined below:

- Project Management Unit: Establish the mechanism, develop knowledge products and ensure continued sustainability, replication and scaling up of the projects interventions
- RFA: Establish and maintain the TREPA-Rep mechanism during and following project closure to ensure continued sustainability, replication and scaling up of the projects interventions
- Beneficiaries: effectively engage project stakeholders' with prompt responses and updates will be deployed through the 'citizen science' approach with market dynamics, data and information inputs from farmers, processors and value chain actors.

Annex 8 Farmer Field School and *Twigire Muhinzi* extension system

The TREPA Project is based on lessons learned and integrated into existing farmer field school/Twigire Muhinzi system. This annex provides details on these systems and their integration into the TREPA project

For the TREPA project, the projects that were analyzed to document the agroforestry best practices and lesson learned in Eastern Province are below:

- Agroforestry tree planting campaign in Rwamagana District (2.200 ha 2018-2020) with the support of the RFA/FMBE project supported by ENABEL;
- Agroforestry tree planting campaign in Gatsibo District (8584 ha in 2017-2019) with the support of IUCN in collaboration with ICRAF.

The projects are implemented using and adapting the existing Forestry Field Schools (FFS)/Tuwigire Muhinzi extension system established by MINAGRI/RAB. Twigire muhinzi consist of extension system established and supported by RAB across the country, where champion farmer promoters (1 per villages) is train and supported to (1) implement innovative good agriculture practices in its parcels serving as demonstration plots and to (2) train/advice/guide neighbouring farmers in implementation of these goods practices.

In each district many groups of neighbouring farmers have been established into FFS groups in order to improve their agriculture practices. The groups are supported by the facilitator assigned per group of 15-20 farmers. The facilitators are trained, supported and supervised by Master Trainers of RAB. Using training plots where the groups experiment new techniques on the field for their own on-job learning process. Additionally, Farmer Promoters (FPs) are supported in implementation of improved agriculture techniques in their own parcels. Until now these FFS group and FPs are supported in conventional agriculture practices. The TREPA project will train the group in agroforestry techniques.

As the FFS and FP groups are already well organized, and they have the mutual willingness of improving their production systems. The groups are ideal for dissemination of TREPA's agroforestry techniques by adding trees, shrubs and new types of crop to their cropping system to increase productivity, soil conservation and the diversification of stocked species with the aim of becoming more resilient to climate change.

These pilot agroforestry projects have demonstrated successful adaptation and provided important lessons learned in term of farmers groups organization, support and training to disseminate adequate agroforestry techniques. In targeted areas, individual farmer's parcels are grouped into blocks of 5-10 ha, and for each block a farmer leader is designated. These farmer leaders are sensitized, supported and coordinated by FFS facilitators and FP along with the support and supervision from the Agronomists and Sector Forest Extensionists assigned for each of these areas. Farmer leader, FFS facilitators and FPs are trained and are playing a key role in the coordination and technical support to farmers in tree/shrub planting and management in targeted parcels. They are responsible for the sensitization and guidance of farmers of their respective blocks. MoU are established between the farmer's groups and the local authorities (Cell and Sector), in which support modalities and commitment in respecting management rules for planted trees/shrubs and associated crops are identified. Baseline data on existing tree/shrubs and on planted tree are collected per block and registered in the DFMP database (under development in RFA with the support of ENABEL-FMBE project), which is tracking MoU respect/implementation. The TREPA project takes these successful design elements and applies them to implementation of agroforestry interventions.

Annex 9 Survey on rural household energy, selected technologies and intervention sites

1. 2018 Survey on rural household energy use in Eastern Province

According to a 2018 survey of 600 rural households in Eastern Province (Rwamagana) by RFA-FMBE project supported by ENABEL, 55% of biomass used for cooking costs of very small branches and grasses collected for free (338 kg/year/person) while 35% is conventional firewood partly bought on the market (229 kg/year/person). Women and children are the primary fuel collectors, spending an estimated 2.5 hours per day collecting firewood and 2.9 hours collecting small branches and dry grasses.

Table 25. Summary on characteristics for cooking fuel type.

Cooking fuel type	Nb HH	% from own land	% from other land	% from market
Biogas	1	100	0	0
charcoal	61	3	2	95
crops_residues	109	74	26	0
firewood	276	33	48	19
grasses_small_branches	383	22	76	2

Approximately 62% of households cook using traditional 3-stone fires, while the most common improved cooking stoves are the fixed mud stove (23%) and the firewood cynarumwe (5.2%). As a result, the average calorific efficiency of cooking technologies in rural areas is only around 16.6%, which is very low compare to the target of 40%. This low efficiency causes a serious waste of woody biomass (250% more consumption of biomass per capita) while contributing to higher greenhouse gas emissions. Compounding these impacts, more than 65% of kitchens are closed rooms without sufficient ventilation, increasing the exposure to harmful household air pollution (especially particulates and carbon monoxide).

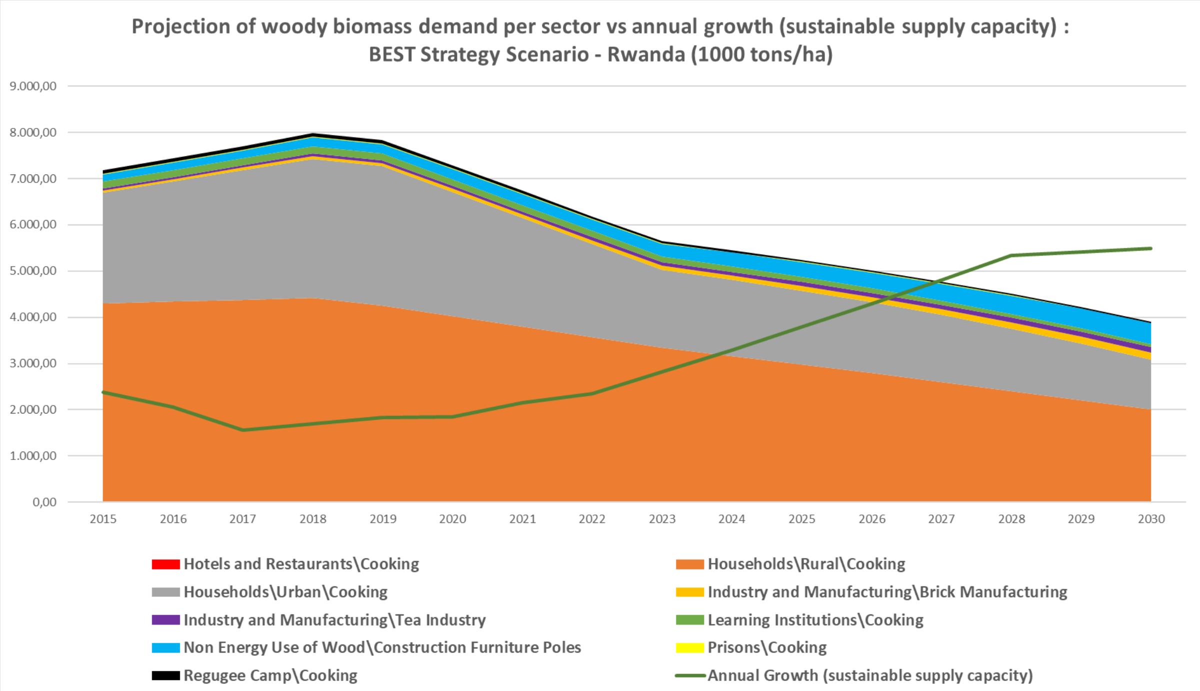


Figure 21. Projection of woody biomass demand per sector vs annual growth.

Rwanda has a national Biomass Energy Strategy (BEST) with a particular focus on improvements to the charcoal supply chain. The goal of the strategy is to ensure a more sustainable supply of biomass energy (e.g. firewood and charcoal) and to promote access to modern fuels as well as to efficient biomass combustion technologies for households and small enterprises.

The related key BEST indicators are:

Indicators		Baseline values and second-level targets
● Percentage of biomass consumers shifting from traditional biomass to clean alternative fuels		Baseline value 2017: 1.1 Target value 2024:42% Target value 2030: 75%
● Percentage of rural population shifting from traditional woody biomass to modern improved cooking solutions (primarily woody pellets and firewood Improved Cookstoves)		Baseline value 2017: 0 % Target value 2024: 30 % Target value 2030: 65 %
● Percentage of public biomass high consuming institutions (e.g. schools, prisons, tea factories) shifting from traditional woody biomass to clean cooking solutions		Baseline value 2017: 0 % Target value 2024: 50 % Target value 2030: 90 %
● Increase of exploited tree plantations under Sustainable Forest Management (SFM)	● Private forests	Baseline value 2017: 3% Target value 2024: 60%Target value 2030: 65%
	● Public forests	Baseline value 2017: 21% Target value 2024: 80% Target value 2030: 90%

The BEST strategy envisions a widespread shift from traditional 3-stone wood stoves and fixed mud stoves to more efficient Tier 3 and Tier 4 stoves in rural areas, as indicated below.

Table 26. Summary of cooking technology types.

Cooking technology type	Calorific Efficiency	% Sharing in HH - BAU 2018	% Sharing in HH - BEST 2030
Briquette Stoves	24%	-	5,0
Tier 4 Wood Pellet Gasifier Stove	50%	-	25,0
Tier 3 Wood gasifier stove	36%	-	50,0
Electric stove	70%	0,1	-
LPG Stove	60%	0,1	5,0
Biogas Stove	45%	0,2	10,0
Kerosene Stoves	43%	0,1	-
Wood Portable Improved Mud Stove	25%	0,5	-
Wood Fixed Improved Mud Stove	25%	23,2	2,0
Wood Improved Stove	18%	4,3	-
Wood Mud stove	20%	5,2	-
Wood Traditional 3 Stone	12%	62,4	-
Charcoal Canamake Ivuguruye	35%	1,7	3,0
Charcoal Improved single Stove	28%	1,4	-
Charcoal Single Pot Metal Stove	20%	0,8	-
	BAU 2018	BEST 2030	
Total Average Efficiency of Cooking Technologies in rural HH of EP	16,6%	40,8%	

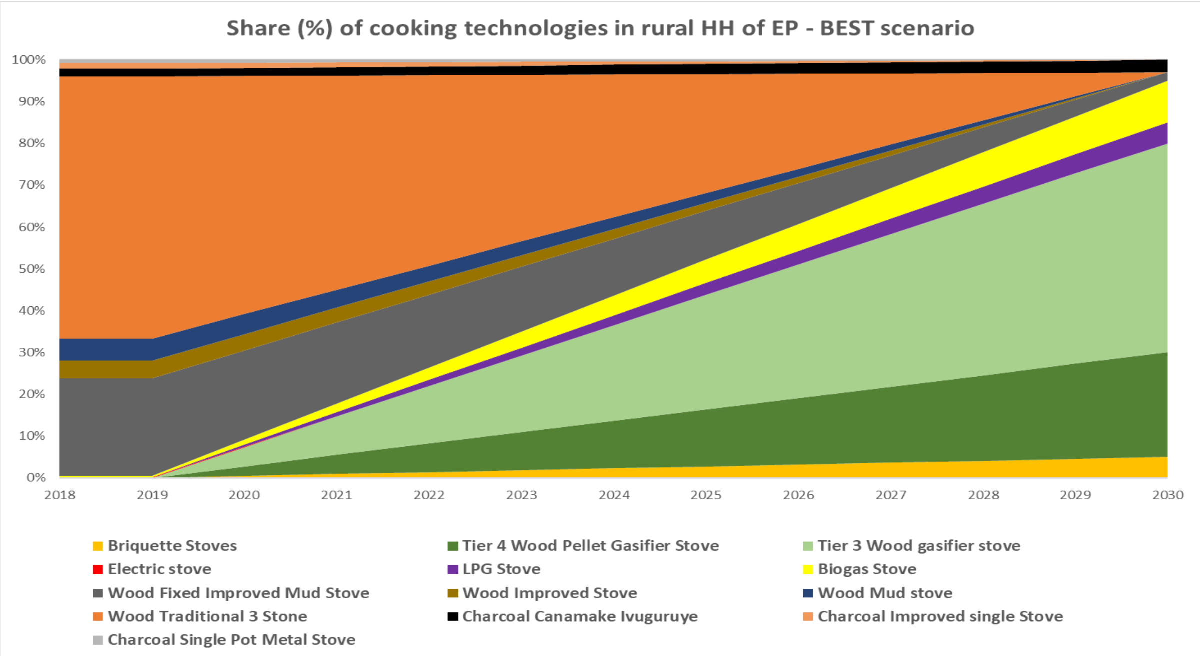


Figure 22. Share of cooking technologies in rural HH of the Eastern Province.

2. Household cooking solution interventions to reduce biomass consumption and reduce forest degradation

The project will work to address simultaneously four challenges related to more efficient cooking in Eastern Province (EP): (1) need to use higher efficiency stoves, (2) need to use cleaner / more efficient fuels, (3) need to improve stove and fuel affordability, (4) need for policies and regulations enforcing a shift to clean / efficient ICS and fuels. Taken together, these efforts will drive scale-up and improve access to a range of existing cooking technologies (stoves & fuels). Each proposed technology will be tested and supported to further improve efficiency before being sponsored for household adoption. Households will be offered a choice of stove technology best suited to their resources, constraints and preferences. The proposed stove technologies (described in detail in Annex 9) may include but are not limited to:

Woody pellet gasifier stove (such as MINIMOTO model):

The INYENERY company started the production of woody pellets in Rubavu (North-West of Rwanda) in 2011, using saw dust and small branches collected by farmers. These pellets are sell (200 RWF per kg) or exchanged with wood raw material (1 kg of pellet for 4 kg of branches) to households, which are receiving freely the Tier 4 (50% efficiency) woody pellet gasifier full combustion stove (see MINIMOTO model) based on long term contract signed with the company. If the households cease purchase of the company's pellets, the stove is sent back to the company hub located in the village. Currently more than 2,000 households are under contract with INYENERY.

Wood gasifier stove (such as the “TLUD Karundura” model):

The ENEDOM company established in Kigali is producing locally made wood gasifier stoves with a calorific efficiency estimated to around 36%. They are distributed at a cost of USD 15 per stove.


Woody & multi-biomass improved metallic full consumption stove (such as “Songa”, “Rahisi” or “Ruhaka” models)

The GGS company established in Kigali is locally producing the “Songa” (below left picture, using firewood/small branches) and the “Rahisi” stove (below right picture, using all type of small biomass and briquette), while ISOKO is proposing the model “Ruhaka” (very similar to Rahisi, using all type of small biomass and briquette). Some other similar models are proposed by a few other small companies. All of these stove have an efficiency between 30% and 36 % depending on the type of biomass used. They are distributed at a cost of USD 20 to 32 per stove.


Compacted Biomass briquette stove:

Even if this technology is not yet clearly developed and commercialized in Rwanda, briquetting solutions that are very similar to pellet solution could be investigated in collaboration with private investors. Briquette making is more adapted to the use of a mix of small biomass/crops residue, while pellet is more limited to the used of small branches and saw wood residues. In the context of EP, if the biomass/crops residues are sufficiently available (briquette factory required a minimum of raw material for being feasible/profitable), considering also invasive biomass from marchlands/lake shore, one briquette factory could be established. The below left picture shows the type of required equipment to produce compacted biomass briquettes by mixing biomass residues (leaves, dry grasses, small branches). The below right picture shows the briquette which can be burned in above presented metallic stove (Rahisi, Ruhaka)

Carbonized Biomass briquette stove:

ISOKO, Red Cross and few other local actors are proposing alternative fuel wood briquettes made from biomass, used with a low-cost clay stove (for the poorest HHs) or with an adapted improved metallic stove (such as above Rahisi/Ruhaka models). The below left picture show local press tools used to produce artisanal briquettes by mixing sandy clay with carbonized biomass residues (leaves, dry grasses, small branches, charcoal dust, etc.). The below right picture shows the briquette and basic clay stove.

The table below summarizes the relative investment cost and payback period of these and other cooking solutions.

Table 27. Relative investment costs and payback period for cooking solutions.

Cooking technology	Total cost per HH 2019 (RWF/year)	Initial ICS Investement RWF	Pay-back period (compare to 3 stones) in nbr of months
3-Stones & wood	125.000	0	NA
T2 clay stove with carbonized briquette	106.000	4.000	3
Tiers 2 Fixed mud stove (firewood/biomass residue)	59.030	12.000	2
Tiers 3 wood gasifier stove (TLUD)	62.926	24.000	5
Tiers 3 metallic stove (Rahisi) multi biomass	58.333	50.000	9
Tiers 4 Woody pellet/compacted briquette gasifier stove	90.909	0	0
LPG Stove	268.986	120.000	NA- More expensive
Basic Charcoal stoves	180.603	6.000	NA- More expensive
Improved Cyanamake charcoal stove	113.852	12.000	13
Electric stove (in KWH)	328.600	50.000	NA -More expensive

3. Criteria for cookstove Intervention sites for forest restoration activities related to output 1.2:

for forest restoration activities under output 1.2 cookstove interventions will reinforce work done at sites identified for each of the 7 districts based on the following criteria outlined in Annex 9.

