REPUBLIC OF RWANDA





CONSULTANCY SERVICES TO CONDUCT THE BASELINE STUDY FOR THE PROJECT "BUILDING THE CAPACITY OF RWANDA'S GOVERNMENT TO ADVANCE THE NATIONAL ADAPTATION PLANNING PROCESS"

Final REPORT

Submitted to:

RWANDA ENVIRONMENT MANAGEMENT AUTHORITY P.O.Box: 7436 <u>Kigali, Rwanda</u>

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ACRONYMS AND ABBREVIATIONS

| APR | Annual Progress Report | | |
|--------------|---|--|--|
| CORAR | Compagnie Rwandaise d'Assurances et de Reassurance | | |
| DDS | District Development Strategy | | |
| EAC | East African Community | | |
| EDPR | Economic Development and Poverty Reduction Strategy | | |
| EE | Executing Entity | | |
| EICV | Integrated Household Living Conditions Survey | | |
| FAA | Funding Administration Agreement | | |
| FAO | Food and Agriculture Organization | | |
| FFS | Field Farmers Schools | | |
| FGD | Focus Group Discussions | | |
| FONERWA | National Fund for Environment | | |
| GCF | Green Climate Fund | | |
| GDP | Gross Domestic Product | | |
| GGCRS | Green Growth and Climate Resilience Strategy | | |
| GoR | Government of Rwanda | | |
| нн | Household | | |
| IEU | Independent Evaluation Unit | | |
| KII | Key Informant Interviews | | |
| M&E | Monitoring and Evaluation | | |
| MMI Military | Medical Insurance | | |
| MINAGRI | Ministry of Agriculture and Animal Resources | | |
| MINALOC | Ministry of Local Government | | |
| MINEDUC | Ministry of Education | | |
| MINECOFIN | Ministry of Finance and Economic Planning | | |
| MININFRA | Ministry of Infrastructure | | |
| MOE | Ministry of Environment | | |
| NAEB | National Agricultural Export Development Board | | |
| NAP | National Adaptation Plan | | |
| NC | National Communication | | |
| NDC | Nationally Determined Contribution | | |
| NGOs | Non-Governmental Organization | | |

| NISR | National Institute of Statistics of Rwanda | | |
|------------|--|--|--|
| NST | National Strategy for Transformation | | |
| ODK | Open Data Kit software | | |
| PIR | Project Implementation Review | | |
| PSU | Primary Sampling Unit | | |
| PV | Solar Photovoltaics | | |
| RAB | Rwanda Agriculture Board | | |
| RFA | Rwanda Forest Authority | | |
| RHA | Rwanda Housing Authority | | |
| REMA | Rwanda Environment Management Authority | | |
| REB | Rwanda Education Board | | |
| RLMUA | Rwanda Land Management and Use Authority | | |
| RPHC | Rwanda Population and Housing Census | | |
| RSSB | Rwanda Social Security Board | | |
| R₩B | Rwanda Water Resources Board | | |
| SDG | Sustainable Development Goals | | |
| SESMEC Ltd | Social Economic Studies, Surveys, Monitoring and | | |
| | Evaluation Consult Limited | | |
| SPSS | Statistical Package for the Social Science | | |
| MM | Task Manager | | |
| TVET | Technical and Vocational Education and Training | | |
| | | | |

EXECUTIVE SUMMARY

The changes in temperatures, fluctuations of rainfall, wind directions and speed and sunshine along with frequent extreme weather events (flooding and drought episodes) observed in recent years in Rwanda have impacted negatively on livelihoods of number of people, ecosystem and food security in Rwanda. The eastern, southern and central plateau have been frequently exposed to droughts while the wet western and north western highlands have been stressed by the landslides, landslips and floods. The main impacts of climate change in Rwanda are among others an increased frequency of extreme flood events – by up to 30% in the short rainy season (September–November) and up to 50% in the long rainy season (March–May) along with an increased duration and frequency of droughts. These impacts are expected to become more severe over the coming decades, with intense negative effects on agriculture, energy production, forestry and water supplies.

On the other hand, the expected general increases in mean rainfall and number of rainy days in the north-west highlands and south-western regions will make them to have a constant supply of water. However, more occurrence of flooding episodes, soil erosion and landslides in these regions might lead to more destruction not only of the physical environment but also human activities. This is the reason why the appropriate adaptation measures should be taken in due time.

Despite different initiatives undertaken by the government of Rwanda and the development of an institutional and policy-enabling environment for climate change adaptation, the mainstreaming of climate change adaptation into medium- to long-term planning remains limited in Rwanda, there are still some limitations to medium- to long-term climate change adaptation in Rwanda. These include:

- (i) limited capacity to develop downscaled climate projections and climate risk assessments;
- (ii) minimal awareness of the medium- to long-term climate change scenarios across the country;
- (iii) limited information on the costs versus benefits of taking a landscape approach to adaptation (e.g. through ecosystem-based adaptation); and
- (iv) Lack of intensive monitoring and evaluation of climate change adaptation interventions.

The overarching goal of the proposed project is the facilitation of country-driven medium- to long-term climate change adaptation in Rwanda. The objective of the proposed project is to increase the capacity of governmental authorities and local communities in Rwanda to plan, fund, implement and monitor climate change adaptation solutions in the medium to long-term. A special focus is the enhancement of the climate change adaptation knowledge base, with a particular emphasis on guiding adaptation planning based on technical and financial effectiveness of adaptation measures to inform the funding of the NAP process. The following are the major components of the project and expected results:

Component I: Technical and institutional capacity for the NAP process in Rwanda;

Under Component I, gaps related to the technical and institutional capacity to advance the

NAP process in Rwanda will be bridged.

Component 2: Advancing climate-resilient practices and technologies

Under Component 2, climate-resilient practices and technologies related to the NAP process will be adopted and advanced.

Component 3: Monitoring, reviewing and knowledge-sharing framework developed to learn from the NAP process in Rwanda

The capacity for monitoring, reviewing and sharing knowledge under the NAP process will be increased. This will entail: i) developing a framework to monitor the effectiveness of NAP process; ii) strengthening the technical and institutional capacity in Rwanda to assess the effectiveness of adaptation outcomes in Rwanda.

The objectives and tasks of the consultancy

The consultant was to collect baseline information for the project indicators and establish an updated project results framework against which the project performance and impact will be measured.

FINDINGS

Scoring of 16 institutions

The scoring at institutional level was done at the beginning of the project, having identified the recipient of different trainings and recording their score and then recording their ultimate scores at different times and observing the progress. The scoringis linked to outocome I Increase in adaptation planning capacities among national staff across four ministries. Furthermore the criteria followed by the TAMD and PPCR and adapted from the GEFSec – AMAT were used.

I. Are the stakeholders aware of the current and expected impacts of climate change and have access to accurate climate information?

2. Do the stakeholders have the capacity to access adaptation funding?

- 3. Do the stakeholders have the capacity to plan for and implement CCA approaches?
- 4. Do the stakeholders have access to proven EbA methods that are specific to Rwanda's various biophysical environments

5. Is there evidence of adequate institutional capacities for the continuous monitoring and reviewing of and learning from adaptation initiatives?

The study conducted an assessment on the ability and preparedness of the targetted governmental institutions (16) to implement NAP process, below is the status of undertaken trainings related to climate change by 16 invistageted institutions. The grading of institutions in trainings was 0 if it never did any trainings, 1 if it rarely did trainings,2 if it did trainings sometimes, 3 if it did trainings frequently and 4 if it did trainings very frequently.

In the end the scores allocated to different institutions were aggregated where I = (0 - 10%); 2 = (11 - 20%); 3 = (21 - 30%); 4 = (31 - 40%); 5 = (41 - 50%); 6 = (51 - 60%); 7 = (61 - 70%); 8 = (71 - 80%); 9 = (81 - 90%) and 10 = (91 - 100%).

It is observable that RDB was accorded the highest score with 8 followed by MININFRA and MINECOFIN with 6, MINEDUC, MINAGRI, MINALOC, MOE, METEO, REMA and RAB with a score of 5, MINEMA and RLMUA with a score of 4, lastly FONERWA, Rwanda Forest Authority and Rwanda Water Authority had a score of 3.

Bio-Physical characteristics of the project sites

Ibanda-Makera Natural Forest, Kirehe District, Eastern Province

Ibanda-Makera Natural Forest currently covers an area of around 169 ha and 180 ha in 2020 which was originally around 1425 ha in 1984. Makera natural forest makes part of the complex of Ibanda-Makera made of two forests, Ibanda (a woodland savanna type located in the East) and Makera (a gallery forest located in the South-West). Makera forest is contiguous to the Akagera wetland associated to Akagera River in the South-East on the border with Tanzania. A stream is located within the forest, making it an important water catchment for local people. Historically, degradation related to human practices (including agriculture and fuelwood harvesting) has transformed large swaths of the forest into bush, thicket and woodland. Only a small remnant of mature forest patch still exists which should be well protected to avoid the extinction of this forest.

Muvumba River site

The Muvumba River site is located in Nyagatare district, Eastern Province. It is transboundary river, shared with Uganda with a total catchment area of 3,714 km² although the catchment within Rwanda is 1,567.8 km², the latter representing 5.95 % of the total surface area of Rwanda (26,338 km² including water bodies). The source of the Muvumba catchment is the Mulindi River located in the mountainous and high rainfall central, northern part of the country at an altitude of 2,030 masl (meters above sea level).

The Mulindi River flows north entirely within Rwanda for a length of 22.5 km towards the Ugandan border and then it crosses the national border onto a flat, wetland zone near Kabale. In Uganda, it joins the Muvumba River, before eventually flowing back into Rwanda. The length of the Muvumba River in Rwanda is around 56 km. Major tributaries within Rwanda are the Warufu River, and its tributary Ngoma River. In Nyagatare district, Warufu River joins the Muvumba, which then flows north-east and forms the border between Rwanda and Uganda,

before finally joining the Akagera River where the borders of Uganda, Rwanda and Tanzania all meet (NWRMP; MINIRENA, 2014, Ministry of environment, 2018).

Nyandungu wetland

Nyandungu Wetland is located in two districts of Kigali City, Gasabo district (Kimironko, Remera and Ndera sectors), and Kicukiro district (Nyarugunga sector). The site covers a total area of 243.92 ha and a total perimeter of 30,650.48 meters. Nyandungu wetland is bounded by the road Kigali-Kayonza (South), the road to the Adventist University (West), the road to Ndera (East). Nyandungu Wetland is drained by two streams: Mwanana and Kabagenda. Both flow into the Mulindi stream, a tributary of the Nyabarongo River.

Shagasha tea factory and plantations, Rusizi District, Western Province

The Shagasha tea factory and surrounding plantations form part of the "Imbarutso" partnership model (initiated in 2012) between the Wood Foundation (jointly funded by the Gatsby Foundation) and around 12,000 smallholder farmers gathered in 2 cooperatives known as "Villageois UMUCYAGI" and "COOPTHE". Imbarutso is designed to strengthen the competitiveness of Rwanda's tea industry and ensure that smallholders benefit from the resulting growth.

The villageois UMUCYAGI is composed of 4032 smallholder farmers and it grows the tea plantation on their own lands extended on 732 ha as reported by the president of the cooperative. They put together the production which is sold to the Shagasha Tea Factory. This cooperative operates in 10 sectors namely Giheke, Nkungu, Nyakarenzo, Mururu, Gihundwe and Kamembe sectors in Rusizi district and Shangi, Bushenge, Ruharambuga and Karengera which are located in Nyamashake district. The grown tea are arranged in 6/8 columns on 176 ha, in 31/8 columns on 220 ha while the baby sheets are grown on 132 ha. Additionnal 204 ha are covered by the tea plantation which are grown without respecting any order.

The COOPTHE is composed of 832 smallholder farmers and it grows the tea plantation on 530 ha in Ruharambuga sector of Nyamasheke district and Giheke, Nkungu, Mururu and Kamembe sectors of Rusizi district. The planted tea are arranged in 6/8 and 31/8 columns on 420 ha with baby sheets grown on 100 ha. The remaining 10 ha are covered by a very old tea plantation which are grown without respecting any order.

Demographic characteristics of respondents

More males (76.1%) compared to females (23.9%) are heading households the highest number of them (24.4%) belongs to the age group of between 36 to 45 years age followed by those

in 46 to 55 years age group while those aged between 26 and 35 years represent 17.6%. Thus, the majority of household head is aged between 25 and 55 years. Those with less than 25 years are less represented (3.8%) as they are relatively unlikely to be married at these ages while those belonging to old age group (above 66 years) are very few in number (12.3%) as it is a case at national level (NISR, 2019). The study revealed that the number of family members varying between one (1) and eleven (11) with the majority of families having between 4 and 6 members. The largest families with more than 7 members (33.8) were seen in Eastern Savannah contrary to the areas around Muvumba River where there is 18.1% of families with more than 7 members. The average household size of 5 people at project intervention is above to the national average of 4.2 people as reported by NISR in 20191.

the majority of household heads (more than 71.3%) is engaged in farming activities based on rain-fed agriculture as reported by respondents during the FGDs. This percentage is higher than national average of 54% reported in EICV 5 in 2018 though it is 15.4% around Nyandungu wetland. A small percentage 4% of household heads is engaged in commercial and transport activities with 4.5% and 9.3% being civil servant and private employee respectively. These two sectors occupy the highest percentage (30.8% for private employee and 10.3% for civil servant) for the areas surrounding Nyandungu weltland It is clear that households of around project intervention areas depend mainly on farming for their livelihood. Therefore, they are probably vulnerable to negative impacts of climate change. Thus, any change in frequency and intensity of rainfall impact negatively on their livelihood.

The analysis of house ownership is necessary to understand better the level of development of households in a given area. Such information may also help in estimating the household expenses; for instance, a household renting a house is spending much more than the ones living in their own houses.

the majority of household heads (above 80%) live in their own houses at project intervention areas against 15.1% who do not own a house in the same areas. All houses are roofed by iron sheets as confirmed by the respondents. To have such high number of household heads having their own houses is a good indicator that the majority of the population live in their own houses which imply that the money they would spend on rent can be saved for meaningful investments.

The majority of household project beneficiaries possess chairs (89.9%), matresses (78.3%), table (70.6%) and beds (62%). Additionnaly, 25.8% and 14.6% do have cupboard and Sofa

¹ National Institute of Statistics of Rwanda, (2019). The annual report, Kigali, Rwanda.

respectively with 5.3% possessing only benches. These percentages depict that the majority of households do have the basic equipment in their houses.

Main sources of household income

According to EICV 5 published in 2018, about 54% of the Rwandan working population is engaged in farming activities. This farming is mainly dominated by food crops namely: bananas, which occupy more than a third of the country's farmland, potatoes, beans, rice, sweet potatoes, cassava, wheat and maize. Coffee and tea are the major cash crops for export. Animals raised in Rwanda include cows, goats, sheep, pigs, chicken, and rabbits, with geographical variation in the relative importance of each. The industry occupied 16% of working population while around 30% was engaged in services (NISR, 2019).

The majority of households reported farming activities as their main occupation as declared by more than 88% at Ibanda-Makela, Muvumba river, Eastern savannah sites with 81.5% at Shangasha and 11.5% at around Nyandungu wetland. Part time employement took the second position in generating income for respondents especially around Ibanda – Makela forest (64.6%) and Nyandungu wetland (43.6%). Parmanent jobs (8.8%) and business (8.1%) come after in generating income for for the households. Animal husbandry and production along with artisan play also a determinant roles in contribution to the income generation for households. The contribution of the remaining professional occupation is very limited as each occupies less than 3% of respondents. Moreover, this figure depicts that the respondents might be engaged in different income generation activities at the same time.

CLIMATE CHANGE - RESILIENT TECHNOLOGIES AND PRACTICES

In the same line, Rwanda has reviewed the environmental and climate change policy in 2019 to guide in implementation of the Green Growth and Climate Resilience Strategy (GGCRS) developed in 2011, NST1 developed for 2017-2024, Agenda 2030, African Agenda 2063 and EAC agenda. Furthermore, different adaptation measures were proposed in NAMA, NAPA, Technology Needs Assessment in Agriculture and Energy undertaken in 2012, National communication (NC) published in 2005, 2012 and 2018, Nationally Determined Contribution (NDC) published in May 2020.

Changes in mean temperatures, rainfall frequency and intensity have negative impacts not only on physical environment but also on human activities. Therefore, it is important to assess whether the local communities are aware of such changes in climate.

More than 65% of beneficiary households are aware that project sites have experienced an increase in temperature throughout the years with 26.4% who said that they noticed the decrease in temperature while 7.6% did not see any change in mean temperature. This view of 65% of respondents is fitting with findings published in Third National Communication where it was highlighted that the progressive increase in temperature was observed across the country since 1971 to 2017 (Republic of Rwanda, 2018)². Furthermore, the majority of respondents (76.9%) reported an increase in mean rainfall and a late onset (61.5%) while the eastern part of Rwanda including Muvumba River, Eastern Savannah and Ibanda-Makela sites along with Nyandungu wetland were reported to became gradually warmer with westen part including Shangasha Tea Estate becoming wetter (Republic of Rwanda, 2018). Thus, the majority of respondents might have reported a rise in mean rainfall based on a number of flooding episodes observed recently around Muvumba River, and Nyandungu wetland though they were occasional. Therefore, there is a need to avail accurate and detailed information on climate change and variability to the local community.

the highest percentage of respondents (45.8%) provided the wrong answers to the possible causes of climate change while 42.3% of respondents across project sites are aware of natural factors which may cause climate change. Poor awareness on the causes of climate changes was seen at Shagasha respondents (54.3%) while the respondents from Ibanda-Makela forest site ara much better in knowing natural causes which may behind climate change and respondents from around Nyandungu wetland are much better in knowing the contribution of human activities in causing climate change. Hence, more trainings and information sharing system to NAP beneficiaries should be enhanced to improve their knowledge in terms of causes of climate change.). It was observede that RDB was accorded

² Republic of Rwanda, (2018). Third National Communication, Kigali, Rwanda.

excellent grade in climate change business while MINECOFIN, MINEDUC, MINAGRI, MINALOC, MOE, MININFRA and METEO were accorded satisfactory while the remaining investigated institutions (RFA, RWB, RLMUA, MINEMA,) showed weaker interest inclimate change activities.

General conclusion

The baseline study was designed to facilitate the implementation of NAP activities in five pilot sites which include Ibanda-Makera forest, Muvumba River in Nyagatare district, Eastern Savannah in Nyagatare district, Nyandungu wetland and Shagasha Tea Estate sites. The target population for the survey is all households living in private dwellings during the interviewing period in areas surrounding the project sites. The Key Informant Interviews were held with selected secondary school teachers, head teachers, local leaders at sector and district level of the project sites along with various stakeholders from central government which are direct or indirectely linked to the climate change activities.

Therefore, NAP came at the right time as it will help the household to restore and enhance ecosystem services in project sites, increase the capacity of communities to renew and sustainably manage forest resources and support smallholders to develop appropriate climate resilient technologies and support community based adaptation planning and build the capacity of both local community and central government to deal with adverse impacts of climate change.

This baseline study has shown that the areas under study are no exception, where the occurrence of extreme weather events (e.g., droughts, strong winds, thunder storms with lightning and floods), the increase in temperatures and in fluctuations of seasonal rainfall patterns, duration and intensity reported by interviewed households have inevitably immediate impacts on cropping patterns, timing of growing crops, agronomic practices and seed needs. These events do not only affect food production but also food and water safety and availability, livelihood assets and human health and properties.

It was declared that in the past 12 months, heavy rainfall has occasioned fluvial erosion and destroyed crops as reported by the majority of respondents. The majority of respondents pointed out heavy rainfall to have occasioned fluvial erosion and destruction of crops and the similar percentage of respondents mentioned drought episodes and long dry spells to have led to poor crop productivity and a shortage of food. Additionally they mentioned floods to have destroyed their crops and caused poor agricultural productivity. Moreover, the households are not very active in adopting climate resilient technologies, as only small percentages of households have been able to adopt the use of crop varieties, develop

technologies for rain water harvesting, waste water management at household level and protecting their housing infrastructure against lightening.

Besides the floods, strong winds have also been very harmful to the project areas. In order to deal with the impacts of the above and to create resilience to climatic changes, GoR has pursued ambitious policies and strategies including the Environment and Climate Change Policy which aims to address climate change by providing strategic direction on environment and climate change, and consequently spur socio-economic development in Rwanda. Another important strategic approach is the NAP which aims to build the capacity of both local community and central government in dealing with adverse effects of climate change. From the findings of the study, the key recommendations were formulated and presented in the following paragraphs.

General Recommendations

The following are key challenges and recommendations that should be taken into account by relevant stakeholders in implementation of NAP project in project intervention area.

- The current vulnerability to the effects of climate change of rural beneficiary populations in project areas is high, and it is necessary to go further to ensure that more communities will have socio-economic capacity to deal with adverse effects of climate change. In this respect, REMA as well as the Ministry of Environment and other stakeholders should continue to strengthen their role in capacity building of local community and implement climate resilience actions and develop useful tools for strengthening the country's capacity to adapt to climate change.
- The population does not take into account weather information and forecasts (especially the likelihood of natural disasters), which renders the population in a perpetual emergency situation without moving to a process of planning and preparing for disasters. The possibility of disseminating weather/climate information to the farmers should be timely and accurate in order to carry out crops monitoring, early warning and disaster management, and the selection of appropriate crops to grow in specific agro-climatic zones and seasons. Futheremore, farmers should also received training on how to effectively use this information best in their planning.
- NAP project should continue activities to promote conservation agriculture in project areas and larger scale adoption by the government in order to improve land management and prevention of land degradation through good agricultural practices. This can be done through the following suggested actions: reforestation activities; terracing activities and reduction of steep slopes, Design Sustainable Land Management Plan; Create awareness raising of population through regular trainings, etc.
- From the study, it is evident that there is need to promote the adaptation to climate change which is bound to include a wide range of anticipatory measures and strategies based on findings of the study and expected goals to the project.. These are as follows:

- > Plant protective forestry near rivers especially Muvumba River to stabilize them, near roadsides and steep slopes to reduce soil erosion.
- Carry out progressive and radical terracing: (terracing refers to landscaping of sloping topography into a series of successively receding flat surfaces or platforms that resemble steps);
- > Agro-forestry has among its advantages the benefit of increasing non-farm incomes;
- Promote afforestation of around Muvumba River;
- Continue to promote the use of energy saving stoves to reduce the amount of wood used as charcoal and hence save the forests from excessive use and destruction;
- Support the promotion of horticulture crops growing because they serve the role as forests and contribute at the same time to the food security;
- Promote soil fertility conservation practices which is the use of manure, mulching, planting of leguminous crops, which help improve soil fertility by increasing the microorganism composition in the soil;
- Support seed and grain storage which involves collecting seeds and grains from farmers at post-harvesting season and releasing them within the timely agreed periods;
- Promote ecological pest management which is the use of natural enemy dynamics or environmental positioning (e.g., crop shading) to eliminate or reduce the presence of pests;
- > Promote the use of improved seeds which is vital to improve crop productivity;
- Train farmers to use crop varieties and diversification consisting of integration of different varieties of crops and hybrids of a particular crop;
- > Train and support land use consolidation programmes by encouraging farmers with adjacent lands to grow the same crop;
- Promote rain water harvesting consisting on collecting and storing rainwater from rooftops, land surfaces or rock catchment areas for different use;
- Develop irrigation systems to provide controlled water in farmlands;
- Promote wastewater reuse to form a reliable source for crop irrigation and a positive way to dispose of sewage water;
- Promote the use of barrier crops that are used as a cultural control strategy for reducing the spread of pests and diseases to the most vulnerable crops;

- Integrate dissemination of meteorological information in daily household activities to develop early warning systems, crop monitoring and disaster management and work on raising awareness among farmers to enable them to take alerts into account especially in the likelihood of an event;
- Train farmers through offering short courses, seminars and group discussions on the impacts of climate changes and variability on natural and artificial environment and on various ways of mitigation and adaptation;

Thus, the use domestic biogas plants and renewable energy are also recommended. The biogas plant have a direct positive effect on rural peoples' energy supply, environment, health and agricultural production. Biogas is part of a closed ecological cycle, which makes it a sustainable and renewable source of energy. By replacing traditional energy sources (notably, firewood) and by digesting cow dung in a closed environment, it results in a significant reduction in the emission of methane, which is a greenhouse gas. This has a positive gender sensitive factor as it reduces the burden on women through collecting firewood. It is also relatively better for the health of family members especially that of women and children who are predominantly present for meal preparation.

I. GENERAL INTRODUCTION

I.I. Background

Although climate change was reported in past centuries, there are projections for more changes and variability in climate patterns and the risk of extreme events throughout the 21st century (Government of Rwanda, 2018³). Notwithstanding that climate change and variability might affect natural and man-made environment, positively or negatively, it is projected that the human activities like ecosystem, rain-fed agriculture, livestock, infrastructures in sub-Saharan Africa (including Rwanda) are likely to be negatively impacted by climate change and variability because the region is viewed as more vulnerable and less able to adapt and compensate for the negative effects of climate change.

The changes in temperatures, fluctuations of rainfall, wind directions and speed and sunshine along with frequent extreme weather events (flooding and drought episodes) observed in recent years in Rwanda have impacted negatively on livelihoods of number of people, ecosystem and food security in Rwanda. The eastern, southern and central plateau have been frequently exposed to droughts while the wet western and north western highlands have been stressed by the landslides, landslips and floods. The main impacts of climate change in Rwanda are among others an increased frequency of extreme flood events – by up to 30% in the short rainy season (September–November) and up to 50% in the long rainy season (March–May) along with an increased duration and frequency of droughts. These impacts are expected to become more severe over the coming decades, with intense negative effects on agriculture, energy production, forestry and water supplies.

Furthermore, the decreasing trends in mean rainfall and number of rainy days expected during the rainy seasons in regions like the south-eastern lowlands and central plateau which already have a limited water supply are likely to cause a decline in water storage (Muhire et al., 2015⁴). This scenario may result in shortening the crop growing period. This will affect negatively the agricultural sector, especially coming at a time crops are in the fields and need an ample supply of water for growth and maturity. Therefore, Rwanda may expected the reduced crop production if the adaptation measures are not taken in due time.

On the other hand, the expected general increases in mean rainfall and number of rainy days in the north-west highlands and south-western regions will make them to have a constant supply of water. However, more occurrence of flooding episodes, soil erosion and landslides in these regions might lead to more destruction not only of the physical environment but also human activities. This is the reason why the appropriate adaptation measures should be taken in due time.

To address the various threats posed by climate change, Rwanda has reviewed the environmental and climate change policy in 2019 to guide in implementation of the Green Growth and Climate Resilience Strategy (GGCRS) developed in 2011, NST1 developed for 2017-2024, Agenda 2030, African Agenda 2063 and EAC agenda. Furthermore, different adaptation measures were proposed in NAMA, NAPA, Technology Needs Assessment in

³ Government of Rwanda, (2018). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Rwanda, Kigali.

⁴ Muhire, I. and Ahmed, F., (2015). Spatio-temporal trend analysis of precipitation data over Rwanda. South African Geographical Journal, 97(1): 50-68.

Agriculture and Energy undertaken in 2012, National communication (NC) published in 2005, 2012 and 2018, Nationally Determined Contribution (NDC) published in May 2020.

Despite the above mentioned initiatives and the development of an institutional and policyenabling environment for climate change adaptation, the mainstreaming of climate change adaptation into medium- to long-term planning remains limited in Rwanda, there are still some limitations to medium- to long-term climate change adaptation in Rwanda. These include:

- (v) limited capacity to develop downscaled climate projections and climate risk assessments;
- (vi) minimal awareness of the medium- to long-term climate change scenarios across the country;
- (vii) limited information on the costs versus benefits of taking a landscape approach to adaptation (e.g. through ecosystem-based adaptation); and
- (viii) Lack of intensive monitoring and evaluation of climate change adaptation interventions.

The overarching goal of the proposed project is the facilitation of country-driven medium- to long-term climate change adaptation in Rwanda. The objective of the proposed project is to increase the capacity of governmental authorities and local communities in Rwanda to plan, fund, implement and monitor climate change adaptation solutions in the medium to long-term. A special focus is the enhancement of the climate change adaptation knowledge base, with a particular emphasis on guiding adaptation planning based on technical and financial effectiveness of adaptation measures to inform the funding of the NAP process. Reference to the project document from page 89 to page 107, the following are the major components of the project and expected results:

Component I: Technical and institutional capacity for the NAP process in Rwanda;

Under Component I, gaps related to the technical and institutional capacity to advance the NAP process in Rwanda will be bridged. This will include:

- i) Establishing a NAP TWG to develop climate risk assessments for four catchments and oversee adaptation planning (Output 1.1);
- ii) Developing downscaled catchment-level climate projections for Rwanda to inform the development of climate risk assessments (Output 1.2);
- iii) Developing climate risk assessments for four catchments to inform the design of CCA strategies, including the selection of adaptation measures (Output 1.3);
- iv) designing four catchment-level CCA strategies based on the results of climate risk assessments to enhance the resilience of the targeted catchments and serve as a model that can be upscaled across the country (Output 1.4);
- v) Extrapolating CCA measures from catchment-level adaptation strategies designed under Output 1.4 – to the national level to facilitate the development of adaptation plans for three priority economic sectors (Output 1.5);
- vi) refining NDC adaptation priorities related to sectoral adaptation plans and the LTRP, to ensure their effective implementation across the country (Output 1.6); and vii) fostering the national ownership of the NAP process through the dissemination of training manuals and the organisation of awareness-raising events for public and private sectors, CSOs and local communities (Output 1.7).