For restoration of State and Districts owned forests (based on DFMP database information: forest stock, soil quality and slope):

1) Very low stocked old forest;
2) On sloppy area expose to erosion;
3) On degraded soil;
4) Included in FMU less financially attractive due to general low stocking and high investment for restoration.

For long term concession and sustainable management of state-owned forests (based on DFMP database information):

1) FMU with attractive financial feasibility assessment;
2) Whit general most sloppy areas expose to erosion.

For restoration and sustainable management under FMU of small-holder forests (based on landscape restoration opportunity assessment done with local communities, supported by maps of slope, of soil, and of landscape degradation):

3) On sloppy area expose to erosion;
4) On degraded soil;
5) On non-forested land where owners are willing to established new plantation and join a FMU
6) On very low stocked old forest where owners are willing to renew the forest and join a FMU

7) On area allowing easy creation of consolidated private FMU due to presence of neighbouring land owners whiling to shift to sustainable forest management through SFMPs.

Annex 10. Financial feasibility for proposed project activities

1.1 Summary of Financial Results

The financial rate of return is calculated separately for each major intervention in Component 1. The measures are not perfectly separable in that many farmers may engage in multiple activities covered by the project. The costs and benefits are calculated based on the activities undertaken in the same geographic areas in the baseline scenario.

Note also the contribution made by the activities in Components 2 and 3 to the success of Component 1. In particular, Component 2 addresses the financial barriers that might prevent farmers from investing in resilience activities. The project aims to diversify and enhance the variety of financial services for farmers engaged in different project activities. The project will facilitate both group and individual loan services. The loan terms will vary depending on the crops, size of farmer groups, resilience technology, past credit history, and source of capital that the MFI is accessing to service the farmers. These will be the result of commercial agreements between the farmers/groups and MFIs – <u>GCF funding will not cross-subsidize these loans or interest rates</u>.

Given the broad spectrum of parameters, the financial analysis does not directly model the impacts of these different types of loans. Instead, the financial analysis assumes that these resilience measures are possibly in large part as a result of having access both to technical assistance and to greater and more affordable access to credit.

Financial returns are calculated (1) assuming business-as-usual, (2) assuming the project investments are made directly by farmers without external support, and (3) assuming GCF support and co-financing. Note that scenario (2) is considered highly unlikely, in that the project will provide considerable capacity building and support to strengthen the enabling environment. Scenario (2) assumes farmers will spontaneously overcome the information, capacity, policy and coordination barriers that hinder climate action. Furthermore, it assumes that farmers will find the means to implement these measures independently, perhaps by taking out commercial loans, when there is no evidence of this happening in reality. The estimated financial returns in Scenario (2) therefore represent the most extreme optimistic case of what is possible without GCF support.

The financial analysis for each output is calculated from the private perspective using a discount rate of 15.28%. This rate was chosen by using the most recent documented interest rate on bank deposits[138] and multiplying by 2 to reflect inherent risks of agricultural activities. While most loans to farmers will have a tenor between 1-5 years, the financial analysis considers the full life of agroforestry and other landscape restoration investments. The discount rate is intended to capture the time element of risk in such an

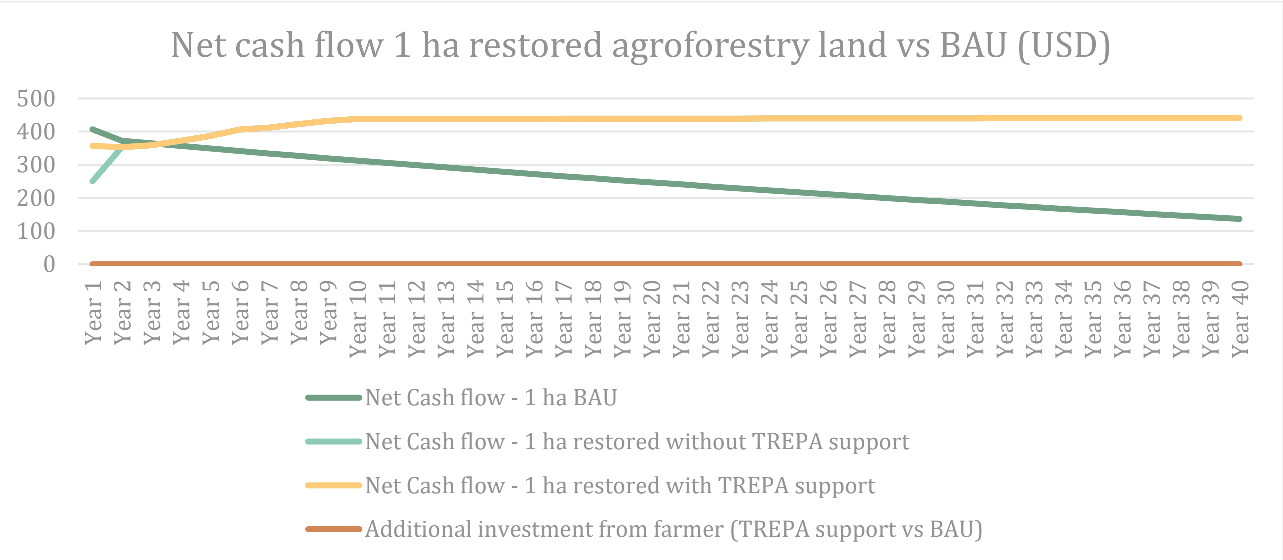
[138] The World Bank lists the 2019 bank deposit rate as 7.64%
https://data.worldbank.org/indicator/FR.INR.DPST?locations=RW

analysis. For example, a promised payoff of USD 100 in 20 years has a net present value of less than USD 6 using the 15% discount rate in this analysis.

The financial analysis for **Output 1.1 (agroforestry)** evaluates the costs and benefits of resilient agroforestry-based land restoration versus business as usual (BAU). The GCF investment case yields a lower per-hectare NPV than business-as-usual (BAU) over the initial 6-year implementation period but remains positive. With-project NPV becomes higher than BAU over 10 and 20 years as the long-lived agroforestry investments bear fruit. for agroforestry measures to generate a flow of revenues. The simple payback time for the additional up-front investments in the GCF TREPA scenario is 6 years.

Table 28- Financial analysis Output 1.1

Climate resilient agroforestry	**6 years**	**10 years**	**20 years**
NPV - BAU	1,389.73	1,782.53	2,121.90
NPV - restored without TREPA support	1,291.06	1,804.70	2,329.77
NPV - restored with TREPA support	1,383.79	1,897.44	2,422.50
NPV - Net cash flow Increment (TREPA support vs BAU)	-5.94	114.90	300.60
IRR - Increment TREPA support vs BAU	12%	38%	43%



For **Output 1.2 (sustainable forest management),** the financial analysis examines the NPV and IRR for multiple restoration scenarios:

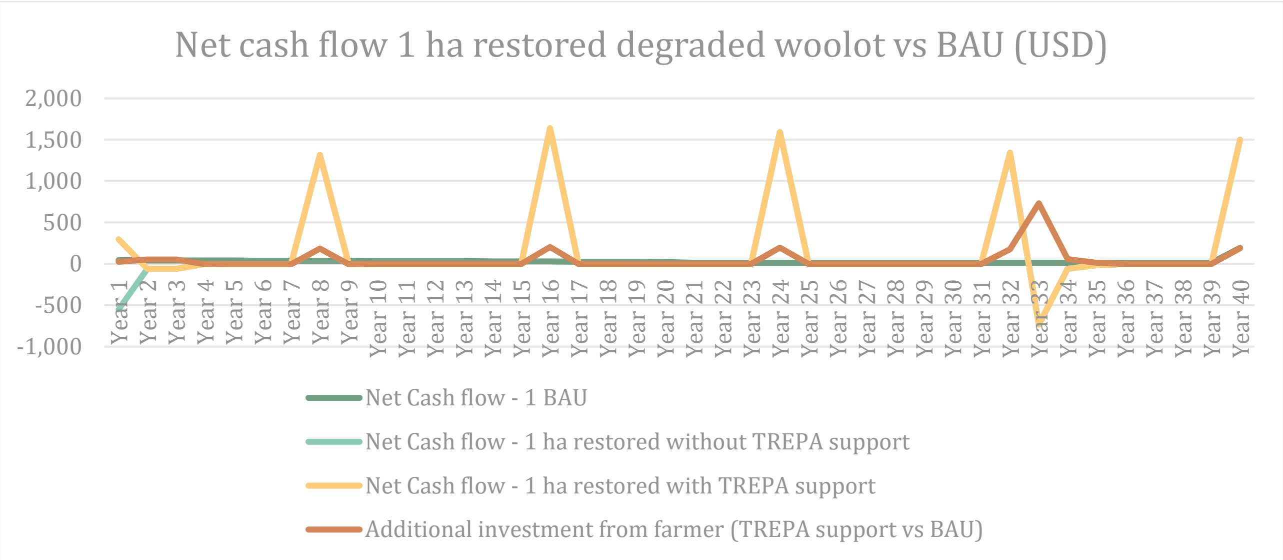
a) Restoration of 1 ha of degraded small-holder woodlot
b) Farmer family scenario with 0.5 ha of agroforestry land (including crops, fruit, fodder and wood) 0.25 ha of woodlots, and adoption of an improved cook stove (ICS)
c) A small holder forest cooperative of 100 ha (around 200 land owners) restored from year 2 to 6 (in average 20 ha per year) and set under management plan

d) Restoration of 1 ha of very degraded State forest
e) Restoration of 1 ha of very degraded State forest
f) Restoration of a State forest FMU concession of 10,000 ha, with 700 ha very degraded restored with TREPA support from year 3 to 5 and the remaining 9300 ha restored from year 3 to year 9 by a private contractor

For scenario (a) TREPA support overcomes the initial costs of restoration activities, and leads to increased cashflows during the initial clearing and during periodic woodlot rotations. As a result, NPV is higher than BAU for all periods.

Table 29 Financial analysis Output 1.2 (scenario a)

1 ha of restored degraded Small-holders woodlot	6 years	10 years	20 years
NPV - BAU	155.63	199.90	235.75
NPV - restored without TREPA support	-558.77	-136.56	31.96
NPV - restored with TREPA support	176.66	598.87	767.39
NPV - Net cash flow Increment (TREPA support vs BAU)	21.03	398.97	531.65
IRR - Increment TREPA support vs BAU	10%	N/A	N/A

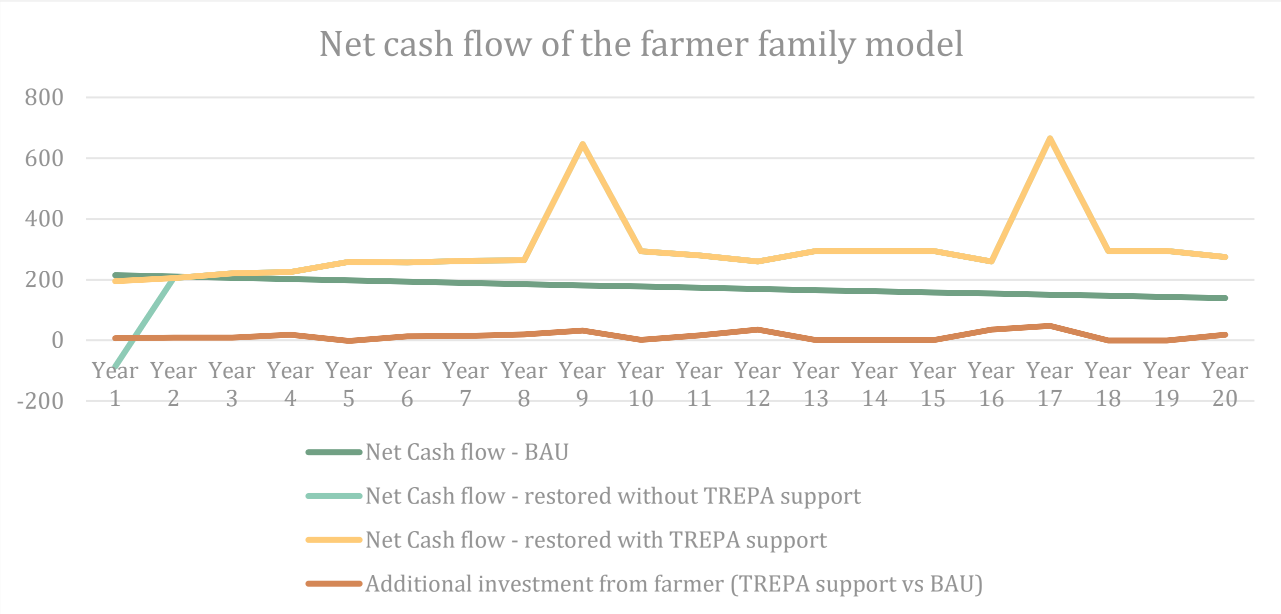


The farmer family scenario (b) provides an illustration of how various project activities combine to smooth out dips and peaks in farmer income. In this scenario, with-project NPV is higher than BAU over all periods of analysis.

Table 30 Financial analysis Output 1.2 (scenario b)

Farmer family with 0,5 ha of agroforetstry land (including crop, fruits, fodder and wood), 0,25 ha of woodlot and using ICS	6 years	10 years	20 years

NPV - BAU	6 years	10 years	20 years
NPV - restored without TREPA support	771.03	993.14	1,185.00
NPV - restored with TREPA support	586.81	1,018.67	1,390.25
NPV - Net cash flow Increment (TREPA support vs BAU)	830.78	1,262.64	1,634.22
IRR - Increment TREPA support vs BAU	59.74	269.50	449.22



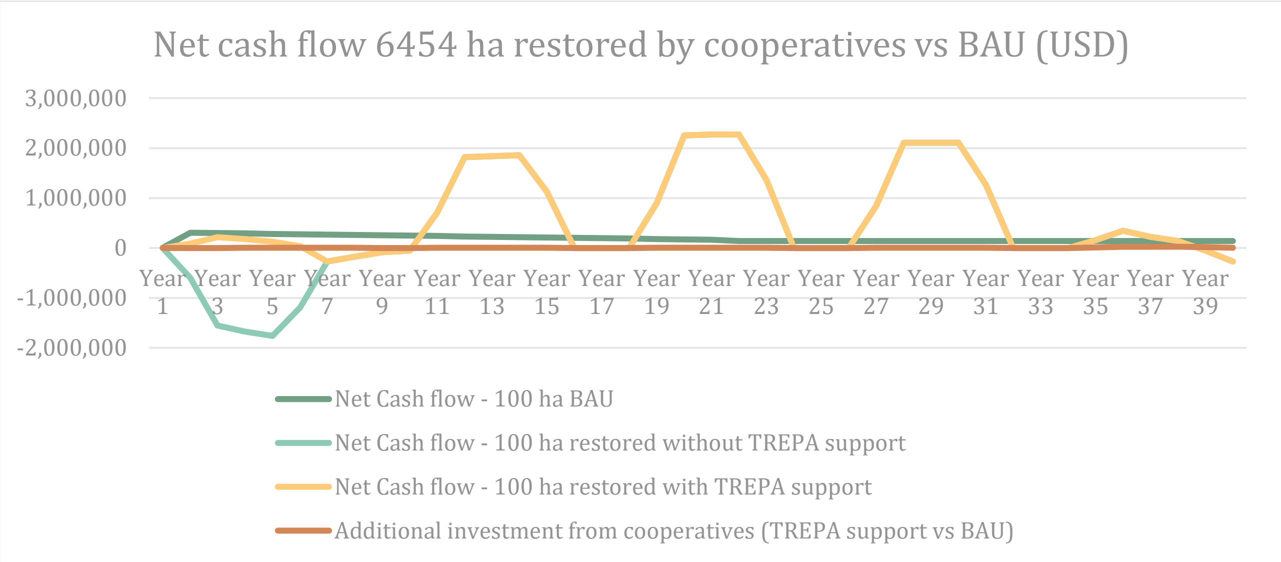
Scenario (c) compares the costs and benefits of restoration of 100 ha by a small holder forest cooperative. While each parcel must be protected during the restoration period, the cooperative undertakes this work progressively over a period of 6 years. In this way, farmers are able to continue collecting wood from other parcels, thereby reducing the short-term financial impact of this initiative.

NPV remains positive in the with-project scenario for all periods of analysis, albeit lower than BAU during the initial 6-year and 10-year timeframes. With-project cashflows dramatically outpace BAU after Year 11, as the restored forest is much more productive than the degraded baseline situation.