Component 2: Advancing climate-resilient practices and technologies

Under Component 2, climate-resilient practices and technologies related to the NAP process will be adopted and advanced. This will be done by: i) updating the 2017 Public Expenditure Review for Environment and Climate Change (PERECC) through the conduction of a Climate Public Expenditure and Institutional Review (CPEIR) to determine available climate finance and assess the effectiveness of climate expenditures to date, determining funding gaps related to sectoral adaptation plans and developing a NAP funding strategy for Rwanda; ii) providing recommendations to relevant ministries on the mainstreaming of CCA into their budgeting and planning processes; iii) establishing a long-term research programme (LTRP) sites – to address gaps in knowledge required to inform the design of adaptation plans, selection of appropriate measures and the funding of CCA in Rwanda; iv) implement landscape-level EbA pilot in four selected catchments; and v) building awareness of the private sector on future climate scenarios, national priorities and investment opportunities related to increasing the climate-resilience of businesses. The following outputs are linked to component 2:

- Output 2.1: A NAP funding strategy developed;
- Output 2.2: Recommendations for relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed;
- Output 2.3: Long-term research programme established to address gaps in knowledge needed to inform adaptation planning and funding in Rwanda;
- Output 2.4: EbA interventions implemented in five pilot sites based on CCA strategy and implementation protocol developed;
- Output 2.5: Strengthened awareness of the private sector on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA;

Component 3: Monitoring, reviewing and knowledge-sharing framework developed to learn from the NAP process in Rwanda

The capacity for monitoring, reviewing and sharing knowledge under the NAP process will be increased. This will entail: i) developing a framework to monitor the effectiveness of NAP process; ii) strengthening the technical and institutional capacity in Rwanda to assess the effectiveness of adaptation outcomes in Rwanda; and iii) producing progress reports and communication material on the NAP process. SESMEC Ltd will recommend appropriate tools for monitoring like the Result Based Monitoring and Evaluation System (RBM&E System) of the Ministry of Environment. The following outputs are linked to the component 3:

Output 3.1: A framework for the monitoring of long-term CCA outcomes developed;

- Output 3.2: Adaptation indicators mainstreamed into the main sectoral and development monitoring frameworks;
- Output 3.3: Progress reports and communication material to learn from the formulation, implementation, funding and monitoring of the NAP process;

1.2. The objectives and tasks of the consultancy

The consultant collected baseline information for the project indicators and established an updated project results framework against which the project performance and impact was measured. The project results framework is identified in Appendix 4 of the Project document and referred to below:

| Table I: | The pro | ject result | framework |
|----------|---------|-------------|-----------|
|----------|---------|-------------|-----------|

| Project objective | Objective indicator | Baseline | Target | Means of Verification |
|---|---|---|---|--|
| Increased capacity of governmental authorities and local communities in Rwanda to plan, fund, implement and monitor climate change adaptation solutions in the medium to long term | I. Degree to which the technical and institutional capacity of targeted government institutions, district-level stakeholders and local communities is strengthened at national and sub-national levels to advance Rwanda's NAP process | I. Despite the development of an institutional, policy, and sectoral mandate for climate change adaptation, Rwanda's capacity to mainstream medium-to long-term adapttion planning remains challenged by several factors. These factors include limited: i) climate data produced by Rwanda's climate information system; ii) awareness of the medium- to long-term climate change scenarios for the country; iii) implementation and research of Ing-term EbA techniques; and iv) implementation techniques for climate change adaptation interventions. | I. Increase of at least 4 points in the capacity score at each level (Max 10, min 0) | I. Verified through scoring methodologies developed by the TAMD and PPCR and adapted from the GefSec – AMAT (2014) The Indicator is based on a five-step criteria of capacity assessment framework (expressed as questions): I. Are the stakeholders aware of the current and expected impacts of climate change and have access to accurate climate information? 2. Do the stakeholders have the capacity to access adaptation funding? 3. Do the stakeholders have |

| | The current capacity of | | the capacity to plan |
|--|------------------------------|----------|--------------------------|
| | government institutions, | | for and implement |
| | district-level stakeholders, | | CCA approaches? |
| | and local communities to | 4. | Do the |
| | advance the process is | | stakeholders have |
| | estimated to be 6, 3, and 2. | | access to proven |
| | respectively ⁵ . | | EbA methods that |
| | | | are specific to |
| | | | Rwanda's various |
| | | | hiophysical |
| | | | environments? |
| | | 5 | ls there evidence |
| | | 5. | of adequate |
| | | | institutional |
| | | | capacitios for the |
| | | | capacities for the |
| | | | continuous monitoring |
| | | | monitoring and |
| | | | reviewing of and |
| | | | learning from |
| | | | |
| | | | initiatives? |
| | | Each a | uestion is answered |
| | | with a | an assessment and |
| | | score | for the extent to |
| | | which | the associated |
| | | criterio | on has been met: |
| | | not at | all (=0), partially |
| | | (=1). | or to a large |
| | | extent | /completely (=2) |
| | | 22.20110 | ·········/ (-/· |

⁵ This scoring will be validated by this baseline study.

| Outcome I Technical and institutional capacity for the NAP process in Rwanda strengthened using up-to- date climate information. | Outcome indicators I. Increase in adaptation planning capacities among national staff across four ministries (three sectoral and MINECOFIN), district and catchment-level committees and senior high school teachers in the four catchmetns targeted by the project | 1. The baseline for this indicator will be determined through this baseline study. | I. By the end of the project's implementation period, adaptation planning capacities have increased by 50% among national staff, across four ministries (three sectoral and MINECOFIN), district- and catchment- level committees and senior high school teachers in the four catchments targeted by the project. | An overall score is calculated with a maximum score of 10 given for the five criteria. These five criteria will be reviewed and validated through this baseline study. I. A tool to measure the change in adaptation planning capacities will be developed through this baseline study. |
|---|---|---|--|---|
| Outcome 2 Climate resilient technologies and practices adopted and scaled up. | Outcome indicator 2. Number of pilot sites established under the LTRP to conduct research on the financial and economic effectiveness of EbA, number of people | 2. Currently, several research programmes on the benefits of climate change adaptation are being undertaken within NAP=catalysed projects in Rwanda. There is, however, limited research | 2. Five EbA pilot sites in four catchmetns established by the end of the project's implementation period. 2.1 At least 20,000 people (50% of which are women) from five cells (4,000 per | 2. Five EbA pilot sties in four catchments established. 2.1 Registers of community beneficiaries kept for each pilot site under the LTRP. Beneficiary surveys |

| | benefitting from the adaptation technologies, and practices implemented at pilot sites; area of land (ha) managed sustainably for long- term adaptation at the pilot sties; and number of adaptation measures/technologies scaled up for sustainable long-term use. | being conducted in Rwanda to inform medium-to long-term adaptation investments across a range of economic sectors. EbA for example, has the potential to benefit a wide range of secotrs including agriculture, water and energy. These benefits need to be quantified to firstly enable EbA to be integrated effectively into long-term land use planning at the national scale and secondly to catalyse investments in to EbA across the country. | cell) benefitting from adaptation technologies and practices implemented at the LTRP's five EbA pilot sties by the end of the project's implementation period. 2.2. At least 500 hectares of land managed sustainably for long-term adaptation at the LTRP's pilot sties by the end of the project's implementation period. 2.3 At least five adaptation measures/ technologies – one per pilot site— scaled up for sustainable long- term use. | conducted under the LTRP. 2.2 Visits to LTRP pilot sties. Project reports. 2.3 Visits to LTRP pilot sties. Project reports. |
|---|--|---|---|--|
| Outcome 3. Capacity for monitoring, reviewing, and knowledge- sharing to learn from the NAP process in Rwanda increased. | Outcome Indicator I. Number of adaptation outcome-level indicators revised and developed to inform the monitoring of adaptation in Rwanda | I. Monitoring and evaluation (M&E) systems have been developed for EDPRS I, GGCRS, EDPRS2 and more recently NST1. Although these systems have numerous indicators covering several broad themes and sectors, they were developed for the | term use. I. By the end of the project's implementation period, at least five existing outcome-level indictaors for adaptation mainstreamed into national planning performance frameworks. | I. Indicators in existing M&E plans revised and new indicators added under a long-term CCA monitoring framework |

| | short-term and have | |
|--|----------------------------|--|
| | limited relevance to long- | |
| | term adaptation. Aas a | |
| | result, there is a limited | |
| | baseline for M&E relevant | |
| | to tracking the | |
| | effectiveness of long-term | |
| | adaptation in Rwanda. | |
| | • | |

2. APPROACHES AND METHODOLOGY FOR PERFORMING THE ASSIGNMENT

An integrated methodology combining the literature review, quantitative and qualitative methods were employed in this study. While the quantitative methods are free from personal biases and thus help ensure objectivity of findings, the qualitative methods reflect better the beneficiary perceptions and experiences and they uphold humanistic values essential to understand perceptions. The main components of the methodology are the following.

2.1. Desk review

Reading and comprehending the project document: "Building the capacity of Rwanda's government to advance the National Adaptation Planning process" including the project log-frame and detailed work plan and assess the project results framework.

The literature review was undertaken by consulting reports and official documents related to the study under investigation, the books, articles of various journals, theses, to provide necessary background of the study including methodologies for measuring and tracking adaptation, Vulnerability Index report 2018, NAMA, NAPA, Technology Needs Assessment in Agriculture and Energy undertaken in 2012, National communication (NC) published in 2005, 2012 and 2018, Nationally Determined Contribution (NDC) of 2020, GGCRS implementation and evaluation reports of 2011 and 2018 respectively and any other relevant reports related to the topic under investigation.

2.2. Analysis of Indicators

Analysis of indicators included a review and careful reconsideration of the existing set of indicators discussions with project team and and stakeholders were held about the relevance and measability of indicators according to project outcomes, outputs and activities. The indicators already formulated in project document were screened based on their measurability and relevance for the related results (at output, outcome level) and ensure that the indicators are SMART (Specific, Measurable, Attainable, Relevant and Time bound). Those that appeared less relevant and/or very difficult to measure were reformulated. As a result, some outcome level indicators may be reformulated and outputs indicators formulated.

| Indicator | Level of analysis | Methodological approach | Specific tasks to review the indicators to be SMART ⁶ | Specific tasks to collect baseline information |
|---|--|---|--|---|
| Project objective indicator Degree to which the technical and institutional capacity of targeted government institutions, district-level stakeholders and local communities is strengthened at national and sub-national levels to advance Rwanda's NAP process | National government insititutions District-level institutions (districts covered by the project pilot sites) Local communities (local communities covered by the project pilot sites) | Scorecard approach with information to be gathered through key informant interviews with stakeholders at the national and district levels | Review the following tools and amend the scorecard as appropriate: - Tracking Adaptation and Measuring Development ⁷ - Updated Pilot Program for Climate Resilience Monitoring and Reporting Toolkit ⁸ - GEF Adaptation Monitoring and Assessment Tool (AMAT) ⁹ - Other relevant M&E frameworks for adaptation Adapt the scorecard questions and scoring methodology as appropriate. Developing the questionnaire and interview protocol see annex 4.1 up to annex 4.4 | Develop a sampling approach across the three groups: - National institutions (Purposive selection of respondents from key stakeholders mentioned in the project document) - District-level institutions (Purposive selection of district leaders at project sites) - Local communities (Purposive selection of local leaders and random systematic sampling of household heads) Apply the scorecard questions through a series of interviews with national and district-level institutions. At the community level, investigate whether focus |
| | | | | group discussions may be |

- ⁶ Specific, measureable, achievable, relevant, and time-bound
 ⁷ <u>https://pubs.iied.org/10100IIED/</u>.
 ⁸ https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/ppcr_mr_toolkit_july_2018.pdf
 ⁹ <u>https://www.thegef.org/documents/gef-climate-change-adaptation-tracking-tool</u>.

| Indicator | Level of analysis | Methodological | Specific tasks to | Specific tasks to collect |
|---|---|--|---|--|
| | | approach | review the indicators | baseline information |
| | | | to be SMART ⁶ | |
| | | | | more appropriate. |
| Outcome I Indicator Increase in adaptation planning capacities among national staff across four ministries (three sectoral and MINECOFIN), district and catchment-level committees and senior high school teachers in the four catchments targeted by the project | National staff / officials District and catchment level staff / officials Senior high school teachers | (Define the tool /methodological approach here to measure increase in adaptation planning capacity, can be developed through a scorecard approach, based on interviews.) | Reviewing the indicator to assess whether it is appropriate, SMART, etc. if not propose the changes to be made; Developing interview protocols; Consultation of secondary data. | Key informant interview with leaders at central and institutional level (see annex 4.4), Key informant interview with district and catchment level staff/officials (see annex 4.3) Focus Group Discussion with senior high school teachers (see annex 4.2). Collection of secondary data related to adaptation planning capacities among national staff, district and catchment-level committees and senior high school |
| | National government | Consultations and desk | Reviewing the indicator to | Assess if there are existing |
| NAP technical working group (TWG) established. | District-level institutions | WOFK | assess whether it is appropriate, SMART, etc. if not propose the changes to be made; Developing interview protocols; Consultation of secondary data. | that can serve as baseline. |
| Output indicator 1.2 | National government insititutions | Consultations and desk work | Reviewing the indicator to assess whether it is | Consult Meteo Rwanda to assess if downscaled climate |
| Downscaled catchment-level climate projections for Rwanda developed. | District-level institutions | | appropriate, SMART, etc. if not propose the changes to be made; | projections have been produced in the past. |

| Indicator | Level of analysis | Methodological | Specific tasks to | Specific tasks to collect |
|---|----------------------|------------------------|----------------------------|-------------------------------|
| | | approach | review the indicators | baseline information |
| | | | to be SMART ⁶ | |
| | | | Developing interview | |
| | | | protocols; | |
| | | | Consultation of secondary | |
| | | | data. | |
| Output indicator 1.3 | National government | Consultations and desk | Reviewing the indicator to | Consultations and desk work |
| Climate risk assessments for four catchments | insititutions | work | assess whether it is | to assess if climate risk |
| in Rwanda developed. | District-level | | appropriate, SMART, etc. | assessments have been |
| | institutions | | if not propose the changes | conducted for catchments in |
| | | | to be made; | Rwanda. |
| | | | Developing interview | |
| | | | protocols; | |
| | | | Consultation of secondary | |
| | | | data. | |
| Output indicator 1.4 | National government | Consultations and desk | Reviewing the indicator to | Consultations and desk work |
| CCA strategies developed for the four | insititutions | work | assess whether it is | to assess if CCA strategies |
| catchments based on climate | District-level | | appropriate, SMART, etc. | have been conducted for |
| risk assessments | institutions | | if not propose the changes | catchments in Rwanda based |
| | | | to be made; | on climate risk assessment |
| | | | Developing interview | |
| | | | protocols; | |
| | | | Consultation of secondary | |
| | | | data. | |
| Output indicator 1.5 | Central and | Consultations and desk | Reviewing the indicator to | Consultations and desk work |
| | decentralised levels | work | assess whether it is | to assess if adaptation plans |
| CCA measures from catchment-level | | | appropriate, SMART, etc. | have been developped in the |
| adaptation strategies | | | if not propose the changes | past to serve as a baseline |
| extrapolated to the national level to develop | | | to be made; | |
| adaptation plans for three priority economic | | | Developing interview | |
| sectors | | | protocols; | |
| | | | Consultation of secondary | |

Output indicator 1.6

 National government
 Consultations and desk
 Reviewing the indicator to
 Reading
 of
 current
 NDC

| Indicator | Level of analysis | Methodological | Specific tasks to | Specific tasks to collect |
|---|----------------------|-------------------------|----------------------------|--------------------------------|
| | | approach | review the indicators | baseline information |
| | | | to be SMART ⁶ | |
| | insititutions | work | assess whether it is | document to understand |
| Refinement of NDC adaptation priorities | District-level | | appropriate, SMART, etc. | adaptation related priorities |
| related to the sectoral | institutions | | if not propose the changes | |
| adaptation plans and LTRP | | | to be made; | |
| | | | Developing interview | |
| | | | protocols; | |
| | | | Consultation of secondary | |
| | | | data. | |
| Output indicator 1.7 | National government | Consultations and desk | Reviewing the indicator to | Identification of existing |
| Training manuals and awareness-raising | insititutions | work | assess whether it is | training manuals on NAP |
| events for public and private sectors, | District-level | | appropriate, SMART, etc. | process in Rwanda. |
| CSOs and local communities on the NAP | institutions | | if not propose the changes | |
| process. | | | to be made; | |
| | | | Developing interview | |
| | | | protocols; | |
| | | | Consultation of secondary | |
| | | | data. | |
| Outcome 2 Indicator | Site level of pilots | (Systematic screening | Reviewing the indicator to | (Examine other projects and |
| | | of projects managed by | assess whether it is | initiatives, including LDCF II |
| Number of pilot sites established under the | | REMA, projects with | appropriate, SMART, etc. | if these pilot sites can be |
| LTRP to conduct research on the financial and | | donor funding, | if not propose the changes | included in the LTRP. |
| economic effectiveness of EbA, number of | | initiatives from other | to be made; | Criteria for including |
| people benefitting from the adaptation | | institutions / district | | initiatives / sites need to be |
| technologies, and practices implemented at | | level, etc.) | | closely aligned with analysis |
| pilot sites; area of land (ha) managed | | | | of financial and economic |
| sustainably for long-term adaptation at the | | | | effectiveness of EbA and |
| pilot sties; and number of adaptation | | | | other elements of the |
| measures/technologies scaled up for | | | | indicator) |
| sustainable long-term use. | | | | |
| Output indicator 2.1 | Site level of pilots | (Systematic screening | Reviewing the indicator to | Assessment of Expenditure |
| | | of projects managed by | assess whether it is | Review for Environment and |
| A NAP funding strategy developed. | | REMA, projects with | appropriate, SMART, etc. | Climate Change |
| Indicator | Level of analysis | Methodological approach | Specific tasks to review the indicators | Specific tasks to collect baseline information |
|--|-----------------------|----------------------------|---|--|
| | | | to be SMART ⁶ | |
| | | donor funding, | if not propose the changes | |
| | | initiatives from other | to be made; | |
| | | institutions / district | | |
| | | level, etc.) | | |
| Output indicator 2.2 | National government | Consultations and desk | | Capacity needs assessment |
| | insititutions | work | | to determine where support |
| Recommendations for relevant ministries on | District-level | | | is needed to ensure the |
| the mainstreaming of CCA into their | | | | mainstreaming of the funding |
| budgeting and planning processes developed | | | | strategy |
| Output indicator 2.3 | National government | Consultations and dask | Poviowing the indicator to | Establish a LTPP batwoon |
| Long-term research programme | insititutions | work | assess whether it is | the LIR and MoE. |
| established to address gaps in knowledge | District-level | WOIK | assess whether it is | Develop a framework for |
| needed to inform adaptation planning and | District-iever | | if not propose the changes | cost-benefit analyses: |
| funding in Rwanda | | | to be made: | Develop business plans and |
| | | | to be made, | financial models. |
| Output indicator 2.4: | Site level of pilots | Developed protocols | Reviewing the indicator to | Developing protocols for the |
| EbA interventions implemented in five pilot | | for the EbA | assess whether it is | implementation of |
| sites based on CCA strategy and | | interventions on the | appropriate, SMART, etc. | agroforestry, intercropping |
| implementation protocol developed. | | basis of the catchment- | if not propose the changes | and the stabilising of |
| | | level adaptation | to be made; | plantation verges with |
| | | strategies | | vegetation |
| Indicator 2.4.1 | Individual level (can | (Identify specific | Reviewing the indicator to | Interviews with household |
| | be done at | adaptation benefit | assess whether it is | heads using individual |
| Number of people benefitting from adaptation | household level x | streams, for example, | appropriate, SMART, etc. | questionnare and conducting |
| technologies, measures, and practices | average household | participation in | if not propose the changes | focus group discussion with |
| | size) | agroforestry intiative, | to be made; | local communities. |
| | | practicing of | Developing individual | |
| | | conservation | questionnaire. (assess | |
| | | agriculture, terracing, | social economic status of | |
| | | etc. Individuals may | households | |
| | | practice more than one | | |

| Indicator | Level of analysis | Methodological | Specific tasks to | Specific tasks to collect |
|---|-----------------------|---------------------------|-----------------------------|--------------------------------|
| | | approach | review the indicators | baseline information |
| | | | to be SMART ⁶ | |
| | | adaptation technology, | | |
| | | measure, or practice so | | |
| | | the methodology | | |
| | | should be clear on how | | |
| | | this is accounted for.) | | |
| Indicator 2.4.2 | Land area in hectares | (Among the pilot sites | Reviewing the indicator to | (Site visits, recording of GPS |
| | | identified, establish | assess whether it is | information of areas with |
| Number of hectares of land sustainably | | method of estimate the | appropriate, SMART, etc. | adaptation practices; |
| managed for long-term adaptation | | number of ha under | if not propose the changes | Use of satellite images, maps, |
| | | sustainable | to be made; | shape files covering the five |
| | | management for | Preparation of field visits | sites under investigation to |
| | | adaptation. This can be | with necessary | describe their bio-physical |
| | | done, for example, by | instruments (Tablets with | characteristics. |
| | | defining what practices | embedded GPS and high- | |
| | | respond to the climate | resolution camera etc.); | |
| | | threats in the area | Looking for satellite | |
| | | (flooding, drought, etc.) | images, maps, shape files | |
| | | and system of | covering the five sites | |
| | | measuring land area | under investigation. | |
| | | through site visits and | | |
| | | GPS recording, etc.) | | |
| Indicator 2.4.3 | Number of strategies | Assessment of | Reviewing the indicator to | (interviews with project |
| | scaled up | appropriate adaptation | assess whether it is | mangers / district staff at |
| Number of adaptation technologies, measures, | - | technologies, measures, | appropriate, SMART, etc. | different sites); |
| and practices scaled up for sustainable long- | | and practices to be | if not propose the changes | The use of secondary data on |
| term use | | scaled up for | to be made; | successful technologies |
| | | sustainable long-term | Listing strategies to be | measures and practices |
| | | use | used in implementation of | elsewhere. |
| | | | appropriate adaptation | |
| | | | technologies, measures, | |
| | | | and practices scaled up for | |
| | | | sustainable long-term use. | |

| Indicator | Level of analysis | Methodological | Specific tasks to | Specific tasks to collect |
|--|---------------------|--------------------------|-----------------------------|------------------------------|
| | | approach | review the indicators | baseline information |
| | | | to be SMART ⁶ | |
| | National and sub- | Consultations and desk | Reviewing the indicator to | |
| Output indicator 2.5: | national levels | review | assess whether it is | |
| | | | appropriate, SMART, etc. | |
| Strengthened awareness of the private sector | | | if not propose the changes | |
| on national adaptation priorities, future | | | to be made; | |
| climate scenarios, risk assessments and | | | Listing strategies to be | |
| investment opportunities, to stimulate the | | | used in implementation of | |
| implementation of CCA. | | | appropriate adaptation | |
| | | | technologies, measures, | |
| | | | and practices scaled up for | |
| | | | sustainable long-term use | |
| Outcome 3 Indicator | Indicators from | (Assessment of existing | Reviewing the indicator to | (Interviews with government |
| | national / sectoral | outcome-level | assess whether it is | staff in charge of reporting |
| Number of adaptation outcome-level | levels | indicators; identify | appropriate, SMART, etc. | and establishing / revising |
| indicators revised and developed to inform the | | which national / | if not propose the changes | indicators) |
| monitoring of adaptation in Rwanda | | sectoral level– | to be made | |
| | | frameworks have such | Developing interview | |
| | | indicators, what are the | protocols | |
| | | entry points for | | |
| | | developing further | | |
| | | indicators, and what | | |
| | | adaptation monitoring | | |
| | | frameworks exist) | | |
| Output 3.1: | Indicators from | | Reviewing the indicator to | Revision of existing |
| A framework for the monitoring of long-term | national / sectoral | | assess whether it is | monitoring and reviewing |
| CCA outcomes developed. | levels | | appropriate, SMART, etc. | systems; |
| | | | if not propose the changes | Develop tools and processes |
| | | | to be made | for technical staff of the |
| | | | Developing interview | government and district |
| | | | protocols | institutions |
| | | | | |
| Output 3.2: | Indicators from | performance indicators | Reviewing the indicator to | Facilitate the assessment of |

| Indicator | Level of analysis | Methodological | Specific tasks to | Specific tasks to collect |
|--|---------------------|--------------------------|----------------------------|------------------------------|
| | | approach | review the indicators | baseline information |
| | | | to be SMART ⁶ | |
| Adaptation indicators mainstreamed into the | national / sectoral | developed will be | assess whether it is | efficiency and effectiveness |
| main sectoral and development monitoring | levels | mainstreamed into | appropriate, SMART, etc. | of climate expenditures; |
| frameworks | | sectoral monitoring | if not propose the changes | Develop user-friendly |
| | | frameworks | to be made | training manual on public |
| | | | Developing interview | financial management |
| | | | protocols | systems. |
| Output 3.3: | Indicators from | Documenting and | Reviewing the indicator to | Assess the progress of the |
| Progress reports and communication material | national / sectoral | analysing the successes, | assess whether it is | advancement of the NAP |
| to learn from the formulation, implementation, | levels | failures and lessons | appropriate, SMART, etc. | process using outcome- |
| funding and monitoring of the NAP process | | learned from the | if not propose the changes | based indicators. |
| | | formulation, | to be made | |
| | | implementation, | Developing interview | |
| | | funding and monitoring | protocols | |
| | | of the NAP process | | |

2.2.1. Project Objective Indicator

To measure the project objective indicator "Degree to which the technical and institutional capacity of targeted government institutions, district-level stakeholders and local communities is strengthened at national and sub-national levels to advance Rwanda's NAP process" a scorecard approach would be followed.

Scoring methodologies

Scoring methodologies developed by the TAMD and PPCR and adapted from the GEFSec – AMAT will be used. The following key aspects will be considered for scoring:

(i) Degree of integration of climate change into national, including sector, planning.

This indicator is designed to capture the extent to which considerations of climate resilience (risks, opportunities) are integrated into planning processes at national and sectoral levels. It is relevant to interventions intended to build the capacity of countries to address climate resilience through the development of climate plans, strategies and mainstreaming mechanisms and systems. Degree refers to the depth of the process of integration of climate resilience within national, ministry and sector planning.

This indicator is a qualitative assessment of the various strategies, policies, plans and documents to observe changes in terms of the integration of climate change priorities into national, including sector planning. The qualitative assessment will focus on the following criteria:

- ✓ Existence of a specific climate change policy, plan
- Climate resilience strategies embedded in the principal planning documents at various levels (national, sector, ministry);
- ✓ Responsibility assigned to coordinate the integration of climate resilience into planning;
- ✓ Specific measures to address climate resilience identified and prioritized e.g. laws, regulations and incentives in these policies and plans; and
- ✓ Routine screening for climate risk in planning.

Defining clear scoring criteria helped to make the subjective assessment more objective, reliable, and consistent. Scoring criteria was established for each of the aspects of the scorecard before the baseline scores can be determined. These criteria, once established, they remain constant throughout the life of the project and become part of the Monitoring and Reporting Plan.

The scoring at institutional level was done at the beginning of the project, having identified the recipient of different trainings and recording their score and then recording their ultimate scores at different times and observing the progress. The scoringis linked to outocome I Increase in adaptation planning capacities among national staff across four ministries. Furthermore the criteria followed by the TAMD and PPCR and adapted from the GEFSec – AMAT were used.

1. Are the stakeholders aware of the current and expected impacts of climate change and have access to accurate climate information?

- 2. Do the stakeholders have the capacity to access adaptation funding?
- 3. Do the stakeholders have the capacity to plan for and implement CCA approaches?

4. Do the stakeholders have access to proven EbA methods that are specific to Rwanda's various biophysical environments

5. Is there evidence of adequate institutional capacities for the continuous monitoring and reviewing of and learning from adaptation initiatives?

The study conducted an assessment on the ability and preparedness of the targetted governmental institutions (16) to implement NAP process, below is the status of undertaken trainings related to climate change by 16 invistageted institutions. The grading of institutions in trainings was 0 if it never did any trainings, 1 if it rarely did trainings,2 if it did trainings sometimes, 3 if it did trainings frequently and 4 if it did trainings very frequently.

In the end the scores allocated to different institutions were aggregated where I = (0 - 10%); 2 = (11 - 20%); 3 = (21 - 30%); 4 = (31 - 40%); 5 = (41 - 50%); 6 = (51 - 60%); 7 = (61 - 70%); 8 = (71 - 80\%); 9 = (81 - 90\%) and 10 = (91 - 100\%).

Possible scenario

| Key question | Institutional | Follow up of | Monitoring | Assess |
|---------------------|----------------|-----------------|-------------------|------------------|
| | capacity | climate | and | climate risks |
| | | change | evaluation | for |
| | | activities | system | sustainable |
| | | | | planning |
| ls there an | Have climate | Has | Have specific | Do all planning |
| approved climate | resilience | responsibility | measures to | processes |
| change plan for the | strategies | been assigned | address climate | routinely screen |
| sector? | been | to institutions | resilience been | for climate |
| | embedded in | or persons to | identified and | risks? |
| | the central | integrate | prioritized? e.g. | |
| | government's/ | climate | investments and | |
| | sector's | resilience | programs | |
| | principal | planning? | | |
| | planning | | | |
| | documents? | | | |
| Gender | Lessons | What have been | Please let us | |
| Mainstreaming: To | learned: | the key | have some | |
| what extent and in | What have | challenges and | insights into the | |
| what ways have | been the key | what | particular | |
| gender and | successes | opportunies for | experience with | |
| socioeconomic | when | improvement | integrating | |
| vulnerability | integrating | do you see? | climate change | |
| concerns been | climate | | in nationnal, | |
| mainstreamed with | change in | | including sector | |
| the climate | national, | | planning | |
| resilience planning | including | | | |
| processes at | sector | | | |
| national and sector | planning | | | |
| levels? | during last | | | |
| | calendar year? | | | |

(ii) Evidence of strengthened government capacity and coordination mechanism

This indicator assessed how the project will contribute to strengthening government capacity in adaptation planning and a coordination mechanism for long term adaptation planning.

The indicator calls for the measurement of two distinct components:

- ✓ strengthened institutional and technical capacity for NAP process in Rwanda
- ✓ strengthened coordination mechanism to mainstream climate resilience.

The indicator is qualitative in nature. Defining clear scoring criteria help making the subjective assessment more objective, reliable, and consistent. The scoring criteria agreed upon by different in-country stakeholder groups (where None = 0; Little = 1; Some = 2; Most = 3 Very high = 4) provides a robust and objective assessment of the progress towards meeting the objective of strengthening government capacity and coordination mechanism to

mainstream climate resilience at national and sector level. Scoring criteria was established for each of the aspects of the scorecard before the baseline scores can be determined. These criteria will remain constant throughout the project life and become part of the Monitoring and Reporting Plan.

| Possible solutions | | | | | | |
|--|--|--|---|--|--|--|
| Key question | Institutional | Follow up of | Monitoring and | | | |
| | capacity | climate change | evaluation system | | | |
| | | activities | | | | |
| Are information, studies and assessments addressing climate change, variability, adaptation and resilience available? | ls the necessary climate change expertise available? | Do national/sector incentives and legislative policies expressly address climate change and resilience? | Does the government/sector participate in the coordination mechanism? | | | |
| Is the coordination mechanism functional e.g., established, effective and efficient? Are females and males participating equally? | Does it coordinate climate adaptation planning | Is there a broad set of nongovernmental stakeholders involved? | Is the relevant climate adaptation information in the public domain? | | | |

(iii) Quality and extent to which climate responsive instruments/investment models are developed and tested

This indicator assessed the extent to which vulnerable households, communities, businesses, and public sector services used improved adaptation tools, instruments, strategies, and activities to respond to climate variability or climate change.

A climate responsive instrument or investment models is one that incorporates climate variability and climate change considerations or can be applied to enhance the climate resilience of people, products, systems or services. Examples are:

- ✓ Technologies or infrastructure investments (e.g., improvements to buildings, agricultural, coastal, hydro-meteorological, transport, water, drainage, ICT and energy systems);
- Data, analytical work, technical studies, and knowledge assets (e.g., climate scenarios, forecasts, vulnerability assessments, climate risk/impact analyses, maps, needs assessments and guidelines/manuals);
- Public awareness platforms (e.g., information dissemination platforms, weather information services, media campaigns, knowledge sharing events, stakeholder networks, websites and e-learning platforms);
- ✓ Financial instruments (e.g., micro/insurance, micro/finance, small grants and loan facilities);
- Public/community services (e.g., services providing water, sanitation, transport, flood protection, irrigation, early warning, social protection, education and health).

The following questions will be asked"

- ✓ Which climate responsive instruments/investment models have been developed and tested?
- ✓ For each instrument/investment model, answer the following questions: a) Has the instrument/investment model been developed and tested? b) Has it been implemented to the scale proposed? c) Has it appropriately incorporated the needs of both female and male users into its design and implementation? d) Has it incorporated the needs of vulnerable populations into its design and implementation?

2.2.2 Outcome I Indicator: Increase in adaptation planning capacities

Increase in adaptation planning capacities among national staff across 16 governmental institutions (see annex 10.5), district and catchment-level committees and senior high school teachers in the four catchments targeted by the project. A scorecard approach, based on interviews were used to measure increase in adaptation planning capacity. Therefore, this require the key informant interviews with leaders at central and institutional level (see annex 10.4), key informant interview with district and catchment level staff/officials (see annex 10.3), Focus Group Discussion with senior high school teachers and Head Teachers (see annex 10.3) and collection of secondary data related to adaptation planning capacities among national staff, district and catchment-level committees and senior high school teachers.