Table 31 Financial analysis Output 1.2 Scenario (c)

A small holder forest cooperative of 100 ha (around 200 land owners) restored from year 2 to 6 (in average 20 ha per year) and set under management plan	6 years	10 years	20 years	40 years
NPV - BAU	845,419	1,157,824	1,414,093	1,465,687

NPV - restored without TREPA support	-3,784,479	-3,978,503	-2,634,357	-2,228,217
NPV - restored with TREPA support	384,012	189,988	1,534,134	1,940,274
NPV - Net cash flow Increment (TREPA support vs BAU)	-461,408	-967,836	120,041	474,587
IRR - Increment TREPA support vs BAU	N/A	N/A	17%	20%

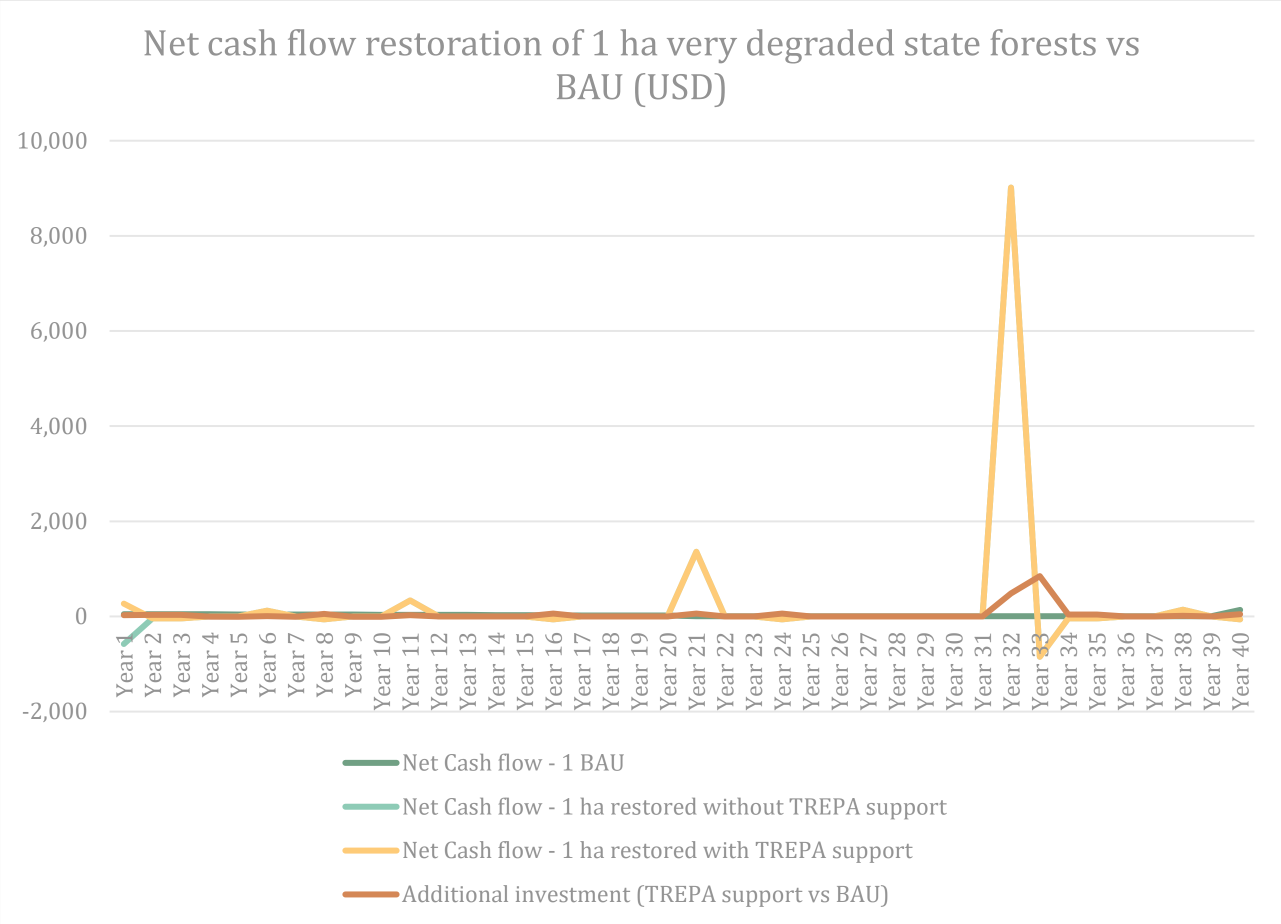


Scenario (d) evaluates the restoration of 1 hectare of very degraded State forest land from the farmer perspective. While restoration without TREPA support is financially unattractive, the with-project scenario has positive NPV across all timescales. With-project NPV is marginally lower than BAU over the 10 year period due to the timing of forest management activities, but higher in all other periods. Note that these are long-term investments; the normal rotation period for State forests is 32 years, leading to a sharp increase in revenues in the with-project scenario at this point. As noted, however, the high discount rate dramatically reduces the present value of that future income.

Table 32 Financial analysis - Output 1.2 (scenario d)

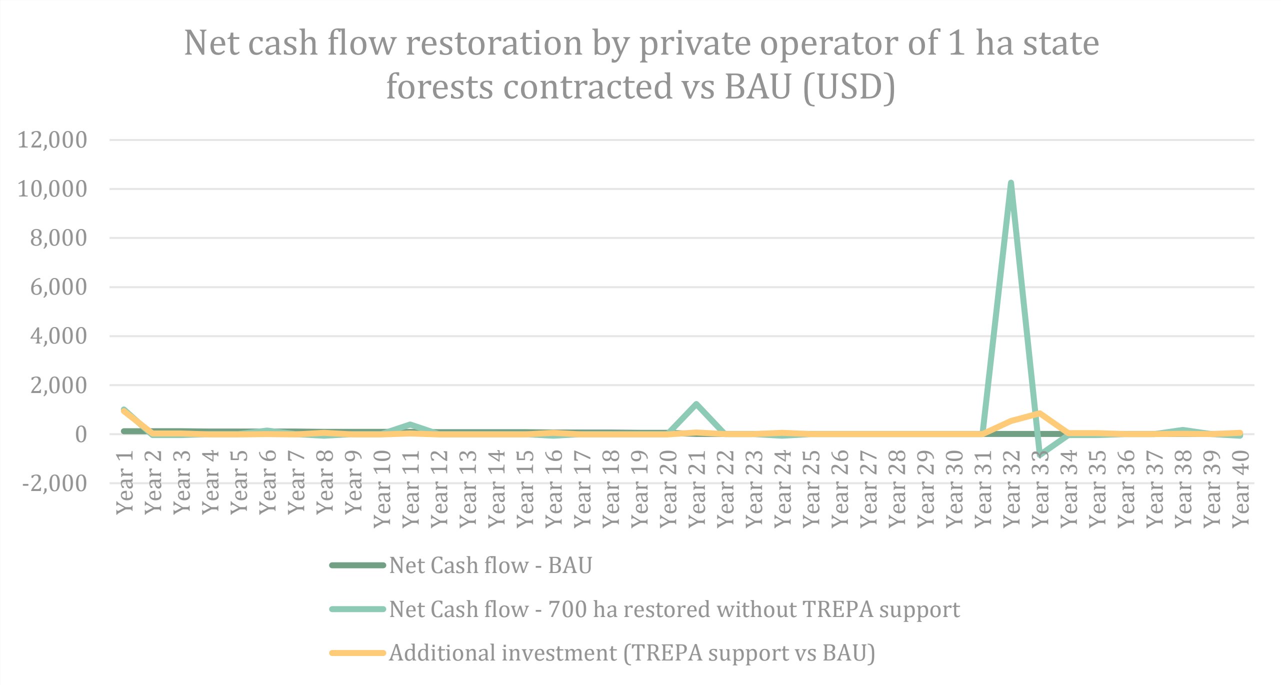
1ha of very degraded State forest restored	6 years	10 years	20 years	40 years
NPV - BAU	172	218	251	253
NPV - restored without TREPA support	-508	-527	-463	-309
NPV - restored with TREPA support	228	209	273	426
NPV - Net cash flow Increment (TREPA support vs BAU)	56	-9	21	173

IRR - Increment TREPA support vs BAU	N/A	17%	11%	N/A



In Scenario (e) the project provides technical support and capacity building to facilitate the restoration of degraded state forest by private small contractors. The contractor can earn income in Year 1 from the sale of cleared shrubs and stumps, and then earns income during 10-year rotations. As a result, NPV is higher in the project scenario than BAU over each time period.

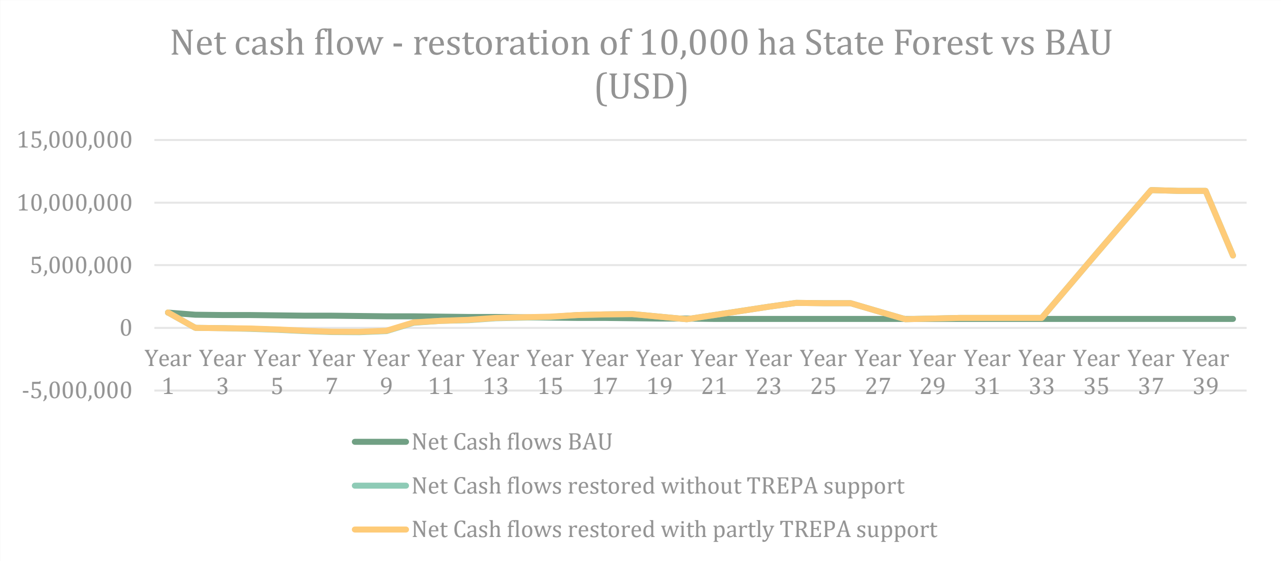
1 ha of State forest contracted to and restored by a private forest operator	6 years	10 years	20 years	40 years
NPV - BAU	432	553	648	652
NPV - 1 ha restored without TREPA support	874	855	931	1,092
NPV - Net cash flow Increment (Restored vs BAU)	442	302	283	440
IRR - Increment Restored vs BAU	-23%	2%	6%	N/A



Scenario (f) examines the costs and benefits of restoration of a state forest concession restored through a mixed management approach. Of the 10,000 ha area covered by the project, 700 ha of very degraded forest would be restored with TREPA support and the remaining 9300 ha restored privately by the contractor. NPV in the project mixed management scenario remains positive throughout the period of analysis but is lower than BAU in all periods. As noted in the Feasibility Study, demand for wood in Eastern Province is estimated at 1.65 million m^3/year while the current sustainable supply capacity of overall forest, shrubland and agroforestry tree resources is only approximately 0.53 million m3/year. The forest restoration activity is profitable for farmers and private actors, but less profitable than illegal overexploitation of forest resources.

Table 33 Financial analysis - Output 1.2 (scenario f)

State forest FMU concession of 10,000 ha, with 700 ha very degraded restored with TREPA support from year 3 to 5 and the remaining 9300 ha restored from year 3 to year 9 by the contractor	6 years	10 years	20 years	40 years
NPV - BAU	4,013,447	5,156,074	6,158,923	6,415,856
NPV - 1 ha restored without TREPA support	825,233	627,078	1,585,790	2,310,104
NPV - 1 ha restored with partly TREPA support	863,879	693,740	1,662,282	2,386,596
NPV - Net cash flow Increment (TREPA support vs BAU)	- 3,149,568	- 4,462,334	- 4,496,640	- 4,029,259
IRR - Increment TREPA support vs BAU	N/A	N/A	N/A	6%



Note also that the forest restoration activities described in Output 1.2 generate large and positive externalities beyond ensuring sustainability of supply and enhancing livelihoods:

18. Increased resiliency of the woodlots to climate impacts through sustainable forest management practices.
19. Improved climate resiliency of forests that will reduce topsoil erosion, improve water quality; protect source water; and ensure uninterrupted water supply for household needs, drinking and irrigation (Wilson and Lovell, 2016. Garrity *et al.*, 2010).
20. Reduced stormwater runoff resulting in flood risk mitigation (e.g. Matthews et al. 2004; Ranieri *et al.* 2004).
21. Increased carbon sequestration in soil and forest biomass.

These benefits, while significant, are not captured by the farmers who restore the forests and collect wood and are therefore not included in the financial cost-benefit analysis.

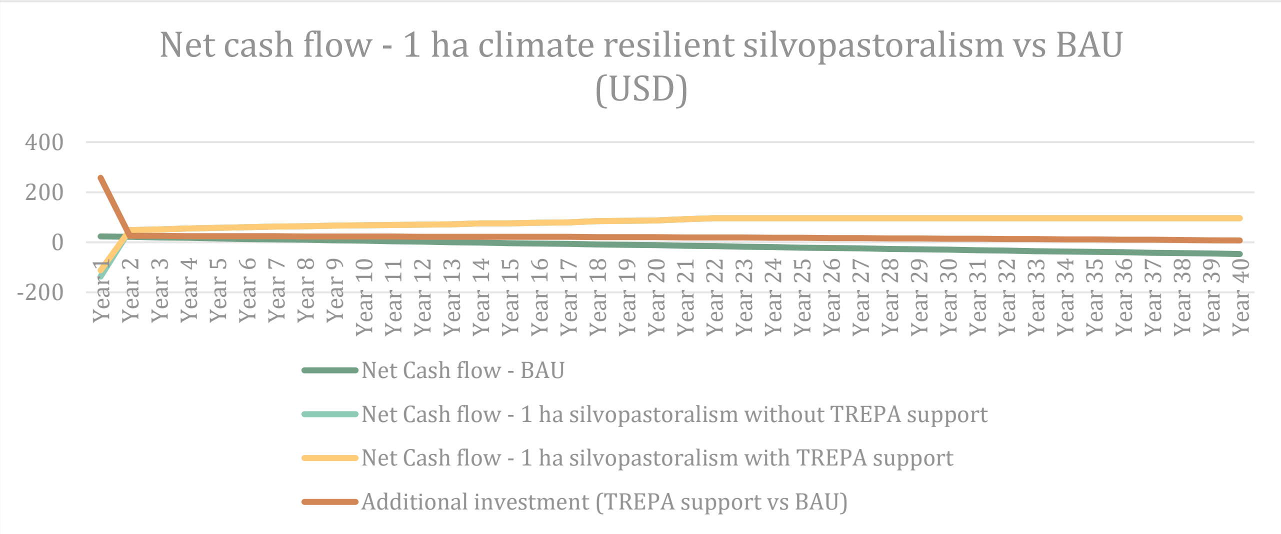
As indicated in the analysis above, most of the climate resilient forest restoration activities present better returns than BAU, and even the ones that do not present positive financial returns for participating farmers over all periods of analysis.

For **Output 1.3 (silvopastoralism)**, investments in resilience activities would yield a negative per-hectare NPV over 6- and 10-year timeframes. GCF support results in a positive financial return for farmers over all timeframes, although lower than BAU during the 6- and 10-year periods as a result of high up-front investment costs on the part of participating farmers.

Table 34 Financial analysis - Output 1.3

Silvopastoralism	6 years	10 years	20 years	40 years
NPV - BAU	72.02	83.00	80.51	72.16
NPV - 1 ha restored without TREPA support	36.66	114.77	205.47	239.73
NPV - 1 ha restored with TREPA support	58.35	136.45	227.16	261.42

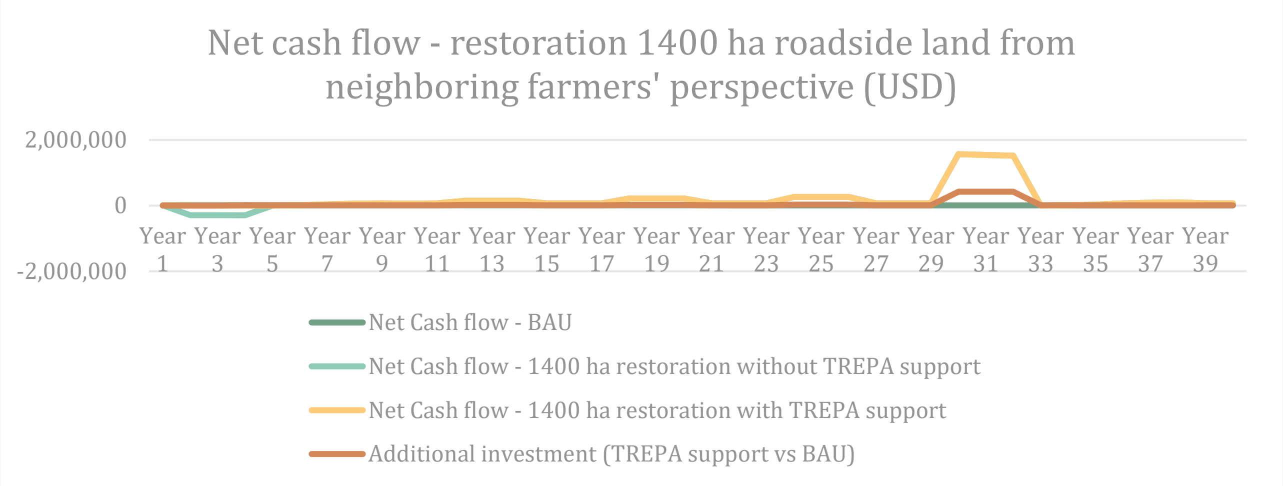
NPV - Net cash flow Increment (TREPA support vs BAU)	-13.67	53.46	146.65	189.26
IRR - Increment TREPA support vs BAU	11%	25%	31%	31%



Output 1.4 focuses on restoring forest and woodland along roadsides and riversides, and in the Akagera National Park Buffer Zone. For the roadside and river / lake shore resoration activities, GCF investment mean that climate resilient restoration activities yield net financial benefits over all periods of analysis. During the initial 6-year period NPV is lower than BAU, and becomes significantly higher in subsequent periods.