2.2.3 Outcome 2 Indicators: Number of pilot sites established

Number of pilot sites were established under the LTRP to conduct research on the financial and economic effectiveness of EbA, percentage of people benefitting from the adaptation technologies, and practices implemented at pilot sites; area of land (ha) managed sustainably for long-term adaptation at the pilot sities; and number of adaptation measures/technologies scaled up for sustainable long-term use. This was achieved through systematic screening of projects managed by REMA, projects with donor funding, initiatives from other institutions / district level, etc.). Additionally, other projects and initiatives, including LDCF II if these pilot sites can be included in the LTRP were examined. Criteria for including initiatives / sites need to be closely aligned with analysis of financial and economic effectiveness of EbA and other elements of the indicator

2.2.3.1 Indicator 2.1: Number of people benefitting from adaptation measures, technologies and practices

This indicator determined whether projects/programs for climate resilience action reached and support people on the ground as intended. The emphasis of this indicator is on availability of the service or facility. The number of people supported by each relevant sub project needs to be established first and then aggregated across projects/programs in order to estimate and report on the total number of people supported by the projects and programs under the project.

For this indicator, a survey was conducted at household level at project EbA five pilot sites namely: Shagasha Tea Estate (Rusizi district), Muvumba river (Nyagatare District) Savannas (Nyagatare district); Ibanda-Makela Natural Forest in the Kirehe district and restoration of a Nyandugu wetland. A questionnaire (annex 1) was used in this regard. The responses from the questionnaire provided baseline information for the beneficiaries of Ecosystem Based Adaptation (EbA) interventions under output 2.2.

2.2.3.2 Indicator 2.2: Number of hectares of land sustainably managed for long-term adaptation

The estimate percentage of area under sustainable management for adaptation was established among the pilot sites. This was done by defining what practices responding to the climate threats in the area (flooding, drought, etc.) and system of measuring land area through site visits and GPS recording, etc.). The satellite images, maps, shape files covering the five sites under investigation were also utilized to describe their bio-physical characteristics

2.2.3.3 Indicator 2.3: Number of adaptation technologies, measures, and practices scaled up for sustainable long-term use.

Assessment of appropriate adaptation technologies, measures, and practices to be scaled up for sustainable long-term use was done based on gathered information through interviews with project mangers / district staff at different sites. The use of secondary data on successful technologies measures and practices elsewhere complemented the above-mentioned assessment.

2.2.4 Outcome 3 Indicator: Number of adaptation outcome-level indicators revised and developed to inform the monitoring of adaptation in Rwanda.

The outcome-level indicators were assessed to identify which national / sectoral levelframeworks have same indicators with possible entry points for developing further indicators along with the establishment of adaptation monitoring frameworks foreseen. This requires interviews with government staff in charge of reporting and establishing / revising indicators. The Result Based Monitoring and Evaluation System (RBM&E System) which aims at providing the Environment sector managers and other sector stakeholders was used. RBM&E provides evidence-based information on performance levels towards achieving respective strategic objective. The RBM&E system is also aimed at establishing causes of observed performance states and trends in order to decide on appropriate corrective or up-scaling interventions.

2.4. Survey design and tools to assess social economic conditions of project beneficiaries

In reference to the terms of reference, the first task says "In close cooperation with the district technicians, develop a questionnaire, collect and document baseline data at project sites : bio-physical status and socio-economic conditions of beneficiaries that are gender-disaggregated when relevant, for the project indicators established. Baseline values should be fully established for the relevant project indicators on the basis of the data collected".

In order to collect baseline information for outcome 2 indicator:

Indicator 2.1: Number of people benefitting from adaptation measures, technologies and practices

A survey was conducted at household level at project EbA five pilot sites namely: Shagasha Tea Estate (Rusizi district), Muvumba river (Nyagatare Districct) Savannas (Nyagatare district); Ibanda-Makela Natural Forest in the Kirehe district and restoration of a Nyandugu wetland. A questionnaire (annex I) was used in this regard. The responses from the questionnaire provided baseline information for the beneficiaries of Ecosystem Based Adaptation (EbA) interventions under output 2.2.

Both quantitative and qualitative approaches were used with a triangulation of data collection/generation methods and techniques. The quantitative approach involved the use of questionnaires, while the qualitative approach combined with desk review, Focus Group Discussions (FGD) and Key Informant Interviews (KII). The following are the key modules of the quantitative questionnaire:

- I- Module one was used to collect information on household characteristics.
- 2. Module two was used for collecting information on basic socio-economic characteristics and for the identification of respondent.
- 3. Module three was used for collecting data on the sources of household income/livelihood. This includes the main source of household income in the last year, household income per month, reared domestic animals and used medical treatment for livestock.
- 4. Module four was used to collect data on land property with specific focus on land ownership, land size and use.
- 5. Module five was used for collecting data on the home/homestead characteristics. It captures information on house ownership, the number of rooms in the house, materials used on the walls, materials used for foundation, materials used for the roof, possession of housing equipments, quality of toilets, causes of damages experienced on the house and location of the house.
- 6. Module six was used to collect data on household financial assets and savings especialy on the possession of a bank account, access to a loan/credit, membership to tontine and cooperative.
- 7. Module seven was used to collect information on the possession of health insurance by household, illness situation in household and distance to the nearest health center.
- 8. Module eight was used for collecting information on food security, especially on the capacity of households in terms of number of meals per day, most important meal of a day, preferable meal, and assistance received in terms of food or money from the government or other institution, experiences of food shortage, and main causes of food shortage.
- 9. Module nine was used to collect information on access to basic facilities and infrastructure. This includes the main source of water for domestic use and for irrigation activities, the quantity of water used per day for domestic usage, possession of water tanks or any other tools used for rain water collection, possession of infrastructure to clean water, responsible person for getting domestic water, distance to the water source, the main source of energy used for cooking, use of firewood and charcoal, the main mode used for cooking, the main source of energy used for lightening in houses, and possession of transport and communication means.
- 10. Module ten was used to collect information on the access to weather/climate information, including access to weather/climate information, reception of weather/climate information and of technical advice or training related to the use of

weather information, adoption of the climate resilient technologies, cropping and agricultural activities, possession of a kitchen garden, growing tea and coffee plantation, possession of forest and progressive terraces in farmland, other methods used to protect land against flooding, soil erosion and landslides, the skills used on the plots, visits by extension services, and members of household who received any agricultural inputs in last 12 months.

- 11. Module eleven was used to collect information on the experiences of climate change and variability, including exposure to climate change during the last 12 months, observed changes in temperature and rainfall, experienced or observed dry spells, the consequences of drought and flooding episodes, occurrences of strong winds and their consequences, experienced severe thunder storms and their consequences, and awarenes of the adverse effects of climate change.
- 12. Module twelve was used to collect information on the capacity to adapt to the impacts of climate change. This includes change in woodland areas, membership to any Forest Management Units, the capacity to deal with climate change, knowledge on the appropriate adaptation measures to be undertaken to deal with climate change, awareness of improved soil management practices, and awareness of erosion control practices, among others.

It is important mentioning that the main topics to be covered in the KIIs are the sources of income for households in areas under investigation, the observed negative impacts of climate change on household welfare and adaptation measures used by households to deal with them. Furthermore, the KII guide were used to investigate on the support received by households in coping with adverse effects of climate change, and the existing relationship between food security in the area and climate change. The key informants were also asked on the appropriate measures which should be used to deal with adverse impacts of climate change in the areas under investigation.

As for the FGDs, the main modules cover the following topics: the main sources of income for your family, negative impacts experienced due to drought, dry spells or flooding episodes, negative impacts faced from any other extreme weather events, support received in case households were affected by weather extreme events, and strategies in place to mitigate the negative impacts of extreme weather events.

All quantitative interviews were held at the respondents' house. The questionnaire were administered to the head of the household when available, or a representative above 18 years old.

KIIs took place at the respondents' office premises or even in the office itself, while the FGDs will be held in the environment where it was easy for the group to meet and held a discussion, such as a common room, outside under a tree shade or anywhere in the compound of the institution or homestead.

For more details on each of the data collection tools to be used please refer to the attached questionnaire as well as the technical note attached to this document.

2.4.1 Target Group

The target population for the survey were all households living around five pilot sites which number to approximately 2,850 households and the sample is of 375 households namely: 35 Shagasha Tea Estate

(Rusizi district), Muvumba River (Nyagatare District) Savannah (Nyagatare district), Ibanda-Makela Natural Forest in the Kirehe district and Nyandungu wetland and officials of key stakeholders who have direct hand on the project not forgetting district leaders, local leaders and other members of the communities.

N Burera Musanze Gicumbi Gatsibo Nyabihu Gakenke Rulindo Kayonza Ngororer Gasabo Rutsiro agenae Rwamagana Kamony Kicu Karongi Ngoma Ruhango Bugesera Kirehe Nyanza amashek Nyamagabe Huye Rusizi Gisagar Nyaruguru Nyagatare (Muvumba & Savannah) Mpanga sector (Ibanda Makera forest) Sectors around Nyandungu marshland 60 15 30 Giheke (Shagasha Tea Estate) Km **District boundaries**

Figure 1: Location of sectors under investigation

It is important to highlight that the study areas include five sites located in four districts. Both site located around Muvumba River and Savannah respectively are found Nyagatare District especially in four sectors namely Karama, Tabagwe, Rukomo, Nyagatare and Rwempasha. Shagasha Tea Estate is located in Rusizi district, Giheke sector while Ibanda-Makela natural is found in Kirehe district, Mpanga sector, Nasho cell and Nyandungu mashland is extended in Gasabo district, Ndera sector and Kicukiro district and Nyarugunga sector.

2.4.2. Procedure for sample design

To respond to outcome I: The respondents were selected from the following three groups:

- National institutions (Purposive selection of 16 respondents from key stakeholders were selected).

- District-level institutions (Purposive selection of 12 leaders at district, sector and school levels were selected at project sites)
- Local communities (Purposive selection of local leaders and random systematic sampling of household heads: 397 with 22 above 375 planned in inception report)

Key informant interview were held with selected leaders/officials at central and institutional level, district and catchment level while Focus Group Discussion were administered to selected senior high school teachers.

To respond to outcome 2: The individual questionnaire were only given to the sampled respondents in process of gathering information on socio-economic conditions of project beneficiaries. The sample in intervention area was selected in two stages: at area (village / umudugudu) and household level. At the village level, villages were purposely selected as only villages falling in sites/areas under investigation were sampled. At the household level, the sampling rates were determined separately for each stratum (village), and sample units (households). It was systematically selected with a random starting number in each stratum using the list of all households established at the village level.

Note that the systematic sampling scans the entire sample frame (list of individuals in the population) to enable a good spatial distribution of the sample across the study area (e.g. Shagasha Tea Estate, around Muvumba River in Nyagatare District, in Savannas in Nyagatare district, around Ibanda-Makela Natural Forest in Kirehe district and Kimicanga wetland. Then, the head/member of household or another household member above 18 years responded to the questionnaire.

To respond to outcome 3: Identified government staff in charge of reporting and establishing / revising indicators) was interviewed

| S | Areas | Sector | Cell | Village | Number of | Total |
|---|----------------|-----------|------------|--------------|-------------|--------|
| Ν | | | | | households | respon |
| | | | | | per village | dents |
| Ι | Around | Giheke | Giheke | Murambi | 25 | 75 |
| | Shagasha Tea | Giheke | Giheke | Karambo | 25 | |
| | Estate | Giheke | Giheke | Wimana | 25 | |
| 2 | Around | Karama | Kabuga | Bukamba | 15 | 90 |
| | Muvumba | Karama | Bushara | Uruyenzi | 15 | |
| | River | Tabagwe | Nkoma | Kabeza | 15 | |
| | | Tabagwe | Gitengure | Gitengure | 15 | |
| | | Rukomo | Nyakagaram | Nyakagarama | 15 | |
| | | | а | | | |
| | | Rukomo | Rurenge | Benishyaka | 15 | |
| 3 | Eastern | Nyagatare | Nyagatare | Nyagatare II | 15 | 60 |
| | Savanna, | Nyagatare | Nyagatare | Nsheke | 15 | |
| | Nyagatare | Rwempas | Cyenjonjo | Cyenjonjo | 15 | |
| | district | ha | | | | |
| | | Rwempas | Rwempasha | Uwinkiko | 15 | |
| | | ha | | | | |
| 4 | Around | Mpanga | Nasho | Nyawera I | 25 | 75 |
| | Ibanda-Makela | Mpanga | Nasho | Nyawera 2 | 25 | |
| | Natural Forest | Mpanga | Nasho | Ibanda | 25 | |

2.4.3. Sample size

| | in Kirehe | | | | | |
|-------|--------------|----------|---------|----------|----|-----|
| | district | | | | | |
| 5 | Around | Ndera | Masoro | Kabeza | 25 | 75 |
| | Nyandunguwet | Ndera | Kibenga | Buhoro | 25 | |
| | land | Nyarugun | Nonko | Runyonza | 25 | |
| | | ga | | | | |
| Total | | | | | | 375 |

The sampling frame for the household's survey on socio-econdomic conditions of beneficiaries covered the areas around Shagasha Tea Estate, around Muvumba River in Nyagatare District, in Savannas in Nyagatare district, around Ibanda-Makela Natural Forest in Kirehe district and Nyandungu wetland.

The village was Primary Sampling Unit (PSU) as recommended by the National Institute of Statistics of Rwanda (NISR). The households to be interviewed were sampled from the 19 villages surrounding the sites under investigation. The table below shows the sample size:

Table 2: Distribution of sampled villages

2.4.4. Data collecting tools

In view of the Survey objectives, the individual questionnaire, Focus Group Discussions and Key Informants Interviews (FGDs/KIIs) guides were designed (attached as appendices), based on the indicators highlighted in ToRs and proposed mixed methods. The structured questionnaire was used for collecting primary numerical/quantitative data, while interview guides were used for qualitative data (FGDs and KIIs).

In order to ensure feasibility of the survey, a pre-test were undertaken after the training of enumerators. The key objective of the pre-test is to test the procedures of data collection, the irregularities that could be still in the individual questionnaire and FGDs/KIIs guides. It also helps to find out how many questionnaires an enumerator can complete in a day. The survey manager received feedback from the field teams which were accounted for in the main field work. The final version of the individual questionnaire and FGDs/KIIs guides were developed, translated in Kinyarwanda. A field interview protocol were developed by consultants indicating the exact procedures to follow at village level (including introductions on first day, time for lunch breaks, return from village to overnight accommodation, etc.).

Guidance to enumerators and supervisors were well documented before taking them to the field. The manual, tabulation and analysis plan were conceived and agreed upon with the client before the field data collection.

(i) Training of enumerators and supervisors

In the preparation of the field work phase, the consultant together with the client were actively involved in training session, analysis of the completeness, comprehension and usability of the individual questionnaire and FGDs/KII guides for data collection. The translated questionnaire in Kinyarwanda were validated by the client and thereafter digitalized and uploaded on the tablets using Open Data Kit software (ODK). This ODK helps to collect field data on a mobile device and transmit it to a server from where they are extracted for analysis. In addition, the GPS incorporated in ODK helped to regularly monitor geographical location

and progress of the interviews. This particularly enhanced quality validity and reliability for the findings.

(ii) **Pre-test of survey tools**

The pre-test was carried out in Ndera Sector, Rudashya Cell, and Munini village to allow enumerators to be familiar with the questionnaire. This area was selected purposively as it has rural characteristics and it is near to Kigali City where the training of enumerators and supervisors will take place. The questionnaire was tested for its comprehension, and the time it takes to fill it in. GPS coordinates were also taken to test the usability of data in mapping. The survey managing team received feedbacks from enumerators which were utilized to fineturn the questionnaire.

2.5. Field work for data collection

2.5.1. Primary data collection

(i) Interviews through individual questionnaire

The consultant conceived an application using survey 123 the one used for the REMA GIS monitoring system and uploaded on the tablets. Data was stored on REMA server from where they were extracted for analysis. Notwithstanding that the GPS incorporated in the tablets provided data to be used in preparation of maps, it also helped to regularly monitor geographical location and progress of the interviews.

(ii) Collection of data with tablet and their transmission to REMA nosting server

The use of SAMSUNG Galaxy 2016 tablets as devices for data collection and the data will be transmitted to the REMA server. Each enumerator filled in information gathered from the respondents. Geo reference of localities were retrieved from the existing GIS database. These were used to display results on maps using GIS technology embedded in the tablets.

(iii) Focus group discussions (FGD)

Two Focus Group Discussions (FGDs) were held in each site under investigation to enhance the in-depth understanding of the topic under study. Hence, 10 FGDs will be undertaken in course of this study. The FGD were composed of 4-6 participants selected from respondents with similar characteristics to ensure that everyone has an opportunity to express their views freely. The FGDs venue were held near participants' area of residence/working place to avoid transport expenses.

(iv) Key Informant Interviews (KII)

The key informant Interviews were also conducted during this study and were mainly targeting the local leaders at study area and other leaders with a hand on the topic under investigation. The annexed KII guide was used and method of gething information was the question-answer method. The interviews were sought and conducted with the following stakeholders.

Table 3: List of Key informants

| SN | Institution/informants | Outcome/Indicat | Tool |
|----|--|-----------------|-------|
| | | or | |
| I | Ministry of Environment (MoE) | Outcome I & 3 | Annex |
| 2 | Ministry of Finance and Economic Planning | | 10.4 |
| | (MINECOFIN) | | |
| 3 | Ministry of Local Government (MINALOC) | | |
| 4 | Ministry of Infrastructure (MININFRA) | | |
| 5 | Ministry of Emergency Management (MINEMA) | | |
| 6 | Ministry of Agriculture (MINAGRI) | | |
| 7 | Ministry of Education (MINEDUC) | | |
| 8 | Rwanda Land Management and Use Authority (RNMUA) | | |
| 9 | Rwanda Development Board (RDB) | | |
| 10 | Rwanda Mines, Petroleum and Gaz Board (RMB) | | |
| | Rwanda Forestry Authority (RWFA) | | |
| 12 | Rwanda Water Resources Board (RWB) | | |
| 13 | Rwanda Green Fund (FONERWA) | | |
| 14 | Rwanda Meteorology Agency (Meteo Rwanda) | | |
| 15 | Rwanda Agriculture Board (RAB) | | |
| 16 | Rwanda Environment Management Authority (REMA) | | |
| 17 | Rusizi district leaders (2) | Outcome I & 3 | Annex |
| 18 | Shagasha Tea Estate leader (I) | | 10.3 |
| 19 | Nyagatare district leaders (2) | | |
| 20 | Muvumba River catchment (I) | | |
| 21 | Gasabo district leaders (2) | | |
| 22 | Kicukiro district leaders (2) | | |
| 23 | Kirehe district leaders (2) | | |

2.5.2. Secondary data collection

The secondary data (reports, communication materials, consultancy products on projects, interventions for Outcome Indicator 2.2, 2.3 and Project Objective Indicator) were collected to complement the primary field data. Project data were sourced from REMA and other stakeholders who have link with the topic under investigation such as Ministry of Environment, Rwanda Meteorology Agency (Meteo - Rwanda), FONERWA, MINAGRI, etc. Additional data were sourced from the National Institute of Statistics of Rwanda (NISR) and other relevant governmental and non-governmental institutions which host a comprehensive and complete dataset needed to perform this assignment. Furthermore, the secondary data were also obtained from published articles, books, thesis and papers.

2.6. Research quality assurance and ethics

The research underpinned by a commitment to integrity, honesty and competence. Participation in the research was voluntary; all informants were asked to give informed consent to their participation. All interviews were carried out in private and confidentially as well as anonymity assured. All survey data were stored to ensure that there was no possibility of data leakage. Participants in FGDs were asked to respect the confidentiality of what members of the group say.

2.7. Data processing

The ODK Collect software on the convenient tablets and capture data were used and the data were sent daily to server hosted by the client. ODK Collect has an inbuilt cleaning checks on outliers and were automatically to the systems administrator the observed errors daily and he/she in turn can verify the data with the enumerator in question. The dataset were exported from the server in CSV format from the server and converted in SPSS format for tabulation and analysis. Maps were processed using Arc Map software.

2.8. Data cleaning, tabulation plan and dataset

Once data file has been produced and exported, tabulations was generated using appropriate software such as SPSS, Arc map (GIS tool), and detailed data were presented in a format which were agreed with the client. It is worth mentioning that the data collected were organized in a form that can allow quantification by use of codes and numbers. The conceived tabulation plan was made to guide in the interpretation of the results.

2.9. Data analysis

Socio-economic conditions of project beneficiaries were analyzed using descriptive and inferential statistics to inform the research. The analysis were done by considering the key indicators and components of the projects. The key findings from individual questionnaire, FGDs, and KIIs were presented in form of tables and graphics and then discussed and interpreted in process of compiling the final report. It is worth noting that these findings were complimented by the secondary information gathered from various sources mentioned in general introduction.

2.10. Collection of bio-physical baseline data.

In response to outcome 2, indicator 2.2, bio-physical characteristics including flora and fauna, geomorphology, geology and soils, topography, climate and hydrology of five sites under investigation: Shagasha Tea Estate (Rusizi district), Muvumba River (Nyagatare District), Savannas (Nyagatare district), Ibanda-Makela Natural Forest in the Kirehe district and Nyandungu wetland were assessed using the direct observation, field based data collection method and existing secondary data. The latter include meteorological data of the neaby weather stations, reports, maps, satellite imegeries, articles, project documents, official publications, ortho-photo, and Google Earth, among others.

The field photographs were taken with camera of high resolution at each of five project sites and the delineation of the sites were made by using GPS receivers with high accuracy and all areas were presented spatially on the map. Additionnaly the secondary data like existing maps, satellite imegeries, ortho-photo and google map, among others were served for the following purpose:

- **Delineation of features:** The areas were delineated using GPS receivers with high accuracy and all areas were presented spatially on the map. The boundaries of areas under investigation, road networks, rivers and forests were delimited from the remaining parts of the study areas and satellite imegeries, ortho-photo and google map were used to validate results.
- **Description of the study areas and acquisition of photographs:** The natural and human made environment including the land use, infrastructures, socioeconomic situation, ecological and environmental challenges were well studied and interpreted. Furthermore, some photographs used the high resolution camera

were taken to show main features of the study areas such agricultural and livestock activities, topography, soil types, vegetation, fauna and flora, etc.

- Analysis of bio-physical characteristics of project sites using the existing maps, Google Earth ortho-photo: The existing map, reports, published documents, photographs taken of field, Google Earth and ortho-photo were studied to evaluate the changes which took place in land use, fauna, flora, topographythroughout the years to be able to assess their impacts on population livelihoods and natural environment. The clear aerial photographs and ortho-photo of the areas of the study will be examined by an analyst in a systematic manner with the help of some supporting information collected from maps, field visit reports, or previously interpreted images of the same area. The interpretation of the information were carried out on the basis of certain physical characteristics of the object(s) and phenomena appearing in the image.
- Fournier Index (FI) and Modified Fournier Index (MFI) will be calculated by way of aggregated the mean monthly precipitation to estimate the spatial variations of rainfall erosivity, run-off at piloted sites which gave the idea on sedimentation taking place in the study area. This method is simpler to be used and to get its inputs compare to Revised Universal Soil Loss Equation (RULSE) which is the product of six factors representing rainfall and run-off erosivity (R), soil erodibility (K), Slope length (L), Slope steepness (S), cover and management practice (C) and supporting conversation practice (P).
- **Preparation of the maps: ArcGIS software (ESRI®, Redlands, CA** will be used to generate maps showing the spatial distribution of the results.

Remote Sensing (RS) imageries, base map components like land use and administrative maps, shape-files and other ancillary maps were used to validate the location of the areas under investigation. Google earth 2017 and 2018 images (0.9 m resolution) were also used in that regard.

2.11. Update the project log frame includinng indicators for tracking project implementation

In order to guide tracking of project implementation, the project log frame and indicators were updated according to the project outcomes and outputs. The following template was used:

The project results framework and indicators

The indicators identified in the NAP Project Document are as follows:

Project objective: The objective of the proposed project is to increase the capacity of governmental authorities and local communities in Rwanda to plan, fund, implement and monitor climate change adaptation solutions in the medium to long-term. A special focus is the enhancement of the climate change adaptation knowledge base, with a particular emphasis on guiding adaptation planning based on technical and financial effectiveness of adaptation measures to inform the funding of the NAP process.

Objective indicator: Degree to which the technical and institutional capacity of targeted government institutions, district-level stakeholders and local communities is strengthened at national and sub-national levels to advance Rwanda's NAP process.

Outcome I: Technical and institutional capacity for the NAP process in Rwanda strengthened using up-to-date climate information.

<u>Proposed Outcome I indicator</u>: Increase in adaptation planning capacities among national staff across sectors, districts- and catchment-level committees and senior high school teachers in the four catchments targeted by the project.

| | Duran and Indian taus |
|---|---|
| Outputs | Proposed Indicators |
| I.I NAP technical working group (TWG) | NAP technical working group (TWG) |
| established. | established and operational |
| 1.2 Downscaled catchment-level climate projections | Downscaled climatic projections for the |
| for Rwanda developed. | four catchments generated. |
| | Staff trained to downscale climatic |
| | projections for the four catchments. |
| | |
| | Climate risk assessment conducted for |
| 1.3 Climate risk assessments for four catchments in | four catchment areas under project |
| Rwanda developed | intervention. |
| 1.4 CCA strategies developed for the four | Climate change adaptation strategies |
| catchments based on climate risk assessments | developed for four catchment areas |
| | under project intervention. |
| | |
| 1.5 CCA measures from catchment-level adaptation | National climate change adaptation |
| strategies extrapolated to the national level to | strategies developed for priority sectors |
| develop adaptation plans for priority economic | (Agriculture, Infrastructure, and Landuse |
| sectors(Agriculture, Infrastructure, | Management as indicated in National |
| Urbanisation and Landuse Management as | Strategy for transformation). |
| indicated in National Strategy for | |
| transformation I. | |
| 1.6 Refinement of National Determined | Adapation actions from NDC across |
| Contributions (NDC) adaptation priorities | different sectors refined |
| related to the sectoral adaptation plans and | |
| Long term research program (LTRP) | |
| 1.7 Develop training manuals and conduct | I rainings conducted in raising the |
| awareness-raising events for public, private | awareness for public and private sectors, |
| sectors, Civil Society Organisations CSOs and | CSOs and local communities on the NAP |
| local communities on the NAP process | process. |
| | |
| | Staff trained on NAP process |

Proposed output indicators for outcome I

Outcome 2: Climate-resilient technologies and practices adopted and scaled up

<u>Proposed Outcome 2 indicator:</u> Number of pilot sites established under the LTRP to conduct research on the financial and economic effectiveness of Ecosystem Based Adaptation (EbA); number of people benefitting from adaptation technologies and practices implemented at pilot sites; area of land (ha) managed sustainably for long-term adaptation at the pilot sites; and number of adaptation measures/technologies scaled up for sustainable long-term use.

| Outputs | Proposed Indicators |
|---|---|
| 2.1 A NAP funding strategy developed | A NAP funding strategy developed. |
| 2.2 Recommendations for relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed | Recommendations for three relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed. |
| 2.3 Long-term research programme established to address gaps in knowledge needed to inform adaptation planning and funding in Rwanda | MoU between REMA and HEC/high learning institutions signed for establishing long-term research programme established. |
| 2.4 A suite of EbA interventions implemented at LTRP pilot sites | Area covered by EbA inteventions implemented in pilot sites based pilot sites. |
| 2.5 Strengthened awareness of the private sector on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA | Awareness campaigns/ meetings for private sector undertaken on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA. |

Proposed output indicators for outcome 2

Outcome 3: Monitoring, reviewing and knowledge-sharing framework developed to learn from the NAP process in Rwanda

<u>Proposed Outcome 3 indicator:</u> Number of adaptation outcome-level indicators revised and developed to inform the monitoring of adaptation in Rwanda

| Proposed | output | indicators | for | outcome | 3 |
|----------|--------|------------|-----|---------|---|
|----------|--------|------------|-----|---------|---|

| Outputs | Proposed Indicators | | |
|---|--|--|--|
| 3.1 A framework for the monitoring of long-term CCA outcomes developed | Framework for the monitoring and evaluating long-term CCA outcomes developed. | | |
| | Staff in charge of monitoring and evaluation trained across different priority sectors. | | |
| 3.2 Adaptation indicators mainstreamed into the main sectoral and development monitoring frameworks | Adaptation indicators mainstreamed into the main sectoral and development monitoring frameworks. | | |
| 3.3 Provide progress reports and communication material to learn from the formulation, implementation, funding and monitoring of the NAP process | Progress reports produced on NAP process. Communication materials produced to disseminate successes, failures and lessons learnt from NAP process in Rwanda. | | |

2.12. Compilation of final report

The final baseline report will be compiled bearing in mind that it will be a milestone for future impact, and interim and final evaluations. Therefore, the baseline study findings on the key indicators of the project will be compiled into final report to be submitted to the client (REMA)

3. Bio-Physical characteristics of the project sites

3.1. Ibanda-Makera Natural Forest, Kirehe District, Eastern Province

Ibanda-Makera Natural Forest currently covers an area of around 169 ha in 2015¹⁰ and 180 ha in 2020¹¹ which was originally around 1425 ha in 1984 which implies a loss of 88.1%¹². This reveals that the remaining 1245 ha are currently covered by the shurbland. Makera natural forest makes part of the complex of Ibanda-Makera made of two forests, Ibanda (a woodland savanna type located in the East) and Makera (a gallery forest located in the South-West).



Figure 2: Ibanda Makera forest

Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus

Makera forest is contiguous to the Akagera wetland associated to Akagera River in the South-East on the border with Tanzania. A stream is located within the forest, making it an important water catchment for local people. Historically, degradation related to human practices (including agriculture and fuelwood harvesting) has transformed large swaths of the forest into bush, thicket and woodland.

¹¹ Area presented on National Updated Basemap, 2020

¹⁰ Ministry of Lands and Forestry, (2015). Forest Investment Program for Rwanda, Kigali, Rwanda

¹² Idem

Only a small remnant of mature forest patch still exists (westen part on figure 2) which should be well protected to avoid the extinction of this forest. The LDCF2 has planned to restore degraded savannah and forests around Ibanda Makera forest by planting 250 ha with agroforestry trees; 68 ha with indigenous species and 20 ha with fruit trees and 92,473,824 Rfw was planned to be used for these activities¹³. Ibanda-Makela forest is accessed via unpaved roads of 45 km approximetry from district head office. It is also near Mpanda Sector, where there is a trading centre. The area is connected to the national grid, and households rely on electricity as the main source of lighting.

3.1.1. Topography and geomorphology of Ibanda-Makera natural forest

The Ibanda-Makera natural forest is located in the depression of the Akagera River¹⁴, in a low plain with an altitude varying between 1000 m and 1,500 m asl. It is surrounded in the south and east by the Akagera Wetland with an average altitude of 1000 m and in the north by a series of hills with an average altitude of 1,500 masl¹⁵.

3.1.2. Geology and soils

Kirehe district including Ibanda-Makera forest is covered by alternating schist and quartzite layers with average groundwater holding potential. There is a big part of the forest covered by granite dominating basement aquifer that results in low storage capacity and conductivity. The most extensive soil types of this site are Ferralsols known as kaolisols as it can be depicted from the figure below.

¹³ Ministry of Environment, 2019. Baseline assessment report for Building resilience of communities living in degraded forests, savannahs and wetlands of Rwanda through an Ecosystem based Adaptation (EbA) approach (LDCF II project), Kigali, Rwanda.

¹⁴ Bizuru E, Nyandwi E, Nshutiyayesu S & Kabuyenge JP., (2011). Inventory and mapping of threatened remnant terrestrial ecosystems outside protected areas through Rwanda. National University of Rwanda.