Table 35 Financial analysis - Output 1.4 (Roadside, river & lake shore)

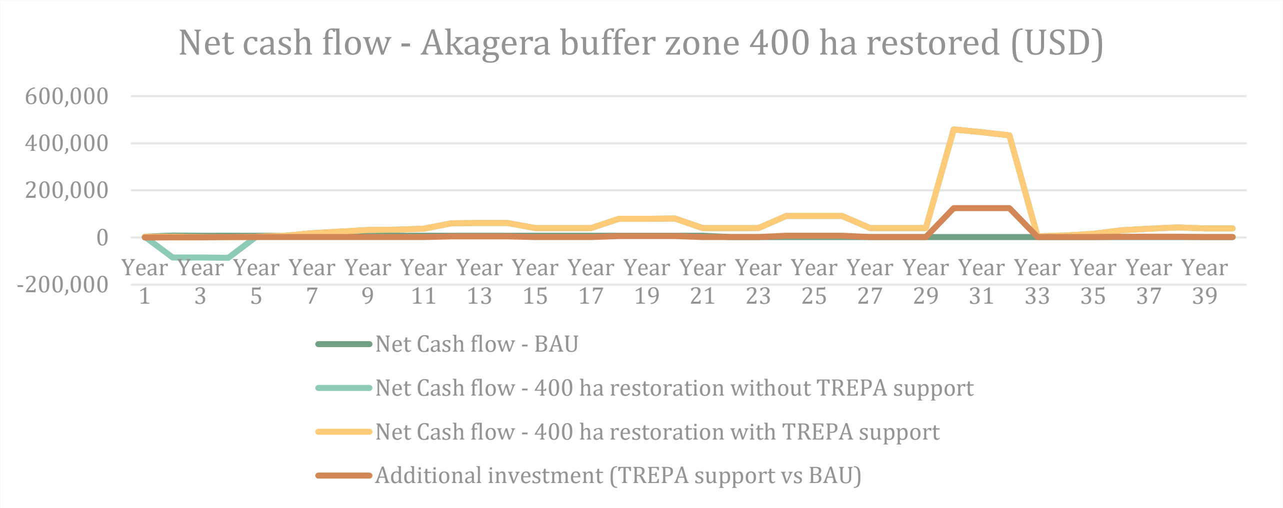
Roadside and river / lake shore 1400 ha	6 years	10 years	20 years	40 years
NPV - BAU	40,972	55,040	68,782	71,544
NPV - 1400 ha restored without TREPA support	-560,841	-494,508	-344,959	-250,413
NPV - 1400 ha restored with TREPA support	18,759	85,093	234,642	329,187
NPV - Net cash flow Increment (TREPA support vs BAU)	-22,213	30,053	165,860	257,644
IRR - Increment TREPA support vs BAU	N/A	36%	49%	49%



For the Akagera buffer zone activity financial returns are positive for every period of analysis. Project returns are lower than BAU for the 6- and 10- year periods, and higher thereafter. These results are indicative of the degree of overexploitation of resources in the base case and the investment in time and resources required to restore forest productivity.

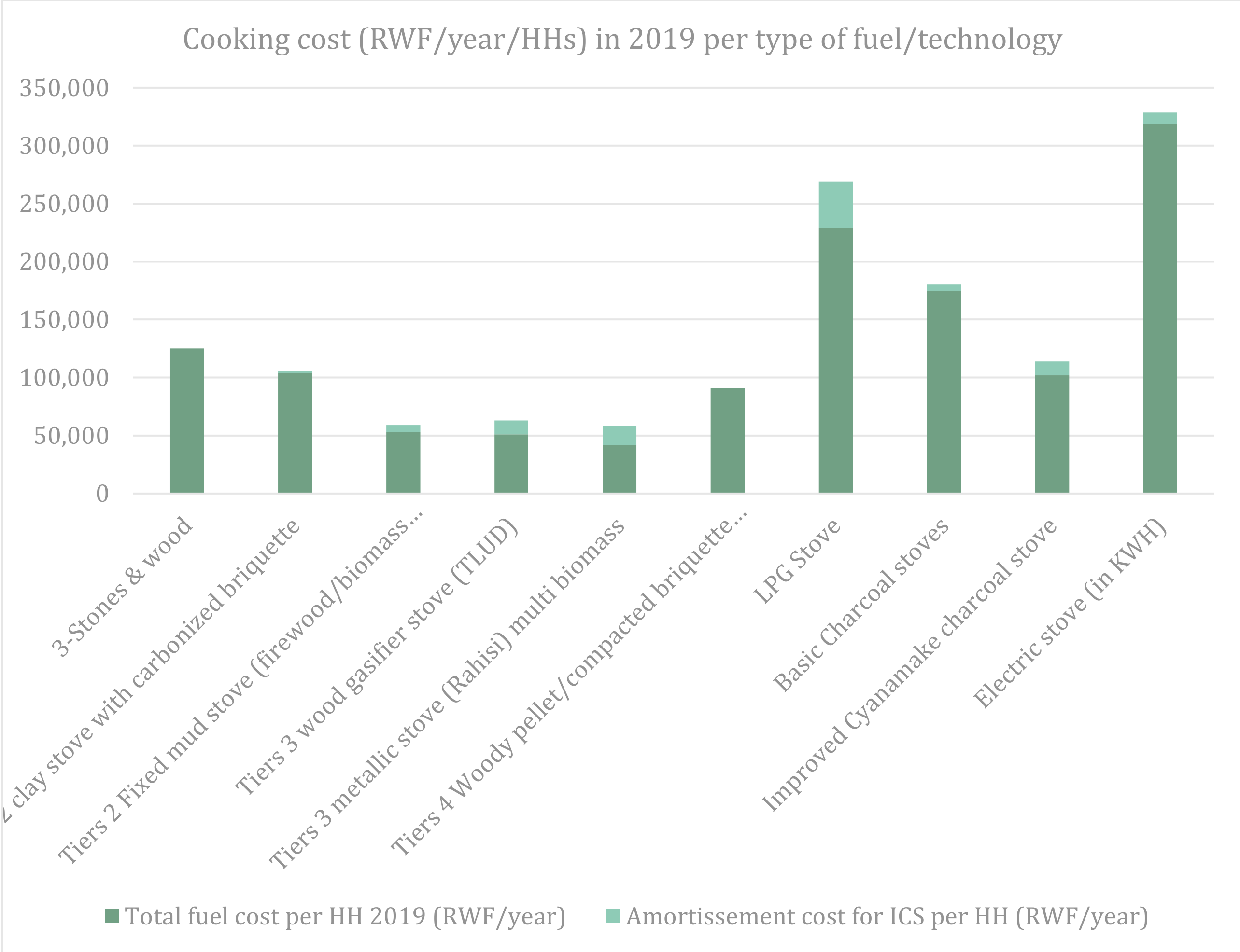
Table 36 Financial analysis - Output 1.4 (Akagera)

Akagera buffer zone 400 ha	**6 years**	**10 years**	**20 years**	**40 years**
NPV - BAU	26,277	35,713	44,690	45,612
NPV - 400 ha restored without TREPA support	-160,353	-128,292	-62,759	-29,797
NPV - 400 ha restored with TREPA support	11,818	43,880	109,413	142,375
NPV - Net cash flow Increment (TREPA support vs BAU)	-14,458	8,167	64,723	96,763
IRR - Increment TREPA support vs BAU	N/A	25%	40%	41%



In each climate resilience scenario, GCF investment makes the project interventions more financially attractive for farmers, forest harvesters and pastoralists, than would be the case if the measures were undertaken without GCF support. GCF support provides incentives for long-term sustainability beyond the implementation phase.

Finally, the financial analysis is used in Output 1.5 to identify the technological interventions that will be used to reduce the use of biomass fuel for cooking and thus reduce reliance on climate sensitive forest resources. The interventions in Output 1.5 are complementary to the measures in Outputs 1.1 – Output 1.4, in that they reduce demand for fuelwood and thereby reduce the demand-supply imbalance that must be addressed by the on-farm resilience activities. These efficiency measures are presented as a separate Output because the nature of the interventions is qualitatively different than for the on-farm resilience activities. Here, the BAU scenario is continued use of traditional 3-stone fires and inefficient charcoal stoves. Project activities are focused on promotion of improved stoves, with subsidies provided only for the poorest households. Affordability is ensured by facilitating access to short term credit, buttressed by the financial and time savings that come from adoption of ICSs.



Since most households will have to make the investment themselves, simple payback period is the critical financial measure for this analysis. The results identify four stove types where the initial investment plus ongoing fuel costs make financial sense for unsubsidized households, meaning they will recoup their initial investment within the lifetime of the product. On the other hand, two improved stove types (LPG and electric) are not cost-effective and will not be promoted by the project because poor households would never recoup their initial investment based on typical usage patterns without subsidies.

Table 37- Payback analysis for efficient stoves in Output 1.5

Payback period: Tier 3 wood gasifier stove (TLUD) without TREPA, years	0.2
Payback period: Tier 3 metallic stove (Rahisi) multi-biomass without TREPA, years	0.3
Payback period: Tier 4 Woody pellet/compacted briquette gasifier stove without TREPA, years	0.0
Payback period: LPG Stove without TREPA, years	NA

Payback period: Improved Cyanamake charcoal stove without TREPA, years	1.4
Payback period: Electric stove without TREPA, years	NA

2. Economic Analysis

An economic analysis of the project was performed to assess the net incremental benefits the project yields for society. The economic analysis compares costs and benefits in the counterfactual (business-as-usual) scenario versus the costs and benefits that accrue in the improved (with-project) scenario.

The analysis considers two types of benefits: (1) marketable benefits that come from avoiding climate change related losses and increasing production in climate resilient agricultural systems, and (2) non-market benefits that result from the provision of ecosystem services as a result of project activities. Since most of these ecosystem services represent public goods, they are not captured by markets and are not usually included in farmers' decision-making processes.

2.1 Marketable Benefits from Output 1.1, Output 1.2, Output 1.3, and Output 1.4

The incremental economic benefit from agriculture comes from a cost-benefit analysis, which considers the increase in production in climate resilient agricultural systems, comparing the situation with and without project. It considers the same methodology and assumptions that are specified in the financial analysis, but with the difference that the full costs of project implementation are included, as are societal benefits that might not be captured by individual farmers. These costs include GCF investment, co-finance from partners and Government during the project period as presented in Annex 4 (Detailed Budget Description). It also includes continued Government financial support for the remainder of the 20-year investment lifetime[139].

Project benefits include the cumulative net financial benefits for participating farmers compared to business-as-usual, as well as financial benefits for improved cook stove manufacturers / retailers, and non-financial benefits like the value of time savings and environmental protection.

The net present value (NPV) of the project-level investment is calculated using a discount rate of 12.1%. This figure represents the Rwanda Central Bank interest rate for a 10-year Treasury bill, as of September 2020[140]. The use of the Government bond rate is justified as this is the rate at which the Government would have to borrow to fund equivalent investments in the absence of grant financing. The sensitivity analysis is performed using alternative discount rates of 8% and 20% (the latter being higher than the average commercial borrowing rate).

The project return varies depending on the period of analysis. The figures below present the NPV and Economic Internal Rate of Return (EIRR) for the 6-year implementation

[139] These are commitments that the Government of Rwanda has made as a result of the planned project activities, and therefore represent an opportunity cost for the Government.

[140] Source: https://www.bnr.rw/browse-in/financial-market/money-market-interest-rates/monthly-interest-rates/

period, and for an estimated 20-year investment lifetime. Given the project's focus on long-term agroforestry, landscape restoration and silvopastoralism activities that often last for 40 years or more, the 20-year investment lifetime is considered most appropriate for this analysis.

The cost-benefit analysis spreadsheet (Annex 3) presents these calculations in detail, with the results summarized below:

Table 38 - Summary - Economic Costs & Benefits

Direct Project Costs (USD) - including GCF costs, cofinance, ongoing post-project expenditure (and excluding -30% taxes paid on staff)	**6-YEAR TOTAL**	**20-YEAR TOTAL**
Total Direct Costs (USD)	**- 49,716,472**	**- 80,168,769**
Marketable Project Benefits (USD) - direct - attributed to Component 1	**6-YEAR TOTAL**	**20-YEAR TOTAL**
Total Marketable Benefits - direct (USD)	**8,420,724**	**205,793,387**
Nonmarketable GHG Benefits (USD) - direct - attributed to Component 1 outputs	**6-YEAR TOTAL**	**20-YEAR TOTAL**
Total GHG Benefits (USD), direct	**53,711,011**	**1,773,597,955**
Time savings - fuelwood collection	**43,332,201**	**163,847,414**
SUMMARY	**6-YEAR TOTAL**	**20-YEAR TOTAL**
Net Benefit, direct (marketable)	-48,348,397	103,681,161
Net Benefit, direct (marketable + non-marketable)	48,694,815	2,041,126,531

Net present value and economic internal rate of return are presented below:

Table 39 - ENPV and EIRR summary

Economic returns, Discount rate 12.1%		
Direct, marketable benefits only	6 Years	20 Years
NPV	-35,435,968	- 6,575,924
EIRR	#NUM!	10%

When only marketable benefits are considered, project NPV is negative over the 6-year and 20-year timeframes. As noted in the financial analysis discussion, the agroforestry, silvopastoralism and forest management outputs require up-front investments that take between 10 and 30 years to mature fully. These future benefits are depressed by the use of a discount rate. In addition, the direct marketable benefits are presented in comparison to baseline revenues that result from severe overexploitation of forest resources.

2.2 Non-Market Benefits from Ecological Services

Key non-market benefits from the project include the following:

1. Reduced topsoil erosion[141];
2. Improved water quality;
3. More reliable water supply for household needs, drinking and irrigation (Wilson and Lovell, 2016. Garrity *et al.*, 2010);
4. Reduced stormwater runoff resulting in flood risk mitigation (e.g. Matthews et al. 2004; Ranieri *et al*. 2004);
5. Time savings, especially for women and girls who traditionally collect fuelwood;
6. Increased carbon sequestration in soils and trees;
7. Reduced GHG emissions from the use of non-renewable biomass as a cooking fuel.

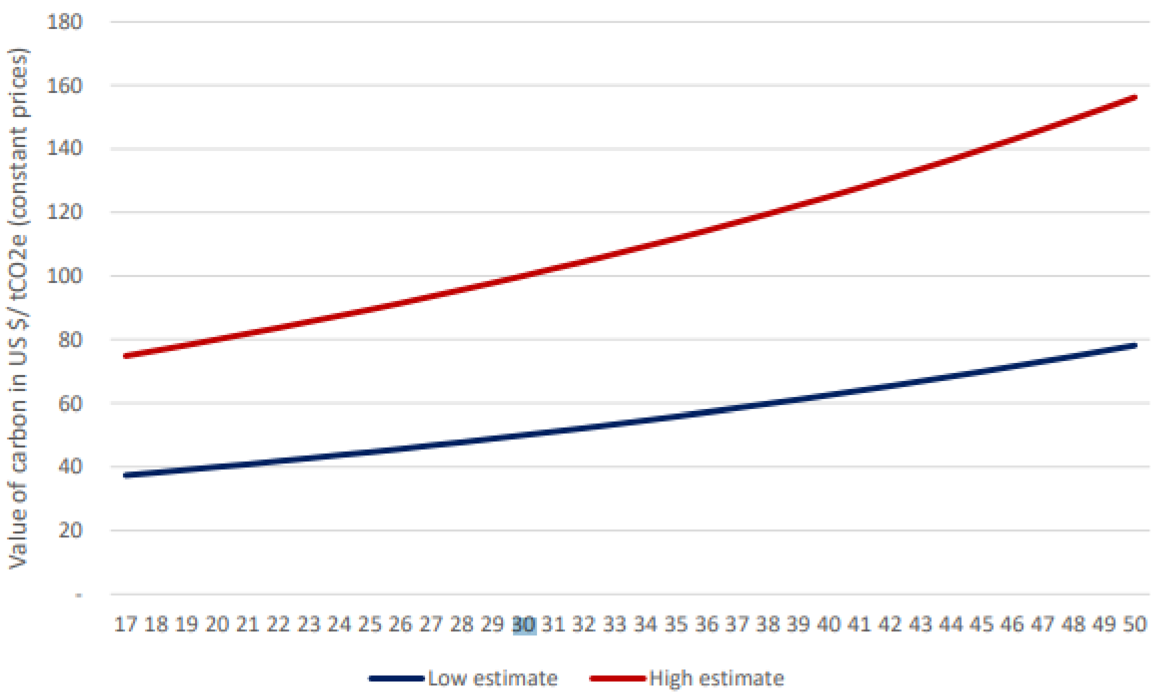
Non-market benefits are valued using shadow prices that attempt to reflect the amount that people would have to pay to obtain an equivalent benefit via the market. In Rwanda, there is limited research about the economic costs of soil erosion, water quality and availability and flood risk. These non-market benefits result from improved agricultural and forest management practices, which also result in reduced forest degradation and increased adoption of agroforestry and silvopastoralism. Therefore, this analysis conservatively uses the social value of carbon sequestration as a proxy for all of these benefits. This approach is reasonable because climate change related weather impacts exacerbate the challenges of soil erosion and water quality, forest degradation, water availability and flood risk. The social cost of carbon is a shadow price that captures the combined impacts of climate change on ecosystem services.