¹⁵ Sirven, P., Gotanegre, J.F. et Prioul, C., (1974). Géographie du Rwanda, A. De Boeck-Bruxelles.

Figure 3: Mpanga soil properties



Source: Prepared by SESMEC Ltd from National Update Basemap, 2020

The warm and dry climatic conditions prevailing in this area are favourable to high alteration of soils leading to degradation, high accumulation of iron and aluminium sesquioxides which make the lateritic soils to be the most abundant in this region¹⁶.

These soils are therefore of low fertility, acidic and prone to toxicity because of its aluminium content though the soil losses are very limited as slope length are very short in low lands prevailing around Ibanda-Makera forest. Furthermore, The calculated Fournier Index (FI) and modified Fournier Index (MFI) for the period of 1941- 1992 revealed that Kirehe district where located Ibanda-Makera forest, is among the regions with the lowest erosivity index varying between (115-120) which implies a lowest potential erosion compared to other part of the country.¹⁷It is worth noting that the Ibanda-Makera forest, yield enough humus which improve the fertility of the soils covered by the forest.

¹⁶ Sirven, P., Gotanegre, J.F. et Prioul, C., (1974). Géographie du Rwanda, A. De Boeck-Bruxelles ¹⁷ Muhire, I., Ahmed, F., and Abd Elbasit, M.M. (2015). Spatio-temporal variations of rainfall erosivity in Rwanda. Vol. 6(4), pp. 72-83, 2015.

Figure 4: The health of Ibanda Makera Natural forest, in Mpanga sector, Nasho cell, Nyawera II village



Source: Photos taken by SESMEC Ltd during field visits, February, 2021

Moreover, along the river valley bottoms and associated with swamps, are either clay soils characterised by moderate fertility and low infiltration capacity or where the permanent presence of water prevents the decomposition of the organic matters there is histosols which makes the peaty soils to be composed of organic matters.

3.1.3. Climate

The Ibanda-Makera Natural Forest's has mean annual precipitation oscillating between 740 mm and 1000 mm¹⁸ occurring predominantly during the long rainy season from March–May (240 mm) and the short rainy season from September–December (282 mm). Both wet seasons have indicated a gradual decrease in precipitation from 1961–2018¹⁹. The average maximum temperature for Ibanda-Makera forest is around 28°C, while the average minimum

¹⁸Muhire, I., Ahmed, F., (2015). Spatio-temporal trend analysis of precipitation data over Rwanda, *South African Geographical Journal*, **97**(1): 50-68.

¹⁹ Government of Rwanda, (2018). Third National Communication, Kigali, Rwanda.

temperature is around $17^{\circ}C^{20}$. Moreover the average annual temperature is varying between 18°C and 22°C²¹.





Source: The third Natiional Communication

3.1.4. Climate change and variability and their impacts

The Kirehe district in eastern Rwanda, in which the Ibanda-Makera forest is located, is among the most disaster-prone districts in the country. This region has shown a progressive increase in temperature with a reduced in mean annual rainfall. Increasingly dry climatic conditions in the region over the last decade (current climate change) have resulted in declines of agricultural productivity of up to 70%²². Consequently, the GoR had to provide additional food to cover the agricultural shortfall. Furthermore, it resulted in the further encroachment of agricultural land into the forest, placing further pressure on its resources and biodiversity, and exacerbating degradation.

Under future climate change scenarios, the dry season in the east of the country is expected to increase in length. This will compound agricultural declines, forcing local communities to encroach further into natural ecosystems to maintain food production and livelihoods. In addition, the resources of natural ecosystems such as the Ibanda-Makera Natural Forest will continue to be overexploited as people search for additional food sources and livelihood options. As a result, degradation of the forest will intensify, reducing its capacity to supply ecosystems goods and services (such as food, wood and water), which will exacerbate the effects of dry conditions on the area. Without the implementation of adequate climate change adaptation solutions, the Ibanda-Makera Natural Forest may become completely degraded, enhancing the vulnerability of the surrounding communities.

²⁰ Ministry of Environment, (2018). Muvumba Catchment Management Plan (2018–2024).

²¹ Government of Rwanda, (2018). Third National Communication, Kigali, Rwanda.

²² According to local stakeholders consulted during the proposed project's PPG phase.

Furthermore, the dry conditions are expected in this region for the period of 1994-2050 (Figure below) with exception during long dry season where an increase in mean monthly rainfall is expected to be seen though the contribution of this season to the annual mean rainfall is not expected to be much as it is normally dry over.





Source: Third National Communication, 2018 and Muhire et al., 2018

Figure 7. Projected change in annual range in monthly rainfall (mm) for Ibanda-Makera from 2020–2099²³



²³ Projected change in annual range in monthly rainfall (mm) for Ibanda-Makera from 2020–2099 under a RCP8.5 scenario compared with historic values from 1986–2005, showing the median and range values for an ensemble of global circulation models (GCMs).
 ²⁴ We table Compared Change Change Keep Keep Long Change Chang



Figure 8. Projected change in monthly rainfall (mm) from 2040-2059²⁵

Source: World Bank Group, 2020

300mm 200mm Rainfall 100mm 0mm -100mm Feb lan Mar Apr May Jul Sep Oct Nov Dec Jun Aug Month

Figure 9. Projected change in monthly rainfall (mm) for Ibanda-Makera from 2080–2099²⁶

The difference between the wettest and driest months is also expected to increase by 22 mm between 2040–2059 and 39 mm between 2080–2099 compared with historic values (1986–2005) under a RCP8.5 scenarios. However, Kirehe district is also prone to floods and landslides caused by water from Akagera River especially during heavy rains periods. The Ibanda-Makera forest area is also exposed to storms with windspeeds of 45–52 km/hr that have a return period of 10 years²⁷. Such storm events in 2013 resulted in 376 damaged or destroyed homes and affected 27 ha of cropland in the Kirehe District.

Source: World Bank Group. 2020

projections. Available at:

https://climateknowledgeportal.worldbank.org/country/rwanda/climate-data-projections#

²⁵ Projected change in monthly rainfall (mm) for Ibanda-Makera from 2040–2059 under a RCP8.5 scenario compared with historic values from 1986–2005, showing the median and range values for an ensemble of global circulation models GCMs).

²⁶ Projected change in monthly rainfall (mm) for Ibanda-Makera from 2080–2099 under a RCP8.5 scenario compared with historic values from 1986–2005

²⁷ MIDIMAR. 2015. The national risk atlas of Rwanda.

Figure 10. Projected change in monthly temperature (°C) for Ibanda-Makera from 2040–2069²⁸



Figure 11. Projected change in monthly temperature (°C) for Ibanda-Makera from 2080–2099²⁹



The average mean temperature is predicted to continue to increase progressively. It expected to increase by $1.7-2.1^{\circ}$ C between 2040–2059 and $3.4 - 4.5^{\circ}$ C between 2080–2099. These longer dry periods and increased evaporation will compound agricultural declines, forcing local communities to encroach further into natural ecosystems to maintain food production and livelihoods. In addition, the resources of natural ecosystems such as the Ibanda-Makera Natural Forest will continue to be overexploited as people search for additional food sources and livelihood options. Without the implementation of adequate climate change adaptation solutions, the Ibanda-Makera Natural Forest may become completely degraded, enhancing the vulnerability of the surrounding communities.

²⁸ Projected change in monthly temperature (°C) for Ibanda-Makera from 2040–2069 under a RCP8.5 scenario compared with historic values from 1986–2005, showing the median and range values for an ensemble of global circulation models (GCMs)

²⁹ Projected change in monthly temperature (°C) for Ibanda-Makera from 2080–2099 under a RCP8.5 scenario compared with historic values from 1986–2005, showing the median and range values for an ensemble of global circulation models (GCMs)

3.1.5. Hydrology

Ibanda-Makera forest is situated within the lower Akagera catchment and shared with Tanzania. This catchment drains the area downstream of Rusumo Falls until the confluence of the Akagera and Muvumba River³⁰. The main rivers passing in or around Ibanda Makera forest are Ibanda, Makera, Rugazi and Gitoke as it can be depicted from the Figure below.





Source: A map prepared by SESMEC Ltd from National Update Basemap, 2020

The dependence of these communities on the forest for their water needs has contributed to its degradation particularly since other catchment areas in the region have become severely degraded.

South of Ibanda-Makera is papyrus swamp which extends to the Akagera River and contributes to the reduction of water loss by evaporation³¹.

³⁰ Rwanda Environment Management Authority. 2015. Rwanda: State of environment and outlook report 2015.

³¹ Bizuru E, Nyandwi E, Nshutiyayesu S & Kabuyenge JP. 2011. Inventory and mapping of threatened remnant terrestrial ecosystems outside protected areas through Rwanda. National

3.1.6. Biological characteristics

The Kirehe District is characterised by savanna vegetation (dominated by the *Vachellia*/Acacia tree species) interspersed with natural forests³², of which Ibanda-Makera is one. The forest is bordered by woodlands to its east and swamp-forest to its south. Ibanda-Makera is nationally recognised as a significant natural forest for its scientific importance, as well as its ecological

(i) Flora

Ibanda-Makela forest contains many endemic and rare plant, and in total harbours approximately 90 tree species, 150 herb species and dominant plant species include:

- small-fruited teclea (Vepris nobilis, locally known as Umuzo),
- s false cape fig (Ficus vallis-choudae),
- ♣ Dracaena afromontana (Umuhati),
- * Nile tulip (Markhamia lutea, locally Umusave),
- coastal golden-leaf (Bridelia micrantha locally mitzeeri),
- African false currant (Allophylus africanus),
- * wild date palm (Phoenix reclinate),
- Srewia trichocarpa (Umukoma),
- Lagenaria abyssinica,
- * Tietie (Paullinia pinnata) and
- Crawcraw vine (Tacazzea apiculata).
- Teclea nobilis,
- Bridellia micrantha,
- & Rhus divsp,
- ♣ Grewia trichocarpa,
- Ficus thonningii,
- ♣ Ficus vallis-choudae,
- Acacia polyacantha,
- ✤ Phoenix reclinata, etc

The forest's central portion is a swamp dominated by the papyrus sedge grass (*Cyperus* papyrus). The edge of the forest contains a combination of the common crown-berry (*Crossopteryx febrifuga*) and violet tree (*Securidaca longepedunculata*). The presence of orchid species in Ibanda-Makera, such as *Eulophia guinensis, Platylepis glandulosa, Cytorkis aquata* and *Malaxis weberbaneriana* indicates that the forest remains less disturbed than surrounding areas.

(ii) Fauna

Ibanda-Makela forest has more than 78 bird species. Some of the notable animal species

University of Rwanda.

³² <u>https://web.archive.org/web/20160305061619/http://www.ibidukikije.com/2012/03/rwanda-kirehe-districts-characterized-high-temperatures/</u>.

include the rare purple-banded sunbird (*Cinnyris bifasciatus*), different migratory bird species including European bee-eater (*Merops apiaster*), and an isolated population of olive baboons (*Papio anubis*).

3.1.7. Land use

3 25

Coffee and Jatropha curcas (commonly referred to as simply Jatropha, or nettlespurge) are significant cash crops grown by smallholder farmers of around Ibanda-Makela forest³³ especially. Other food crops grown in the communities surrounding Ibanda-Makera include bananas, maize, beans and sorghum³⁴. Burning for land clearance and wood cutting are also activities associated with land use around the forest³⁵ along with livestock grazing in the agricultural lands around Ibanda-Makera. These have contributed to the reduction of Ibanda-Makela forest area as shown on the following maps. Local community representatives raised concerns about the LDCF project's proposed establishment of a buffer zone around the forest, specifically regarding its size and location.



19.5

Figure 13: : Land use in 2010 and 2020

Grassland Cropland Water bodies Settlements

Feb,2021

³³ Ntaribi T & Paul DI. 2019. The economic feasibility of Jatropha cultivation for biodiesel production in Rwanda: A case study of Kirehe district. *Energy for Sustainable Development*. 50: 27–37.

³⁴ The Rufford Small Grants Foundation. 2009. Eastern Gallery Forest Conservation Project: Biodiversity survey.

³⁵ The Rufford Small Grants Foundation. 2009. Eastern Gallery Forest Conservation Project: Biodiversity survey.



Source: Prepared by SESMEC Ltd from National Update Basemap, 2020

| SN | Land use | Size in ha in 2010 | Size in ha in 2020 |
|----|--------------|--------------------|--------------------|
| 1 | Forest Cover | 739320.03 | 716572.064 |
| 2 | Grassland | 399190.14 | 333910.147 |
| 3 | Cropland | 1116723.6 | 1606843.222 |
| 4 | Water bodies | 257992.92 | 217130.021 |
| 5 | Settlements | 20945.25 | 43371.341 |
| 6 | Other Land | 198.08 | 350.745 |

Table 4: The area covered by each land use type

Source: Prepared by SESMEC Ltd from National Update Basemap, 2020

The figure and table above revealed that the area covered by forest and grassland decrease from 739,320.03 ha to 716,572.064 ha and from 399190.14 ha to 333910.147 ha respectively which implies a reduction of 22,747.966 ha and 65,279.993 ha from the forest and grassland cover of 2010 respectively. Moreover, the area covered by cropland, settlements and water bodies increase since 2010 to 2020 which left Mpanga sector covered by 24.55% of forest cover. This makes a call for more effort to protect the existing forests which is already less than a national coverage of 30%. Furthemore, the agro-forestry is extended on 2,131.6 ha across Kirehe district with 3,309 of planted forest along with 249,141 fruit trees in 2019³⁶.

Local communities own the land around the forest, with land titles extending right to the forest's edge. Two villages are located within 500 m of the Ibanda-Makera forest boundary, one to the forest's north and one directly south (Figure 8). While the actual settlements are

³⁶ Imihigo of Kirehe District for 2019-2020.

not located on the forest boundary, the land owned by these communities extends to the forest edge, and cultivation of crops occurs right up to the margin.

3.2. Muvumba River site

The Muvumba River site is located in Nyagatare district, Eastern Province. It is transboundary river, shared with Uganda with a total catchment area of 3,714 km² although the catchment within Rwanda is 1,567.8 km², the latter representing 5.95 % of the total surface area of Rwanda (26,338 km² including water bodies). The source of the Muvumba catchment is the Mulindi River located in the mountainous and high rainfall central, northern part of the country at an altitude of 2,030 masl (meters above sea level)³⁷.

The Mulindi River flows north entirely within Rwanda for a length of 22.5 km towards the Ugandan border and then it crosses the national border onto a flat, wetland zone near Kabale. In Uganda, it joins the Muvumba River, before eventually flowing back into Rwanda. The length of the Muvumba River in Rwanda is around 56 km. Major tributaries within Rwanda are the Warufu River, and its tributary Ngoma River. In Nyagatare district, Warufu River joins the Muvumba, which then flows north-east and forms the border between Rwanda and Uganda, before finally joining the Akagera River where the borders of Uganda, Rwanda and Tanzania all meet³⁸. Muvumba River is located near Nyagatare city as it can be seen on aerial hotograph presented below.



Figure 14: Location of Muvumba river to Nyagatare district city

Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus

 ³⁷ Ministry of Environment, (2018). Muvumba Catchment Management Plan (2018–2024)
 ³⁸ idem

3.2.1. Topography and geomorphology of the project site

The Muvumba catchment rises in the Buberuka highlands, with altitudes up to 2,500 masl. The Warufu sub-catchment starts in the Eastern Plateau, which extends over highlands (around 1,750 m asl) and hills of medium altitude and flows through the Eastern savanna, where it joins the main Muvumba River (1,250 m asl). The Eastern Savanna has gentle slopes, and includes numerous lakes and wide areas covered by marshes extending along the Akagera River into which Muvumba River discharges at an altitude of around 1,250 masl at the confluence.





Source: Ministry of Environment, 2018³⁹.

3.2.2. Geology and soils

The western part of the catchment, draining into Uganda through the Mulindi River, is

³⁹ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).

characterized by alternating schist and quartzite layers with average groundwater holding potential. The eastern part has granite as the dominant basement aquifer that results in low storage capacity and conductivity.