As indicated in the World Bank's 2017 guidance note on the shadow price of carbon in economic analysis[142], a low estimate of the shadow price would be between USD 40 and USD 75 per tCO_2e in 2020, rising to between USD 63 and USD 125 per tCO_2e in 2040. However, these figures are global estimates, and the guidance note acknowledges that there may be considerable variation between countries. To ensure conservatism, this analysis uses the low-value of USD 40/tCO2e and holds this figure constant for the 20-year lifetime of the investment.

[141] Karamage, et. al. 2016. Extent of Cropland and Related Soil Erosion Risk in Rwanda. *Sustainability* **2016**, *8*, 609; doi:10.3390/su8070609

[142] *Guidance note on shadow price of carbon in economic analysis (English).* Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/621721519940107694/Guidance-note-on-shadow-price-of-carbon-in-economic-analysis

Figure 19 - Recommended shadow price in USD per 1 metric tonne CO2 equivalent (constant prices)



Year	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Low	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	55	56	57	58	60	61	63	64	65	67	68	70	71	73	75	76	78
High	75	77	78	80	82	84	86	87	89	91	94	96	98	100	102	105	107	109	112	114	117	120	122	125	128	131	134	137	140	143	146	149	153	156

Carbon sequestration is associated with each of Outputs 1.1 through 1.4. As noted previously, the promotion of clean and efficient cooking energy technologies is intended to reduce the demand for fuelwood and thereby contributes to the sequestration totals presented in the other Outputs.

GHG sequestration figures are estimated according to the following methodology:

The “above ground” volume has been converted into tons of CO2 sequestered as follow: one m³ of woody biomass standing above the ground is equivalent to:

- 1 m³ above ground = 1 x (1+0,8) = 1,8 m³ above and into the ground woody biomass, using the **root-shoot ratio of 0,8**[143]
- 1,8 m³ woody biomass = 1,8 x 0,75 ton / m³ = 1,35 tons[144] of woody biomass (average **wood density of 0.75** ton/m3);
- 1,35 tons of woody biomass = 1,35 x 0,725 = 0,979 ton of dry woody biomass (**conversion factor 12% moisture to oven dry wood of 0.725**);
- 0,979 ton of dry woody biomass = 0.979 x 0,5 = 0,489 ton of carbon (**1 tons of dry wood = 0.5 tons of carbon**); and finally
- 0,489 ton of carbon = 0.489 x 3,67 = circa 1,8 ton of CO_2 sequestrated (**1 tons of carbon = 3.67 tons of CO2**) = circa 1,8 ton of CO_2 sequestrated.

[143] Research conducted on the assessment of root-shoot ratio and carbon storage od Quercus b. in Iran gave a root-shoot ratio of 0,72 in the case of high forest and 0,88 in the case of coppice.

[144] 12% moisture

The aggregated conversion factor is 1.8, i.e. 1 m^3 of woody biomass above the ground is associated to 1.8 ton of CO_2 sequestrated.

Outputs 1.1 – 1.4 support the restoration of degraded forest land and increased tree density on farm and pasture land. Meanwhile, Output 1.5 reduces the use of non-renewable biomass by replacing inefficient traditional cook stoves with more efficient models.

Total carbon sequestration / emission reduction over these five outputs is presented below:

Table 40 - Value of ecosystem benefits from project activities

	6 year total	*20 year total*
Direct carbon sequestration / emission avoidance, tCO2e	*1,342,775*	*44,339,949*
Value at USD 40/tCO2e	40,991,277	1,674,643,918

Time savings

Output 1.5 generates non-marketable benefits in the form of time savings. Under BAU, women and girls are expected to spend approximately 2.2 hours per day on fuelwood collection. According to the WB, 2019 per capita GDP in Rwanda was USD 820, equivalent to USD 2.25 per day. Valued at the USD 2.25/day shadow cost of time, this yields a BAU implicit cost of USD 226 per year spent on fuelwood collection per household. In the with-project scenario traditional stoves with an estimated efficiency of 16% are replaced with improved varieties at 40% efficiency, yielding a 60% reduction in fuelwood consumption. The adoption of improved cook stoves therefore is expected to reduce fuelwood collection time by 60.2 days per year, with an implicit value of USD 135 per household.

The analysis assumes that the project's 100,000 ICS are adopted over the first four years of the project, and that adoption falls by 5% each year after the GCF funding period ends.

Table 41 - Non-marketable benefits - time savings

Other non-marketable benefits	***6-YEAR TOTAL***	***20-YEAR TOTAL***
Time savings - fuelwood collection	43,332,201	163,847,414

The combined value of non-marketable benefits is indicated below:

Table 42 - Combined value of non-marketable benefits

Total value of non-marketable benefits	***6-YEAR TOTAL***	***20-YEAR TOTAL***
	97,043,212	1,937,445,370

2.3 Total Economic Benefits

Combining the non-market benefits from ecosystem services dramatically changes the cost-benefit ratio for the project. Project NPV shifts from negative when only marketable benefits are considered, and become strongly positive for the 6- and 20-year periods of analysis.

Table 43 - Economic returns including marketable and ecosystem benefits

	6 Years	20 Years
NPV	21,062,054	409,682,560
EIRR	41%	69.63%

2.4 Sensitivity Analysis

A sensitivity analysis was performed to evaluate how project returns are affected by changing parameters. This analysis is useful when the long-term applicability of project assumptions cannot be guaranteed. The sensitivity analysis looks at the impact of increasing the discount rate, which has the effect of reducing the weight assigned to costs and benefits that occur in the future. As noted previously, this project stimulates long-term investments in landscape restoration, so increasing the discount rate is expected to dramatically decrease economic net present value.

Economic returns – lower discount rate		8%
Marketable benefits only	6 Years	20 Years
NPV	-39,135,124	9,677,555
EIRR	N/A	10%

Marketable and non-marketable benefits	6 Years	20 Years
NPV	28,140,019	677,042,867
EIRR	41%	70%

Economic returns – base case		12.1%
Marketable benefits only	6 Years	20 Years
NPV	- 35,435,968	- 6,575,924
EIRR	N/A	10%

Marketable and non-marketable benefits	6 Years	20 Years
NPV	21,062,054	409,682,560
EIRR	41%	69.63%

Economic returns - disc rate		20%
Marketable benefits only	6 Years	20 Years
NPV	- 29,705,278	-18,184,572
EIRR	N/A	10%

Marketable and non-marketable benefits	6 Years	20 Years
NPV	11,558,675	171,900,695
EIRR	41%	70%

The sensitivity analysis does not dramatically affect views of project viability. The only shift that occurs when reducing the discount rate to 8% is that the discounted present value of the project's marketable benefits become very slightly positive over a 20-year timeframe. No significant changes occur when the discount rate increases to 20% - the present value of marketable benefits remain negative, and the present value when non-marketable benefits are included remain strongly positive.

A further sensitivity analysis was conducted to explore the effect of different assumptions regarding the social cost of carbon. Table 18 below shows the how adjusting the carbon price estimate between USD 5 (the typical price for REDD+ projects) and USD 75 (the WB high estimate for the year 2020) affects ENPV.

Table 44 - Sensitivity analysis - shadow carbon price vs ENPV

Social Carbon Price, USD	Project 6-Yr NPV	Project 20-Yr NPV

	Base case: $40	21,062,054	409,682,560
REDD+ market price	$5.00	- 3,375,087	341,776,836
	$7.50	- 1,629,577	346,627,245
	$10.00	115,933	351,477,654
	$20.00	7,097,973	370,879,290
	$30.00	14,080,014	390,280,925
WB low value	$40.00	21,062,054	409,682,560
WB high value	$75.00	45,499,194	477,588,284

Over the 6-year implementation period, the project requires a carbon price just over USD 9.80 to reach a positive NPV. Over the longer 20-year time period the project time savings from reduced fuelwood collection are sufficient to generate positive NPV, even if the carbon price were set to zero.

3. Conclusion

The results of the economic analysis show that the project does not generate sufficient financial returns to be undertaken without GCF funding. At the same time, the project generates robust economic benefits from a societal perspective, contributes to the long-term sustainability of productive landscapes in Rwanda, and supports the GCF's goal of low-carbon and climate resilient development.

The results of the financial analysis show clearly that the project activities would not be undertaken by farmers without GCF support. In many cases, the project activities generate lower (but still positive) returns than unsustainable BAU practices, but when taken together (as in the farmer family model) remain financially attractive to farmers when GCF support.

Appendix - Draft sample memoranda of understanding to be used for the "last mile agreements"

REPUBLIC OF RWANDA

RWAMAGANA DISTRICT

Memorandum of Understanding for

SUPPORTING AGROFORESTRY TREE PLANTING AND MAINTENANCE ON FARMS OF THE ABANYAMURAVA FFS GROUP MEMBERS OF FUMBWE SECTOR IN RWAMAGANA DISTRICT

Between

The District of RWAMAGANA, represented by Mr **MBONYUMUVUNYI Radjab,** the Mayor of the District,

on one hand,

and

ABANYAMURAVA FFS Group members of FUMBWE Sector, NYAMIRAMA Cell, represented by Mr.**HITAYEZU Ferdinand**, the designated FFS representative and facilitator,

on the other

INTRODUCTION

Considering:

- The country priority set in the under revision Green Growth and Climate Resilience Strategy (2021) and in the 2018 National Forest Policy (NFP) and National Forestry Sector Strategic Plan (FSSP), where the dissemination of agroforestry best practices through Farmer Field School (FFS) extension system, with an increase of the tree density from 25 to 75 tree par ha in average, is highlighted as a key priority to support the effort of the country in the climate change adaptation and mitigation;
- The objective of the TREPA project funded by GCF and implemented by UICN/RFA in close collaboration with the District authorities, where the dissemination in Eastern Province of best agroforestry practices in degraded crop lands exposed to drought hazard and soil erosion is one of the key targeted intervention to increase the resilience of ecosystems and dependent vulnerable communities to climate change;
- The participatory local landscape restoration plans developed (in the Sector of …., Cell of…) by the TREPA project in collaboration with local communities and authority's representatives, where priority degraded crop areas owned by vulnerable farmers with low tree density and exposed to drought and soil erosion (slope areas) are identified as to be restored through agroforestry dissemination;

Rwamagana District and **ABANYAMURAVA"** FFS group have agreed on the following:

ARTICLE 1. OBJECTIVE

The objective of this MoU is to define modalities of collaboration, tasks, responsibilities and commitments of the ABANYAMURAVA" FFS group members and the Rwamagana District.

This MoU describes also all planned activities and specific tasks and responsibilities of each party involved in the implementation of the Agroforestry program of increasing and maintaining Agroforestry trees planted on-farms aiming at increasing forest cover, erosion control, resilience to drought, agricultural production and contribution to the community welfare.

ARTICLE 2. THE FFS GROUP CROP LANDS LOCATION, OWNERS AND REPRESENTATIVES

The FFS group name "…………" is located in the Sector of………………….. (cellule of ………………), in the District of …………………..

The list of FFS member's crop land parcels (with their area, and their Land Administration ID) targeted by the agroforestry dissemination is provided in appendix I, indicating name, ID card number and contact of each land owners. If an owner is living in other remote region, name and contact of its formally designated local representative is provided.

The location map of crop lands owned by the listed members is given in appendix II.

The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities.

The assembly of the FFS group member, held in ….. (location) on the …. (date), designated the FFS group committee members and representatives, as presented in the table below approved by local authorities. This list has been established in respect of the rule of the at least 30% female representation, while the overall areas is subdivided into blocks of 5-10 ha each, for which farmer leaders are designated to ease the communication/coordination, the field work supervision and the monitoring/control over the time.

List of FFS group committee member and representatives:

Full name	Function in the FFS groups	Parcel concerned	Signature	Gender	ID card	Phone contact
	Chair	All				
	FFS facilitator/promotor	All				
	Etc…					
	Farmer leader block 1	Parcel 1,..3…15				
	Farmer leader block 2	Parcel 16, etc,..				
	….					

ARTICLE 3. FFS FARMERS COMMITMENT and TASKS

All members of the FFS group are understanding their important roles in the contribution to the adaptation of the Eastern Province to the climate change, especially to increase the resilience of their land to drought in dry season and reduce the water run-off and soil erosion during rainy season), while contributing to the reduction of C02 emission. Thus each member, on its parcel, is committing to:

a) Provide baseline (in the first 6 months) information including:

i. number of existing tree/shrubs per species,

ii. number of tree to be planted per species (filling the appendix III),

iii. type of planting (boundary planting, intercropping, etc.);

b) Participate actively in the sensitization and training activities that will be delivered to their attention, including following items: agroforestry opportunities to address climate change adaptation and mitigation, agroforestry best practices adapted to their context, agroforestry and fruit tree planting and maintenance, proper use of ICS, gender issues and solutions, saving group establishment and management, etc. All FFS group representative and farmer leader have to participate in each session.

c) With the support of the project, ensure the planting of agroforestry trees (by the year 2) at an average density of 100 trees per ha, with 10 % fruit trees (see list of species in appendix III). Farmers will avail the man-power required for tree planting starting from tree seedling production to tree planting and maintenance. At least 30% of the man-power should be female, with specific attention the give job priority to vulnerable.

d) After planting, protect the trees and ensure their proper maintenance (pruning, roots shaping, etc.), and ensure the re-integration of sufficient organic matter in the soil through the use of best agroforestry technics (compost, mulching, etc.), according training and technical guidance provided by the extension services;

e) Ensure the replacement (re-planting) of any harvested mature tree to keep the tree density at the whished level (100 trees/ha);

f) Acquire (in the first 12 months, with the support of local saving group and the TREPA subsidy) and use properly an improved ICS (at least 1 per household) adapted to their context, to be selected among the list recommended by the TREPA project based on the type of fuel use, on the family size, on cooking habits and on financial capacity. Any damaged ICS has to be replaced and the household has to use permanently at least 1 ICS.

➢

g) For each block, designated farmer leader will provide weekly data on ICS use and related wood consumption, on the wood harvesting in the parcel, and on the different crop area sharing and yield obtained (to be registered in a dedicated book according to a well-defined protocol provided by the project);

h) Participate in the elaboration and implementation of the **gender principle rules and action plan** for the FFS group;

i) Participate in the regular monitoring /assessment (tree counting, etc.) of the restored agroforestry parcels conducted by the Sector officer.

j) FFS groups member are responsible for the permanent control and protection of trees newly planted or already existing in their own parcel, but also collectively in the entire area of intervention of the FFS group. FFS group members must detect all non-respect of trees and should address a warning to the concerned land owner. In case of recidivism or negative reaction from one land owner, the member should raise the issue and find solution by amicable way inside the committee. If necessary, the representative of the FFS groups will request the support of the local authorities including cell and sector levels for final solution/resolution. In case of serious damage caused intentionally by a landowner to the planted trees, District can apply sanction/penalties accordingly to the national regulation;

k) Develop detailed internal rules for the FFS groups that can support effectively the implementation and respect of above commitment. These internal rules, that will be approved by local authorities, will have to integrate a written ‘statement of intent’ showing the intent and ownership of the relevant beneficiaries to implement the proposed activities being requested in order to address the specific vulnerability(ies) and their commitment to participate in the activities until their finalization;

ARTICLE 4. TASKS AND RESPONSIBILITIES OF THE DISTRICT AND SUPPORT PARTNERS

The District, with the support of the TREPA project and implementing partners, is committing to:

a) Conduct sensitization session on agroforestry opportunities to restore degraded land, increase the resilience to drought, reduce the exposure to soil erosion, and contribute to C02 sequestration, address climate change adaptation and mitigation;

b) Support the FFS groups in the participatory identification and mapping of parcel and owners to be targeted by the agroforestry dissemination, and in the elaboration and signature of the present MoU. The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities.

c) Support the FFS groups in the baseline assessment of their parcel (see article 3.a)

d) Contract and supervise/monitor a professional service provider to produce quality agroforestry and fruit tree seedlings, and conduct/supervise the planting and maintenance activities (100 tree/ha, with 10 % fruit trees, see list in appendix III). The service provider will use in priority the man-power (at least 30% female) from FFS groups member’s families, giving priority to the most vulnerable based on list provided by local authorities.

e) Ensure the capacity building (training session and on the job technical advice) of the FFS group in following items;

   i. Agroforestry best practices adapted to their context,

   ii. Agroforestry and fruit tree planting and maintenance,

   iii. Proper choice and use of ICS,

   iv. Gender issues and solutions, with establishment of a gender action plan for the group

   v. Saving group establishment and management

   vi. Cooperative opportunities, rules and establishment

f) Support establishment and proper management of saving groups, with specific internal rules;

g) If relevant, support FFS group in cooperative establishment and management and in linkage with other professionals of agroforestry product value chains for business opportunities development.

h) Support access to ICS (subsidy) for each targeted farmer family;

i) Ensure regular monitoring mission to assess the respect of agroforestry practices and respects of planted trees,

j) Provide book and protocol for regular monitoring data collection by block farmer leader (see article 3.g), and check, register and analyze their data;

k) Ensure good implementation of this collaboration framework and resolve any problems that may raise;

l) In case of serious damage caused intentionally by a landowner to the planted trees, apply sanction/penalties accordingly to the national regulation;

ARTICLE 5: MONOTORING & EVALUATION AND REPORTING

a. The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities. The baseline tree density (see article 3.a) and the planted agroforestry tree (see 3.c) are registered in the same database by the forest officer.

➢

b. According to article 3.g and 4.j, farmer leaders are collecting on the agroforestry block under their supervision the basic monitoring field data (number of tree per species planted or harvested, volume of wood harvested, % sharing of crop land and yield per season, etc.). These data are checked and registered in the FMES by the forest officer.

➢

➢

c. Regular evaluation mission (at least 1 per 6 months) will be conducted by the Sector and/or the District officer in charge of agroforestry, in collaboration with the TREPA project technical team (in the first years) and with FFS groups representatives. The main results of assessment and recommendation /eventual corrective action plan, will be reported to Cell/Sector/District authorities and to the project team (in the first years).

➢

d. Sector Agronomist in collaboration with forest Extensionists and District Forest Officer should ensure monitoring the implementation of this MoU. They should produce progress report on the implementation of the works planned in this MoU, quarterly report and annual report describing implementation progress and challenges faced in the course of implementation. This report should be submitted to the District and its partners

e. In order to monitor and periodically report about climate change mitigation impacts of planted trees, all the concerned parties (land owners, District and RFA) voluntarily accept to collaborate with the MRV (Monitoring , Reporting and Verification) Team as well as any Third Parties involved, on collecting and reporting relevant data and information on carbon sequestration and reduced emissions.

-

ARTICLE 6. ENTRY INTO FORCE AND DURATION

This MoU enters into force on the date of signing by District, for an indeterminate duration.

Done at Rwamagana (in two original copies).

on: 22/08/2018

For the ABANYAMURAVA FFS group

Mr. HITAYEZU Ferdinand
FFS Facilitator

Signature:

For the District of Rwamagana

Mr. MBONYUMUVUNYI Radjab
Mayor of the District

Signature:

Appendixes

The following documents are annexed to the present specific conditions and are an integral part of the MoU:

Appendix I: List of FFS targeted parcels and related owners/members

Appendix II: Map of the FFS group overall crop land intervention area.

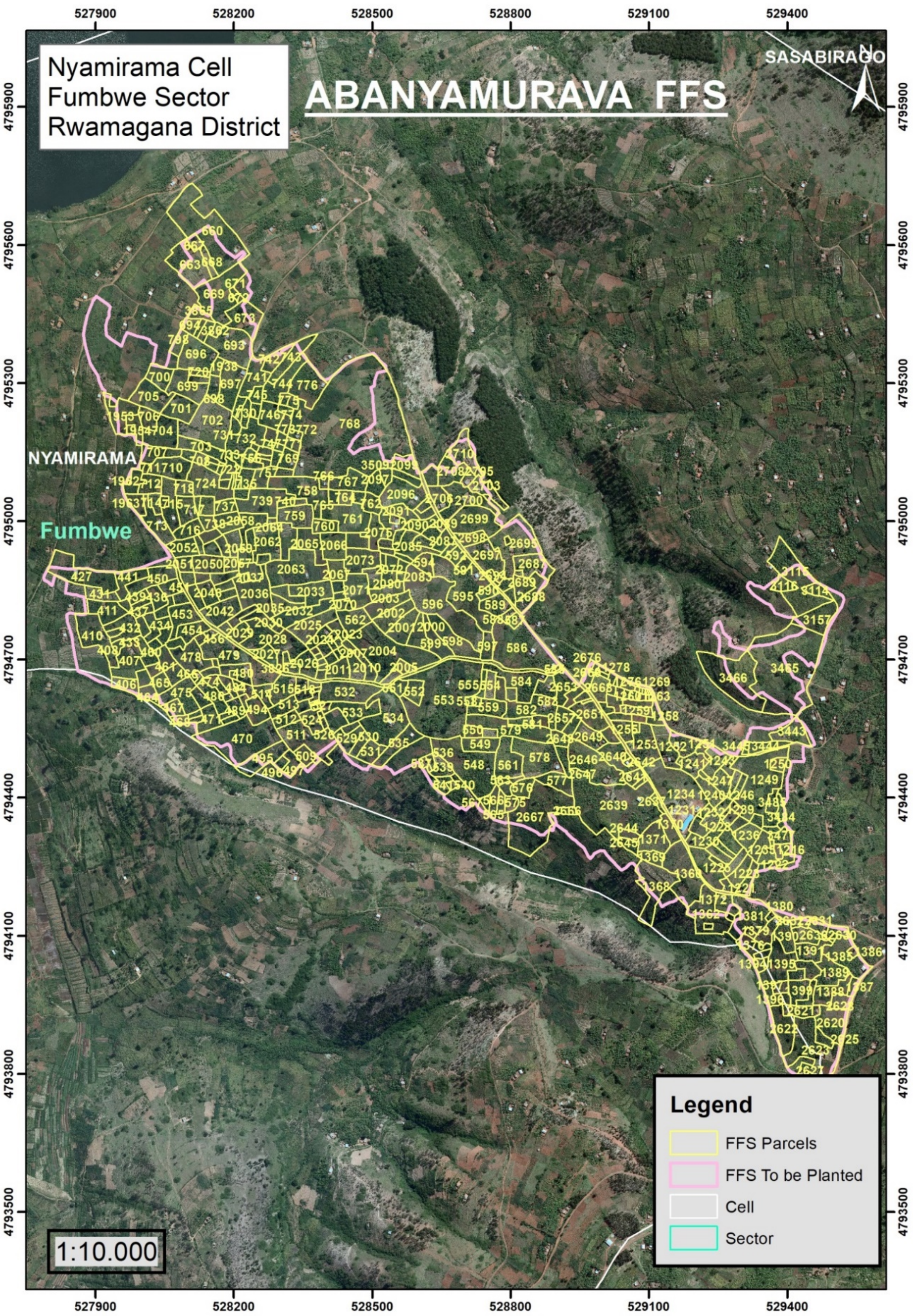
Appendix III: List of species to be planted

APPENDIX No 1: List of FFS targeted parcels and related owners/members

List of FFS targeted parcels and related owners

Internal Code Parcel	ID LAIS Parcel	Ha	Name (s) of land owner(s) (in case of co-owners, all the owners have to complete and sign, using 1 row per owner)	Gender	Signature of member	ID Card	Phone contact

APPENDIX No 2: MAP OF ABANYAMURAVA FFS GROUP OVERALL CROP LAND INTERVETION AREA



APPENDIX No 3: Number of tree to be planted per species

Number of tree to be planted per species

Internal Code Parcel	Tree species 1: Grevillea	Tree species 2: ………	Tree species 3: …………	Tree species 4: Mango	Tree species 5: ………..	Tree species 6: …………..	Tree species 7: ……
1	3		1	1			
2	2	3			1		
3							
4							

REPUBLIC OF RWANDA

RWAMAGANA DISTRICT

Memorandum of Understanding for

RESTORATION AND SUSTAINABLE MANAGEMENT OF SMALL HOLDER WOODLOTS OF THE PFMU OF …….. FUMBWE SECTOR IN RWAMAGANA DISTRICT

Between

The District of RWAMAGANA, represented by Mr **MBONYUMUVUNYI Radjab,** the Mayor of the District,

on one hand,

and

The members of the PFMU of…….. FUMBWE Sector, NYAMIRAMA Cell, represented by Mr.**HITAYEZU Ferdinand**, the designated representative,

on the other

INTRODUCTION

Considering:

- The country priority set in the under revision Green Growth and Climate Resilience Strategy (2021) and in the 2018 National Forest Policy (NFP) and National Forestry Sector Strategic Plan (FSSP), where the restoration of degraded small-holder woodlots through the Private Forest Management Unit (PFMU) approach is highlighted as a key priority to support the effort of the country in the climate change adaptation and mitigation;
- The objective of the TREPA project funded by GCF and implemented by UICN/Enable/RFA in close collaboration with the District authorities, where the restoration in the Eastern Province of degraded small-holder woodlots exposed to soil erosion is one of the key target intervention to contribute to the adaptation of ecosystems to drought and soil erosion/flooding events and increase the resilience of the dependent vulnerable communities to climate change, while contributing to the national effort on C02 sequestration.
- The participatory local landscape restoration plans developed (in the Sector of …., Cell of…) by the TREPA project in collaboration with local communities and authority's representatives, where priority degraded small holder woodlots are identified as to be restored into productive plantation sustainably managed through the PFMU approach;

Rwamagana District and …………… **PFMU** members have agreed on the following:

ARTICLE 1. OBJECTIVE

The objective of this MoU is to define modalities of collaboration, tasks, responsibilities and commitments of the …….. PFMU members and the Rwamagana District.

This MoU describes also all planned activities and specific tasks and responsibilities of each party involved in the woodlot restoration and sustainable management aiming at increasing sustainable wood supply capacity, erosion control, resilience to drought, C02 sequestration and contribution to the community welfare, while reducing the risk of floods in downstream areas of the water catchment.

ARTICLE 2. THE PFMU LOCATION, OWNERS AND REPRESENTATIVES

The PFMU of "…………" is located in the Sector of………………….. (cellule of ………………), in the District of …………………..

The list of the woodlot parcels (with their area, and their Land Administration ID) targeted by the intended restoration and constituting the PFMU named ………….is provided in appendix I, indicating name, ID card number and contact of each land owners. If an owner is living in other remote region, name and contact of its formally designated local representative is provided.

The location map of PFMU's woodlot parcels is given in appendix II. The polygons of parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities.

The assembly of the PFMU land owners (members) held in ….. (location) on the …. (date), designated the PFMU committee members and representatives, as presented in the table below approved by local authorities. This list has been established in respect of the rule of the at least 30% female representation.

List of PFMU committee members and representatives:

Full name	Function in the PFMU group	Signature	Gender	ID card	Phone contact
	Chair				
	FFS facilitator/promotor				
	Etc…				
	….				

<u>ARTICLE 3</u>. PFMU MEMBERS COMMITMENTS and TASKS

All members of the FFS group are understanding their important roles in the contribution to the adaptation of the Eastern Province to the climate change, especially to increase the resilience of their land to drought in dry season and reduce the water run-off and soil erosion during rainy season), while increasing the CO_2 sequestration. Thus each member, on its parcel, is committing to:

l) Participate actively in the sensitization and training activities that will be delivered to their attention, including following items: productive woodlot opportunities to address climate change adaptation and mitigation, productive plantation best practices to adapt to drought and risk of erosion/floods, design and respect of Simplified Forest Management Plan, proper use of ICS, gender issues and solutions, cooperative and saving group establishment and management, etc. All FFS group representative and farmer leaders have to participate in each session;

m) Made all necessary procedures in order to be established and recognized as a cooperative of sustainable management and production of wood products, and establish and manage properly a saving group;

n) With the support of the District forest officer, design the Simplified Forest Management Plan of the newly constituted PFMU (see appendix IV), using the FMES RFA system and according to template and technical modalities instructed by RFA, and make it approved by District;

o) Removed (in the first 6 months) the old exhausted degraded forest and prepare (clearing) the land to prepare it for re-planting. Old stump cannot be removed and have to remain in the soil to avoid its structure disturbance and keep organic matter in the soil.

p) Participate (by the year 1) in the tree seedlings production, planting, and in the establishment of anti-erosive ditches and firebreak (if required), respecting the tree density, species and others specification agreed in annex III). Members will avail the man-power required for these work, with at least 30% female, with specific attention the give job priority to vulnerable.

q) After planting, protect the trees and ensure their proper maintenance (pruning, weeding in year 1 and 2, etc) and proceed with the wood harvesting in strict respect of the technical prescription provided in the approved SFMP (appendix III). PFMU forest owners will have to request to the District the necessary cut permit before any harvesting. The District will deliver the cut permit (using the FMES system) in the strict respect of the planning and modalities set in the SFMP. Any change in the silviculture/harvesting plan and modalities of the SFMP has to be formally submitted by the cooperative to the District authority, and this last one can approve it only if the sustainability and profitability of the PFMU is not negatively affected;

r) At any time when a part of the forest is harvested or damaged and accordingly to the SFMP, ensure re-investment of part of the benefit in silviculture operations (replanting, beating-up, cleaning/weeding, thinning, etc.).

➢

s) Acquire (in the first 12 months, with the support of local saving group and the TREPA subsidy) and use properly an improved ICS (at least 1 per household) adapted to their context, to be selected among the list recommended by the TREPA project based on the type of fuel use, on the family size, on cooking habits and on financial capacity. Any damaged ICS has to be replaced and the household has to use permanently at least 1 ICS.

➢

t) Properly register (in a dedicated book according to a well-defined protocol provided by the project) any forestry activity implemented in the PFMU (maintenance, pruning, replanting, harvesting, etc.);

u) Participate in the elaboration and implementation of the **gender principle rules and action plan** for the cooperative;

v) Participate in the regular monitoring /assessment (tree counting, etc.) of the restored woodlots conducted by the Sector/District officer.

w) Member are responsible for the permanent control and protection of trees newly planted in their own parcel, but also collectively in the entire PFMU area. Members must detect all non-respect of the SFMP prescription and should address a warning to the concerned land owner. In case of recidivism or negative reaction from one land owner, the member should raise the issue and find solution by amicable way inside the committee. If necessary, the representative of the PFMU cooperative will request the support of the local authorities including cell and sector levels for final solution/resolution. In case of serious damage caused intentionally by a landowner to the planted trees, District can apply sanction/penalties accordingly to the national regulation;

x) Develop detailed internal rules for the cooperative that can support effectively the implementation and respect of the SFMP prescription. These internal rules, that will be approved by local authorities, will have to integrate:

   i. a written ‘statement of intent’ showing the intent and ownership of the relevant beneficiaries to implement the proposed activities being requested in order to address the specific vulnerability(ies) and their commitment to participate in the activities until their finalization;

   ii. The benefit sharing mechanisms between members;

   iii. The management rules for the saving group;

   iv. Principle to ensure gender equity in the cooperative management;

   v. Internal penalties procedures in case of failure of a member.

ARTICLE 4. TASKS AND RESPONSIBILITIES OF THE DISTRICT AND SUPPORT PARTNERS

The District, with the support of the TREPA project and implementing partners, is committing to:

a) Conduct sensitization session on woodlot restoration opportunities to restore degraded land, increase the resilience to drought, reduce the exposure to soil erosion, and contribute to C02 sequestration, address climate change adaptation and mitigation;

b) Support the participatory identification and mapping of parcel and owners to be targeted by the restoration, and in the elaboration and signature of the present MoU. The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities.

c) Support PFMU in the design and approval of the Simplified Forest Management Plan of the newly constituted PFMU, according to template and technical modalities instructed by RFA and using the FMES system;

➢

d) Contract and supervise/monitor a professional service provider to produce quality tree seedlings, and conduct/supervise the tree planting, the anti-erosive/firebreak establishment and the maintenance activities according target and specification provided in annex III.

The service provider will use in priority the man-power (at least 30% female) from PFMU member's families, giving priority to the most vulnerable based on list provided by local authorities.

e) Ensure the capacity building (training session and on the job technical advice) of the PFMU members in following items;

   i. Productive plantation best practices to adapt to drought and risk of erosion/floods;

   ii. Design and respect of Simplified Forest Management Plan,

   iii. Proper choice and use of ICS,

   iv. Gender issues and solutions, with establishment of a gender action plan for the group

   v. Saving group establishment and management

   vi. Cooperative opportunities, rules and establishment

f) Support establishment and proper management of saving groups, with specific internal rules;

g) Support PFMU in cooperative establishment and management and in linkage with other professionals of agroforestry product value chains for business opportunities development.

h) Support access to ICS (subsidy) for each targeted farmer family;

i) Ensure regular monitoring mission to assess the respect of the SFMP prescription,

j) Provide book and protocol for regular monitoring data collection by PFMU leader (see article 3.i), and check, register and analyze their data;

k) Ensure good implementation of this collaboration framework and resolve any problems that may raise;

l) In case of serious damage caused intentionally by a landowner to the planted trees, apply sanction/penalties accordingly to the national regulation;

ARTICLE 5: MONOTORING & EVALUATION AND REPORTING

f. The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities. The planted tree (see 3.c) and the approved SFMP are also registered in the same database by the forest officer.

➢

g. According to article 3.i and 4.j, PFMU leaders are collecting the basic monitoring field data (planted trees, volume of wood harvested, etc). These data are checked and registered in the FMES by the forest officer.

➢

h. Regular evaluation mission (at least 1 per 6 months) will be conducted by the Sector and/or the District officer in charge of forests, in collaboration with the TREPA project technical team (in the first years) and with PFMU groups representatives. The main results of assessment and recommendation /eventual corrective action plan, will be registered into the FMES system and reported to Cell/Sector/District authorities and to the project team (in the first years).

➢

i. Sector Agronomist in collaboration with forest Extensionists and District Forest Officer should ensure monitoring the implementation of this MoU. They should produce progress report on the implementation of the works planned in this MoU, quarterly report and annual report describing implementation progress and challenges faced in the course of implementation. This report should be submitted to the District and its partners

➢

j. In order to monitor and periodically report about climate change mitigation impacts of planted trees, all the concerned parties (land owners, District and RFA) voluntarily accept to collaborate with the MRV (Monitoring , Reporting and Verification) Team as well as any Third Parties involved, on collecting and reporting relevant data and information on carbon sequestration and reduced emissions.

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ARTICLE 6. ENTRY INTO FORCE AND DURATION

This MoU enters into force on the date of signing by District, for an indeterminate duration.

Done at Rwamagana (in two original copies).

on: 22/08/2018

For the …… PFMU

Mr. HITAYEZU Ferdinand
Representative

Signature:

For the District of Rwamagana

Mr. MBONYUMUVUNYI Radjab
Mayor of the District

Signature:

Appendixes

The following documents are annexed to the present specific conditions and are an integral part of the MoU:

Appendix I: List of the PFMU parcels and related owners/members

Appendix II: Map of the PFMU parcels.

Appendix III: Forestry work prescription and target per block (1 block is a group of neighbouring parcels where the same prescriptions apply)

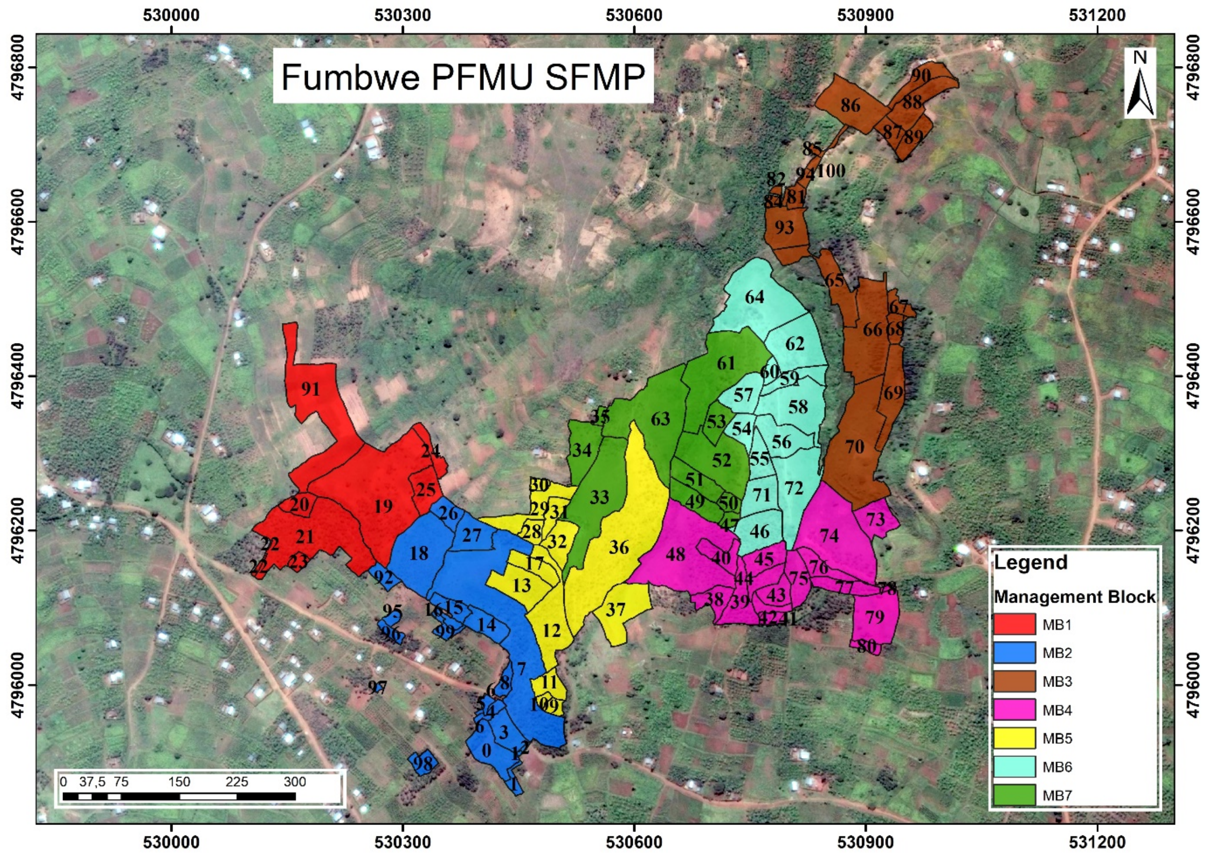
Appendix IV: approved SFMP

APPENDIX No 1: List of PFMU parcels and related owners/members

List of FFS targeted parcels and related owners

Internal Code Parcel	ID LAIS Parcel	Ha	Name (s) of land owner(s) (in case of co-owners, all the owners have to complete and sign, using 1 row per owner)	Gender	Signature of member	ID Card	Phone contact

APPENDIX No 2: MAP OF **PFMU parcels**



APPENDIX No 3: Target and prescription for the forestry work to be done in the PFMU

Block n°	Code of concerned Parcels	Tree species to be planted	Tree planting density	Meters of anti-erosive ditches	Meters of fire break	Weeding year 1	Weeding year 2
1	1 to 10	Eucalyptus camaldulensis	2500	50	0	yes	no
2	11 to 25						
3							
4							

Block n°	Code of concerned Parcels	Tree species to be planted	Tree planting density	Meters of anti-erosive ditches	Meters of fire break	Weeding year 1	Weeding year 2

APPENDIX No 4: approved SFMP

See template already shared

REPUBLIC OF RWANDA

RWAMAGANA DISTRICT

Memorandum of Understanding for

SUPPORTING THE SILVOPASTORAL PLAN DEVELOPMENT ON THE …………………. RANCH

SECTOR OF……….IN ………………..DISTRICT

Between

The District of RWAMAGANA, represented by Mr **MBONYUMUVUNYI Radjab,** the Mayor of the District,

on one hand,

and

The Ranch …….. of FUMBWE Sector, NYAMIRAMA Cell, represented by Mr.**HITAYEZU Ferdinand**, the designated ranch representative,

on the other

INTRODUCTION

Considering:

- The country priority set in the under revision Green Growth and Climate Resilience Strategy (2021), the 2018 National Forest Policy (NFP) and National Forestry Sector Strategic Plan (FSSP), and the PSTA-4 (Strategic Plan for the Agricultural Sector), where the restoration of very degraded shrubland used for cattle grazing through the establishment of silvopastoral plans, is highlighted as a key priority to support the effort of the country in the climate change adaptation and mitigation;
- The objective of the TREPA project funded by GCF and implemented by UICN/RFA in close collaboration with the District authorities, where the establishment of silvopastoral plan in the Eastern Province ranches exposed to drought hazard and soil erosion, with the use of best silvopastoral practices (improved forage and increased fodder trees, grazing rotation, Ankole shifted to cross breed dairy cows, etc), is one of the key targeted intervention to increase the resilience of ecosystems and dependent vulnerable communities to climate change;
- The participatory local landscape restoration plans developed (in the Sector of …., Cell of…) by the TREPA project in collaboration with local communities and authority's representatives, where priority degraded ranch land areas with low tree density are identified as to be restored through best silvopastoral practices;

……………..District and **the Ranch of……….** have agreed on the following:

ARTICLE 1. OBJECTIVE

The objective of this MoU is to define modalities of collaboration, tasks, responsibilities and commitments of the …………ranch group members and the ……….. District.

This MoU describes also all planned activities and specific tasks and responsibilities of each party involved in the implementation of the silvopastoral activities aiming at increasing tree cover, erosion control, resilience to drought, dairy production and contribution to the community welfare.

ARTICLE 2. THE RANCH LOCATION, OWNERS AND REPRESENTATIVES

The ranch of "…………" is located in the Sector of………………….. (cellule of ………………), in the District of ………………….

The list of land parcels constituting the ranch (with their area, and their Land Administration ID) is provided in appendix I, indicating name, ID card number and contact of each land owners. If an owner is living in other remote region, name and contact of its formally designated local representative is provided.

The location map of parcel of the ranch is given in appendix II.

The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities.

The assembly of the ranch's parcel owners, called members, held in ….. (location) on the …. (date), designated the Ranch committee representatives, as presented in the table below approved by local authorities. This list has been established in respect of the rule of the at least 30% female representation.

List of the Ranch committee representatives:

Full name	Function in the FFS groups	Parcel concerned	Signature	Gender	ID card	Phone contact
	Chair	**All**				
	FFS facilitator/promotor	**All**				
	Etc…					
	Farmer leader block 1	**Parcel 1,..3…15**				
	Farmer leader block 2	**Parcel 16, etc,..**				
	….					

<u>ARTICLE 3</u>. RANCH's MEMBERS COMMITMENT and TASKS

All members of the ranch are understanding their important roles in the contribution to the adaptation of the Eastern Province to the climate change, especially to increase the resilience of their land to drought in dry season and reduce the water run-off and soil erosion during rainy season), while contributing to the reduction of C02 emission. Thus each member, on its parcel, is committing to:

y) Participate actively in the sensitization and training activities that will be delivered to their attention, including following items: silvopastoral opportunities to address climate change adaptation and mitigation, silvopastoral best practices adapted to their context, silvopastoral tree planting and maintenance, proper use of ICS, gender issues and solutions, saving group establishment and management, etc.;

z) Participate in the design of the silvopastoral plan for their ranch, with provision of the very detail technical prescription (carrying capacity, fruit/fodder tree density, grazing rotation and paddocking, etc);

aa) Provide baseline (in the first 6 months) information including:

   i. number of existing tree/shrubs per species,

   ii. number of tree to be planted per species (filling the appendix III),

   iii. type of planting (boundary planting, intercropping, etc.);

bb) With the support of the project, ensure the planting of silvopastoral trees (by the year 2) at an average density of …….trees per ha, with … % fruit trees and ….% fodder trees (see list of species in appendix III). Farmers will avail the man-power required for tree planting starting from tree seedling production to tree planting and maintenance. At least 30% of the man-power should be female, with specific attention the give job priority to vulnerable.

cc) After planting, protect the trees and ensure their proper according training and technical guidance provided by the extension services;

dd) Ensure the replacement (re-planting) of any harvested mature tree to keep the tree density at the whished level (……. trees/ha);

ee) If required and according to the approved silvopastoral plan, replace …X…Ankole cows by …Y .. cross breed dairy cows, to reduce the carrying to the optimal capacity fixed at …..Z … heads per ha.

ff) If required and according to the approved silvopastoral plan, with the support of partner's project, invest in the management of water access facilities for cattle's and in establishment of natural fences to demarcate grazing parcels (paddocking);

gg) Acquire (in the first 12 months, with the support of local saving group and the TREPA subsidy) and use properly an improved ICS (at least 1 per household) adapted to their context, to be selected among the list recommended by the TREPA project based on the type of fuel use, on the family size, on cooking habits and on financial capacity. Any damaged ICS has to be replaced and the household has to use permanently at least 1 ICS.

   ➢

hh) Designated ranch leader will provide monthly data on ICS use and related wood consumption, on the wood /fodder /forage harvesting in the parcels, on the herd evolution and diary production, etc. (to be registered in a dedicated book according to a well-defined protocol provided by the project);

ii) Participate in the elaboration and implementation of the **gender principle rules and action plan** for the ranch;

jj) Participate in the regular monitoring /assessment (tree counting, etc.) of the restored silvopastoral ranch conducted by the Sector officer.

kk) Ranch member are responsible for the permanent control and protection of trees newly planted or already existing in their own parcel, but also collectively in the entire area of intervention of the ranch. Members must detect all non-respect of the silvopastoral plan and prescriptions and should address a warning to the concerned farmer. In case of recidivism or negative reaction from one land owner, the member should raise the issue and find solution by amicable way inside the committee. If necessary, the representative of the ranch will request the support of the local authorities including cell and sector levels for final solution/resolution. In case of serious damage caused intentionally by a farmer, District can apply sanction/penalties accordingly to the national regulation;

ll) Develop detailed internal rules for the ranch that can support effectively the implementation and respect of above commitment. These internal rules, that will be approved by local authorities, will have to integrate a written 'statement of intent' showing the intent and ownership of the relevant beneficiaries to implement the proposed activities being requested in order to address the specific vulnerability(ies) and their commitment to participate in the activities until their finalization;

ARTICLE 4. TASKS AND RESPONSIBILITIES OF THE DISTRICT AND SUPPORT PARTNERS

The District, with the support of the TREPA project and implementing partners, is committing to:

m) Conduct sensitization session on silvopastoral opportunities to restore degraded ranch land, increase the resilience to drought, reduce the exposure to soil erosion, and contribute to C02 sequestration, to address climate change adaptation and mitigation;

n) Support the participatory identification and mapping of ranch parcel and owners to be targeted by the silvopastoral plan, and in the elaboration and signature of the present MoU. The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities.

o) Support the ranch members in the baseline assessment of their parcel (see article 3.c)

p) Support the participatory design and approval of silvopastoral plan, in line with the District Land Use Plan and other relevant sectorial plans (see appendix 4);

q) Contract and supervise/monitor a professional service provider to produce quality silvopastoral and fruit tree seedlings, and conduct/supervise the planting and maintenance activities (…. tree/ha, with … % fruit trees and … % fodder trees, see list in appendix III). The service provider will use in priority the man-power (at least 30% female) from the ranch member's families, giving priority to the most vulnerable based on list provided by local authorities.

r) Ensure the capacity building (training session and on the job technical advice) of the ranch members on;

i. Silvopastoral plan design and best practices adapted to their context,

ii. Silvopastoral and fruit tree planting and maintenance,

iii. Proper choice and use of ICS,

iv. Gender issues and solutions, with establishment of a gender action plan for the group

v. Saving group establishment and management

vi. Cooperative opportunities, rules and establishment

s) Support establishment and proper management of saving groups, with specific internal rules;

t) If relevant, support ranches in cooperative establishment and management and in linkage with other professionals of the dairy/fodder/forage value chains for business opportunities development.

u) Support access to ICS (subsidy) for each targeted farmer family;

v) Ensure regular monitoring mission to assess the respect of silvopastoral plan and best practices prescription,

w) Provide book and protocol for regular monitoring data collection by farmer leader (see article 3.j), and check, register and analyze their data;

x) Ensure good implementation of this collaboration framework and resolve any problems that may raise;

y) In case of serious damage caused intentionally by a landowner, apply sanction/penalties accordingly to the national regulation;

ARTICLE 5: MONOTORING & EVALUATION AND REPORTING

k. The polygons of targeted parcels and the list of owners are registered by the District Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities. The baseline tree density (see article 3.c) and the planted tree are registered in the same database by the forest officer.

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l. According to article 3.j and 4.j, farmer leaders are collecting the basic monitoring field data (number of tree per species planted or harvested, volume of wood/fooder/forage harvested, dairy production, etc.). These data are checked and registered in the FMES by the forest officer.

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m. Regular evaluation mission (at least 1 per 6 months) will be conducted by the Sector and/or the District officer in charge of agriculture, in collaboration with the TREPA project technical team (in the first years) and with FFS groups representatives. The main results of assessment and recommendation /eventual corrective action plan, will be reported to Cell/Sector/District authorities and to the project team (in the first years).

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n. Sector Agronomist in collaboration with forest Extensionists and District Forest Officer should ensure monitoring the implementation of this MoU. They should produce progress report on the implementation of the works planned in this MoU, quarterly report and annual report describing implementation progress and challenges faced in the course of implementation. This report should be submitted to the District and its partners

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o. In order to monitor and periodically report about climate change mitigation impacts of planted trees, all the concerned parties (land owners, District and RFA) voluntarily accept to collaborate with the MRV (Monitoring , Reporting and Verification) Team as well as any Third Parties involved, on collecting and reporting relevant data and information on carbon sequestration and reduced emissions.

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ARTICLE 6. ENTRY INTO FORCE AND DURATION

This MoU enters into force on the date of signing by District, for an indeterminate duration.

Done at Rwamagana (in two original copies).

on: 22/08/2018

For the …… Ranch

Mr. HITAYEZU Ferdinand
Representative

Signature:

<u>For the District of Rwamagana</u>

Mr. MBONYUMUVUNYI Radjab
Mayor of the District

Signature:

Appendixes

The following documents are annexed to the present specific conditions and are an integral part of the MoU:

Appendix I: List of Ranch's parcels and related owners/members

Appendix II: Map of the ranch's parcel.

Appendix III: List of tree species to be planted

Appendix IV: Approved silvopastoral plan

APPENDIX No 1: List of ranch's parcels and related owners/members

List of FFS targeted parcels and related owners

Internal Code Parcel	ID LAIS Parcel	Ha	Name (s) of land owner(s) (in case of co-owners, all the owners have to complete and sign, using 1 row per owner)	Gender	Signature of member	ID Card	Phone contact

APPENDIX No 2: MAP OF **…………Ranch**

APPENDIX No 3: Number of tree to be planted per species

Number of tree to be planted per species

Internal Code Parcel	Tree species 1: Grevillea	Tree species 2: ………	Tree species 3: …………	Tree species 4: Mango	Tree species 5: ………..	Tree species 6: …………..	Tree species 7: ……
1	3		1	1			
2	2	3			1		
3							
4							

Appendix IV: Approved silvopastoral plan

REPUBLIC OF RWANDA

RWAMAGANA DISTRICT

Memorandum of Understanding for

THE MANAGEMENT OF ROAD/RIVER SIDES PLANTATION"

DISTRICT OF ………………,

SECTOR OF …………...

FARMER'S ASSEMBLY NAME: ………………………

Between:

District of……………..........…., Represented by Mr/Madam……………..., The Mayor (hereinafter referred to as "the District")

and

Assembly of farmers whose farms touch protected public land where plantation are established (hereinafter referred to as “Assembly”), represented by Mr /Madam…………………., ID:................., residing in ....Village,.............Cell,...................Sector of ....District

INTRODUCTION

Considering:

- The country priority set in the under revision Green Growth and Climate Resilience Strategy (2021) and the 2018 National Forest Policy (NFP) and National Forestry Sector Strategic Plan (FSSP), which are recommending the restoration and sustainable management of public land under special protection measures (road/river side) in collaboration with local Community Vigilance Committees (CVC) to support the effort of the country in the climate change adaptation and mitigation;
- The objective of the TREPA project funded by GCF and implemented by UICN/RFA in close collaboration with the District authorities, where the restoration/tree planting and sustainable management of degraded river/road sides exposed to soil erosion is one of the key intervention to contribute to the adaptation of ecosystems to drought and soil erosion/flooding events and increase the resilience of the dependent vulnerable communities to climate change, while contributing to the national effort on C02 sequestration.
- The participatory local landscape restoration plans developed (in the Sector of …., Cell of…) by the TREPA project in collaboration with local communities and authority's representatives, where priority road/rive sides / are identified as to be restored through the establishment of multipurpose protective tree plantation in collaboration with local CVC;

Rwamagana District and …………… **ASSEMBLY** of farmers have agreed on the following:

Article 1: Objective

The objective of this MoU is to define modalities of collaboration, tasks, responsibilities and commitments of above mentioned Parties in plantation and sustainable management of multipurpose protective tree plantation on road/river sides of "………………..…", aiming at increasing sustainable wood supply capacity, erosion control, resilience to drought, C02 sequestration and contribution to the community welfare, while reducing the risk of floods in downstream areas of the water catchment.

ARTICLE 2. THE ROAD/RIVE LOCATION and the CONCERNED ASSEMBLY of FARMERS

The targeted road/river side of "………..." is located in the Sector of………………….. (cellule of ………………), in the District of ………………….. (see map of the road/river in annex 4, with its distinctive sections)

The list of the parcels (with their Land Administration ID) adjoining the protected road/river side is provided in annex 2, indicating name and ID card number of each land owners constituting the Assembly of Farmers concerned by the management of the intended road /river side plantation, and established according terms presented in annex 1.

As described in annex I, the concerned Assembly of Farmer designated the Community Vigilance Committee members and representatives, which is approved by local authorities.

This committee has been established in respect of the rule of the at least 30% female representation.

Article 3: Tasks and responsibilities of Assembly 's members

All members of the Assembly are understanding their important roles in the contribution to right management of the protective plantation established on the road/river side, and their contribution to the adaptation of the Eastern Province to the climate change, especially to increase the resilience of their land to drought in dry season and to reduce the water run-off and soil erosion during rainy season, while increasing the CO_2 sequestration. Thus members, on section road touching their parcels, are committing to:

a) Participate actively in the sensitization and training activities that will be delivered to their attention, including following items: protective plantation opportunities to address climate change adaptation and mitigation, tree plantation best practices to adapt to drought and risk of erosion/floods, gender issues and solutions, etc;
b) Participate to the establishment of the Assembly of the farmers whose farms touch the road side, election of assembly representative(s) and members (at least 5) of the Vigilance Committee (VC) in charge of enforcement and respect of MoU prescriptions, and signing meeting minutes establishing the Assembly and the VC;
c) While signing the meeting minutes establishing the Assembly of farmers (annex 1), they commit to respect any prescription of this MoU;
d) When require, put in place internal rules and regulations regarding establishment and management of farmer's assembly and of the CVC and guiding implementation of all planned activities; these rules have to ensure gender equality and special consideration to ensure commitment of women;
e) Participate (avail man-power, with at least 30% women and with priority to vulnerable) to the tree seedling production and planting works, according specification provided in article 5;
f) Ensure weeding, protection and guarding of any trees planted on the border of their parcels;
g) Respect and implement guidelines (see Article 5, 6 and 7) regarding pruning, harvesting and benefit sharing modalities of products coming from trees planted on the road side;
h) Replant/replace immediately any tree planted on the road side which have been damaged by one of the farmers of due to their negligence;
i) If replanting after planned final harvesting is under the responsibility of the Assembly (see article 7 below), replant/replace immediately any harvested trees in their own parcels.
j) Participate in the elaboration and implementation of the gender principle rules and action plan for the Assembly;

Designated Vigilance Committee members have the following tasks and responsibilities:

k) Ensure regular awareness/sensitization and remind of farmers on understanding and on the content of the MoU, and communicate any technical guidance/prescription which should be provided by the Assembly or by local Authorities;
l) Ensure permanent control of respect of MoU's prescriptions by every concerned farmer, especially protection, maintenance and pruning/harvesting/replanting of planted trees according to modalities set in this MoU;
m) Recall/advertise on the field any farmers which is not respecting strictly the MoU's prescriptions;
n) In case of serious breach, report immediately cases to the Assembly which is responsible to instruct the concerned farmer on immediate corrective measures he has to implement.
o) Contribute to the collection of information on farms touching the concerned roadside (owner name, gender and contact), estimation of the existing (baseline) tree density (in number of trees/km) per section, and participation in the definition per section and for both sides of the road, of the number of lines, the tree species and the spacing recommended for planting (see article 5);
p) Coordinate activities on planted trees on the road/river side (pruning, harvesting, re-planting, weeding, etc.) and record (in site logbook) related information and any relevant event (illegal cut, accidental damage, etc.);
q) For activities under the Assembly responsibility, coordinate farmers to mobilize necessary man-power and supervise/guide them in implementing protection, maintenance, pruning, harvesting, re-planting, etc.;
r) Participate in any training session which may be organized to support Assembly and VC in good implementation of the MoU;

In case of no respect of planted tree by farmer(s):

In case of recidivism or negative reaction from concerned farmers, the Assembly representative(s) should request the support of the sector authorities for final solution/resolution and instruction of corrective/punishment measures. In case of serious damage caused intentionally by a landowner to the planted trees, District can apply sanction/penalties according to the national regulation, such as the replacement of damages trees when they are still young (less than 2 years), or payment of a fine equivalent to the current value of the damaged trees if trees are older then 2 years. Additional penalties to someone who make any damages to environment may also be applied.

Article 4: Duties and Responsibilities of the District and partners

District authorities, with the support of TREPA project and partners, have the following duties and responsibilities:

a) Conduct awareness/sensitisation campaign targeting road/river side neighbouring farmers on importance of good protection and maintenance of planted trees to increase the resilience to drought, reduce the exposure to soil erosion, and contribute to C02 sequestration;
b) Facilitate establishment of Assembly of farmers and of CVC, contribute to the elaboration of the MoU and making it signed;
c) Support the CVC in the elaboration and implementation of the gender principle rules and action plan for the Assembly;
d)
e) Contract and supervise/monitor a professional service provider to produce quality tree seedlings, and conduct/supervise the tree planting according target and specification provided in article 5. The service provider will use in priority the man-power (at least 30% female) from the Aseemby member's families, giving priority to the most vulnerable based on list provided by local authorities.
f) Facilitate and ensure general supervision/control/final reception of planting/harvesting activities supported by contracted service provider;
g) Ensure permanent technical guidance/remind to the Assembly/VC on how to manage planted trees according to MoU prescriptions;
h) Provide book and protocol for regular monitoring data collection by CVC (see article 3.p), and check, register and analyse their data;
i) Ensure regular M&E of planted tree and respect of MoU prescriptions by Assembly/VC (including respect of benefit sharing mechanisms);
j) When required, support Assembly/VC in conflict resolution;
k) To put in place sanctions in case of any damages on planted trees caused by farm owners;
l) To provide support in seeking market for road side tree products

Article 5: <u>MONOTORING & EVALUATION AND REPORTING</u>

p. The road/river plantation, the list of neighboring farmers and CVC members are registered by the Sector Forest Officer into the Forest Monitoring and Evaluation System (FMES) developed by the Rwanda Forestry Authorities. The baseline exiting tree and the new planted tree are registered in the same database by the forest officer.

q. According to article 3.p and 4.f, CVC leaders are collecting the basic monitoring field data (planted trees, volume of wood harvested, etc). These data are checked and registered in the FMES by the Sector forest officer.

r. Regular evaluation mission (at least 1 per 6 months) will be conducted by the Sector and/or the District officer in charge of forests, in collaboration with the TREPA project technical team (in the first years) and with CVC members. The main results of assessment and recommendation /eventual corrective action plan, will be registered into the FMES system and reported to Cell/Sector/District authorities and to the project team (in the first years).

s. Sector Agronomist in collaboration with forest Extensionists and District Forest Officer should ensure monitoring the implementation of this MoU. They should produce progress report on the implementation of the works planned in this MoU, quarterly report and annual report describing implementation progress and challenges faced in the course of implementation. This report should be submitted to the District and its partners

➢

t. In order to monitor and periodically report about climate change mitigation impacts of planted trees, all the concerned parties (land owners, District and RFA) voluntarily accept to collaborate with the MRV (Monitoring , Reporting and Verification) Team as well as any Third Parties involved, on collecting and reporting relevant data and information on carbon sequestration and reduced emissions.

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Article 5. Baseline and Planned afforestation works in this road/river side

The already existing trees counted in 20…. with the collaboration of the Assembly, by road section (see map in annex 4), is presented below:

		Existing road side trees (baseline)					
		Tree species 1		Tree species 2		Other species	
Road section	Lenght (m)	Name	Nb Tree/km	Name	Nb Tree/km	Other	Nb Tree/km
A							
B							
C							
D							
E							
F							

After assessment with the Assembly, the trees to be planted (20….-20….) per section for both side of the road/river and for each line are foreseen as follow:

	Trees to be planted (2018-2020)											
	Side 1						Side 2					
	Line 1		Line 2		Line 3		Line 1		Line 2		Line 3	
Road section	Species	Spacing (m)	Species	Spacing (m)	Species	Spacing (m)	Species	Spacing (m)	Species	Spacing (m)	Species	Spacing (m)
A												
B												
C												
D												
E												
F												

The spacing between line 1 and line 2 should be ….. m. The spacing between line 2 and line 3 should be …… m.

After joint final reception of planting works (made and signed by District Forest Officer and representative of service provider and of Assembly), number of trees truly planted on the field per road section will be provided in the table constituting **the annex 3** of this MoU.

Article 6. Technical specification for maintenance, pruning and harvesting

- ***Protection, guarding and weeding of planted tree by farmers of the Assembly***: farmers have to ensure protection of planted trees against livestock damage (control/guarding of animals or vegetal fence surrounding the young plants if required) and protect them against removal during surrounding crops harvesting and land preparation for cropping. Farmers have to ensure proper weeding by removing any invasive vegetation threatening young seedling in a circle of 0.5m radius around the young planted trees.
- ***Pruning by farmers on the Assembly***: farmers have to ensure pruning according to following modalities:

Species	Pruning type	Year	Technical prescriptions
Grewillea	1st pruning	2024	Only on first 2 m height
	2nd pruning	2028	Only on first 3 m height
	next pruning	Every 3 years	Removal of maximum 50% of branches, without touching the main top branches
	1st pruning		
	2nd pruning		
	next pruning		

	1st pruning		
	2nd pruning		
	next pruning		

Branches obtained from pruning are the property of farmers directly neighbouring the planted road side trees.

- ***Harvesting***: harvesting has to be done according to following modalities
  - Harvesting has to be conducted by the owner of the planted road side tree (see property of trees in article 7 below);
  - Final harvesting should be done only when:
    - The trees are mature and have to be harvested (in 2038 for Grewillea, in …. for ….. , etc);
    - Or at any time when MININFRA/RWFA/District require removal of the trees for road management/works/infrastructure purpose.
  - Before harvesting, the owner of the trees (RWFA, District or Assembly) has to required official cut permit to District (for District Road) or to RWFA (National State Road).
  - When required by the Assembly, only one cut permit for the entire part of the road side trees managed by the Assembly can be delivered (1 permit for the 5 km), avoiding splitting of harvesting over the years.

Article 7: Benefit sharing for road side tree products

Before harvesting, the farm owners are allowed to use silviculture products coming from trees planted (from pruning) in their respective farms touching roads. But these should be in full respect of technical norms provided in this MoU (article 6) and /or by the forest officer/agronomist of the sector.

Where farm owners have got compensation due to expropriation (national State roads, some of District Roads class 1), planted trees are belonging to the State for national State road or to the District for District roads. Harvesting is decided and conducted under the authority of the RWFA/District. Eventual benefit sharing mechanism of the harvested products with the Assembly or compensation mechanisms for the good maintenance of trees may be instructed through a ministerial decree to be published by the minister that have forest in his attribution. These benefit sharing/compensation mechanisms cannot be proceeded without publication of these ministerial instruction.

Where farm owners do not get compensation (District road class 1 and secondary Roads), planted trees are belonging to the farmers owning the parcels where trees have been planted on their borders. Harvesting is conducted under the authority of Assembly, after requesting cut permit to the District and following instruction of article 6 above. Concerned farmers owning trees will get …..% of total harvest after paying the associated tax as it has been set by authorised organs, then the remaining …..% will be given to the Community Vigilance Committee for control/guarding/communication costs and for organizing re-planting campaigns.

Article 8: Legal quality of the MoU

The Parties acknowledge that this MoU is for collaboration and shall be governed by the laws of Republic of Rwanda.

Article 9: Entry into Force and duration

This MoU inters into force on the date of signature by the District, and remain valid for unknown period. If one party need to change or adjust some of articles in this MoU, a written consent should be addressed to the second part explaining clearly what to be changed and why; then both parties meet, write and sign minutes showing their full agreement about articles to be changed and reason behind. Fail to come up with full agreement, the parties call upon the upper level government institution (Province) to intervene and when issues persist, competent tribunal come in.

Article 10: Counterparts

***This MoU is executed in four counterparts, each of which shall be deemed an original, and both of which together shall constitute one and the same instrument*.**

For the District	**For the Assembly**
Date: ……………………… Signature: …………………. Mr/Madam: …………………………….. The Mayor of Rwamagana District	Date : ………………………. Signature: …………………. Mr/Madam: …………………………….. President of Assembly

ANNEX I.

Minute of the meeting establishing the Assembly of farmer and nominating the Vigilance Committee for the road side tree plantation of "………………………………"

Done the ……(date)…………2018 at (venue)……………………. (District of…………, Sector of…………)

After discussion between all farm owners whose plots buffer the selected road/river;……………..… (see map in annex 4), the following decisions are taken:

Each farm owner agreed on establishment of what is called "**the Assembly of farmers of ……………(name)",** which is constituted by each farmers signing the list below (see annex II)

Each farm owner agreed upon all terms and conditions stipulated in this MoU related to maintenance and protection of trees planted on road/river side; by signing on the list below (see annex II).

The Assembly of farm owners designated Mr/Madam ……………to represent them in signature of MoU between the assembly and the District of Rwamagana, and for any administrative procedure which required signature of a representative of the Assembly.

The Assembly put in place their Community Vigilance Committee as follows:

Community Vigilance Committee composition

N°	Name	Signature	Id Card	Phone umber	Function and Road section (see map in annex 4) under his/her supervision

N°	Name	Signature	Id Card	Phone umber	Function and Road section (see map in annex 4) under his/her supervision

Annexe II.

List of farm owners whose farms buffer the road/river of ……….…………..,

constituting "the Assembly of farmers"

N°	Name of farm owner	Signature of farm owner	Id CARD	ID of farmer parcel

N°	Name of farm owner	Signature of farm owner	Id CARD	ID of farmer parcel

N°	Name of farm owner	Signature of farm owner	Id CARD	ID of farmer parcel

N°	Name of farm owner	Signature of farm owner	Id CARD	ID of farmer parcel

ANNEX 3: Table of number of trees truly planted on the road side (after final reception of planting works)

Date of planting works final reception: …………..

	Total Nb of trees trully planted (2018-2020)					
	Tree species 1		Tree species 2		Tree species 3	
Road section	Name	Nb	Name	Nb	Name	Nb
A						
B						
C						
D						
E						
F						
Total						

Annex 4: Map of the road/river side to be managed in collaboration with the Assembly of farmers, with sections.