Figure 16. Geology of Muvumba catchment

Source: Ministry of Environment. 2018⁴⁰

The most extensive soil types of this site are Ferralsols. These are derived from deeply weathered siliceous rocks and thus are of low fertility, acidic and increasingly with aluminium toxicity.

⁴⁰ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).


Source: Prepared by SESMEC Ltd from the national soil map, 2020

In the southwestern uplands on steep slopes are Cambisols and Alisols, which are moderately deep and more fertile than Ferralsols since they possess a higher Cation Exchange Capacity (CEC). Given their location on steep slopes they are particularly susceptible to erosion. Furthermore, along the river valley bottoms and associated with swamps, are the clay soils characterised by moderate fertility and low infiltration capacity.

3.2.3. Climate at the project site

The Muvumba River site is located in eastern lowlands where the average monthly temperature is varying between 20 °C and 22 °C with precipitations oscillanting between 700 mm and 1150 mm. It falls in the hot and dry lowland agro-climatic zone which means that rainfall in the project area is low compared with the remaining parts of the country and it mostly occurs mostly during the short and long wet seasons. The long rainy season is extended from March, to May while the short rainy season occurs in September, October, November and December. The long dry season runs from late May to early September with a short dry season running from mi-December to February.



Figure 18: Spatial variation of mean annual rainfall and temperature (1961-2016)

Source: The Third National Communication, 2018⁴¹

A progressive increase in mean temperatures (minimum and maximum) is expected in coming year along with a slight increase in mean annual rainfall.

3.2.4. Climate change and its adverse impacts

The historical dataset for Rwanda combining station and satellite data (Rwanda Meteo Maproom 6), revealed an increase of about 0.35°C per decade since the 1980s, which is higher than the global average. However, an increase of between 1°C and 2°C over Nyagatare was reported in the Third National Communication. The same document reported a slight increase in mean annual rainfall in coming years⁴².

⁴¹ Government of Rwanda, (2018). Third National Communication, Kigali, Rwanda
⁴² Idem





Source: Third National Communication, 2018 and Muhire et al., 2018

The figure above reveals a rise in seasonal rainfall around Muvumba River during short and long dry season along with the long rainy season with short rainy season expected to become warmer for the period of 1994-2050.



Figure 20. Projected change in rainfall of very wet days (%) from 2020–2099⁴³.

Source: World Bank Group. 2020

⁴³ Projected change in rainfall of very wet days (%) for the Nyagatare pilot sites from 2020–2099 under a RCP8.5 scenario compared with historic values from 1986–2005, showing the median and range values for an ensemble of global circulation models (GCMs).



Figure 21. Projected change in monthly precipitation (mm) from 2040–2059⁴⁴

Figure 22. Projected change in monthly precipitation (mm) for the Nyagatare pilot sites from 2080–2099⁴⁵



The intensity and frequency of heavy rainfall events (particularly in upstream catchment areas) is expected to increase under future climate change scenarios. Between 2020–2059 and under RCP8.5, rainfall is expected to increase by 17 mm during the first, short wet season (May–March) and 30 mm in the longer, second wet season (September–December) compared with historic values (1986–2005). By 2080–2099, rainfall increases by 36 mm in the shorter wet season and 131 mm in the longer wet season by 2080–2099. The amount of rainfall during very wet days will increase by 4% between 2040–2059 and by 33% between 2080–2099 compared with historic values⁴⁶. These Changes in rainfall are less certain, partly due to high levels of year-to-year precipitation variability, and the limited dataset for the country.

⁴⁴ Projected change in monthly precipitation (mm) for the Nyagatare pilot sites from 2040–2059 under a RCP8.5 scenario compared with historic values from 1986–2005, showing the median and range values for an ensemble of global circulation models (GCMs).

⁴⁵ Figure 19. Projected change in monthly precipitation (mm) for the Nyagatare pilot sites from 2080–2099 under a RCP8.5 scenario compared with historic values from 1986–2005, showing the median and range values for an ensemble of global circulation models (GCMs)

 ⁴⁶ World Bank Group. 2020. Climate Change Knowledge Portal: Rwanda climate data projections.
 Available at: <u>https://climateknowledgeportal.worldbank.org/country/rwanda/climate-data-</u>

Relevant adverse impacts of climate change at this site include droughts, windstorms and flooding. Drought conditions in the Muvumba catchment results in reduced water availability for surrounding communities during the dry season, leading to increased costs of vendor-supplied water in urban areas, increased time spent searching for and collecting water, as well as increased reliance on groundwater reserves47.



Figure 23: Siltation and sedimentation around Muvumba River resulting from flooding episodes

Source: Photo taken By SESMEC Ltd in December, 2020 and February, 2021 in Tabagwe sector, Gitengure cell and Nshuri village

Increased flooding during heavy rainfall events occurs along riparian areas of the river, particularly in the Mulindi marshlands which contains poorly drained tea plantations and along areas surrounding rivers⁴⁸. Flooding in the Muvumba catchment is increased by the presence of mountainous terrain, resulting in the erosion of exposed riparian areas and riverbanks. The loss of fertile soils leads to reduced soil fertility and poor agricultural productivity in higher parts of the watershed. The section of the Muvumba River in the vicinity of the city of Nyagatare is regularly affected by floods that cause substantive losses to farmers.

projections#

⁴⁷ Nzeyimana I & Philliper K. N.d. Drought conditions and management strategies in Rwanda.

⁴⁸ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).

This flooding increases siltation within the river, which decreases the water intake capacity of water supply stations that service local communities. Siltation negatively affects water supplies to surrounding communities and increases maintenance costs. Productivity at water treatment plants found on the river is also reduced when water turbidity (associated with siltation) increases during the wet seasons. As water becomes more turbid, the treatment costs increase. Once turbidity rises over the upper limit of 10,000 Nephelometric Turbidity Units (NTU), production is halted as the costs and volume of the necessary treatment chemicals are too high49.

3.2.5. Hydrology of Muvumba river site

The Muvumba catchment consists from upstream to downstream of the relatively small catchment of the Mulindi River that is located in the mountainous and high rainfall central northern part of the country. The average annual rainfall is rated at 995 mm/annum, which equates to some 1,560 hm³/annum from the total land surface area of 1,568 km².

The Mulindi River flows into Uganda onto a flat wetland zone near Kabale from where a complex flow pattern originates that ultimately joins the Muvumba River before it eventually flow back into Rwanda. Within Rwanda a number of relatively small tributaries join the Muvumba River which flows in a north easterly direction to follow the border between Rwanda and Uganda before it reaches the K-Water" Dam project location in Karama sector. The river later flows downstream to join the Akagera River in the North East where the borders of Uganda, Rwanda and Tanzania meet.





Source: A map prepared by SESMEC Ltd from topographic map of Rwanda

Long-term river flow observations are available for the confluence of the Muvumba River with the Akagera River at Kagitumba, the location where Rwanda, Uganda, and Tanzania meet. The seasonal distribution of discharge intensity is depicted in figure below indicating an annual average flow of about 14 m3/s50.



Figure 25. Muvumba River flow regime curves (m3/s) at Kagitumba51.

⁵⁰ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).

⁵¹ Ministry of Environment, 2018. Muvumba Catchment Management Plan (2018–2024).

The significance of the different colours is as follows: Q95 is the average monthly flow exceeding 95% of monthly flow events in m³/sec; similarly, Q65 is the flow exceeding 65% of events, etc. Catchment-wide green and blue water balances reveals that ~65% of all precipitation is used by vegetation (rainfed agriculture, forests, and nature), or lost to evaporation. Only 2% of all precipitation is eventually abstracted for domestic, industrial, irrigation or livestock use. Outflows from the catchment and groundwater recharge are other important components of the Muvumba River's water budget, accounting for 28% and 12% of the catchment's outputs respectively (M Of these last catchment outputs, groundwater recharge indirectly contributes to was security through the long-term storage of water in aquifers that has the potential to be access with boreholes.

| Inputs | MCM/yr | Outputs | MCM/yr |
|----------------|--------|---------------------------|--------|
| Green water | | | |
| Precipitation | 1,543 | Evapotranspiration | 995 |
| Return flows | 10 | Withdrawals for human use | 32 |
| Storage change | 0.7 | Outflow | 469 |
| Inflow | 148 | Groundwater recharge | 206 |
| Total | 1,702 | Total | 1,702 |
| Blue water | | | |
| Runoff | 39 | Domestic | 2 |
| Baseflow | 303 | Industry | 0.2 |
| Groundwater | 0 | Irrigation | 29 |
| Return flows | 10 | Livestock | 0.7 |
| Inflow | 148 | Outflow | 469 |
| Total | 501 | Total | 501 |

 Table 5: Green and blue water balances for the Muvumba River catchment

Source: Ministry of Environment, 2018

A basic analysis of the catchment-wide green and blue water balances reveals that about 65% of all precipitation is used by vegetation (rainfed agriculture, forests, and nature), or lost to evaporation. Only 2% of all precipitation, three times the amount of blue water, is eventually abstracted by anthropogenic users (for domestic, industrial, irrigation or livestock use). Outflow from the catchment and groundwater recharge are other important components. The Ngoma sub-catchment makes the smallest contribution to the water balance and all catchment surface water leaves via the downstream Muvumba subcatchment at Kagitumba.

| Parameters | | Unit | Sample taken | Sample taken | Sample taken |
|-----------------|-----------|------|-------------------|-------------------|-------------------|
| | | | on | on | on |
| | | | 21/08/2014 | 23/09/2014 | 15/02/2021 |
| Fecal Coliforms | CFU/100ml | 4*10 | 3*10 ² | 6*10 ² | 8*10 ² |
| E. | CFU/100ml | 4*10 | 3*100 | 5*10° | 6*10 ⁰ |
| T⁰ | ٥C | 25 | 22 | 21.33 | 20.33 |
| Р | | 9 | 6.8 | 7 | 8.2 |
| E | μS/c | 1000 | 125 | 228.33 | 254.6 |

Table 6: Physico-Chemical and bacteriological results of Muvumba River

| Turbidity | NTU | 5 | 142 | 318 | 347 |
|-----------------|------|-----|-------|--------|--------|
| Т | mg/l | 100 | 90 | 93 | 97 |
| Alkalinity | mg/l | | 26 | 32 | 35 |
| NH | mg/l | 5 | 0.122 | 0.1 | 0.146 |
| NO | mg/l | 10 | 0.003 | 0.007 | 0.012 |
| NO | mg/l | 25 | 0.072 | 0.063 | 0.083 |
| PO ₄ | mg/l | 5 | 0.002 | 0.0018 | 0.0037 |
| SO ₄ | mg/l | 250 | 6.3 | 9.1 | 10.2 |
| Ca ² | mg/l | 200 | 80 | 87 | 94 |
| Mg | mg/l | 200 | 24 | 36 | 48 |
| CI | mg/l | 250 | 18.7 | 9.5 | 9.8 |
| М | mg/l | 0.1 | 0.021 | 0.41 | 0.47 |
| Fe | mg/l | 0.3 | 0.038 | 1.25 | 1.12 |
| F | mg/l | 2 | 0.36 | 0.41 | 0.69 |
| DO | mg/l | 5 | 8.4 | 6.1 | 5.4 |
| CO | mg/l | 50 | 9.6 | 8.3 | 8.1 |
| BO | mg/l | 30 | 5.4 | 4.9 | 4.9 |
| Т | mg/l | 3 | 0.174 | 1.7 | 1.8 |
| С | mg/l | 0.1 | 0.24 | 0.93 | 0.78 |
| Z | mg/l | 3 | 0.031 | 0.052 | 0.087 |

Figure 26: Collection of Muvumba River water sample on 15/02/2021



It is worth noting that two samples of water were collected from the above presented site using polyethylene bottles. Both samples were taken in the laboratory. One sample was immediately used to measure physico-chemical characteristics and was not acidified. The other sample was immediately acidified with nitric acid (10%) in order to avoid further modification of the chemical composition during preservation period prior to analysis. The physico-chemical parameters of water were measured using portable devices. It was revealed that the turbidity increase from 318 in 2014 to 347 NTU may be due to agricultural activities taking place around Muvumba river. Furthermore, the other physico-chemical parameters were most of them increased (Table 6) as result of human activities (Figuire 29) and flooding episodes (Figure 23).

3.2.6. Biological characteristics of Muvumba river site

(i) Flora

The Vegetation of Nyagatare district is dominated by savanna grasslands represented by Themeda triandra and Hyparrhenia filipendula, in which the wetlands are dominated by Cyperus papyrus and Cyperus latifolius. The savanna is a mosaic of individual trees in a landscape open grassland and dense forest which is restricted to river banks and elevations. The predominant species are Acacia Senegal, A.hockii, A.sieberana, Lannea stuhlmannii, Ozoroa reticulata, Entada abyssinica and Solanum species tree (Ministry of Environment 2017⁵²). Species found in the marshlands surrounding Muvumba river and their vicinities have various uses, including the following:

- Improvement of soil (Acacia sieberana, A. albida, Albizzia gummifera, Erythrina abyssinica, etc.);
- ✓ Stabilization of soil (Albizziagummifera, Erythrina abyssinica, Vernoniaamygdalina, etc.);
- Construction and carpentry (Acacia sieberana, A.albida, Erythrina abyssinica, Vernonia amygdalina, etc.);
- ✓ Fuelwood and charcoal (all species and woody species);
- ✓ Crafts (Acacia sieberana, A.albida, Erythrina abyssinica, etc...);
- ✓ Support hives (Acacia sieberana, A.albida, Albizziagummifera, Erythrina abyssinica, etc.).
- ✓ Forage (Acacia sieberana, A. albida, Albizzia gummifera, etc...)
- ✓ Mulch (Acacia albida, Albizzia gummifera, Vernonia amygdalina,etc..)
- Limits fences and properties (Acacia albida, Erythrina abyssinica, Vernonia amygdalina, etc.)
- ✓ Gums and tannins (Acacia sieberana, A. albida, etc...)
- Pharmacopoeias (Acacia sieberana, A. albida, Erythrina abyssinica, Vernonia amygdalina, etc.)
- ✓ Shade for livestock farms and coffee plantations (Acacia albida, Albizzia gummifera, Erythrina abyssinica, etc.).
- ✓ Basketry, box, enclosures and ceilings (Cyperus papyrus)
- ✓ Mats (Cyperus latifolius).

The main crops grown in the developed marshland and its hillsides are beans, maize, banana, sorghum, cassava, sunflower and sweet potatoes, vegetables including cabbages, tomatoes, eggplants, nightshade, and various onions

⁵² Ministry of Environment, 2017. Muvumba multipurpose dam development project, Kigali, Rwanda.

| Family Scientific name | | Vernacular name (in |
|------------------------|------------------------|----------------------|
| | | Kinyarwanda) |
| Asteraceae | Vernonia amygdalina | Umubilizi |
| Cyperaceae | Cyperus papyrus | Urufunzo |
| | Cyperus latifolius | Umuberanya |
| | Cyperus latiforialius | Urukangaga |
| | Fuirena pubescens | lsovu |
| Euphorbiaceae | Euphorbia tirucalli | Umuyenzi |
| | Euphorbia conderablum | Umuduha |
| Fabaceae | Erythrina abyssinica | Umurinzi/Umuko |
| Loganiaceae | Strychnos usambarensis | Umuhoko |
| Malvaceae | Hibiscus div. spp | Umugusa |
| Mimosaceae | Acacia sieberana | |
| Loganiaceae | Strychnos usambarensis | Umunyinya |
| Rosaceae | Albizzia gummifera | Umusebeya |
| Sapindaceae | Rubus spp | Umukeri |
| | Dodonea viscose | Umusasa |

Table 7: Main plant species observed in the study area

Source: Ministry of eEnvironment, 2017⁵³

(ii) Fauna

Apart from domestic animals dominated by cows, goats, sheep, poultry, pigs etc, the area accommodates a huge diversified variety of birds such as birds of prey, guineafowl, partridges, heroes and so forth. The project area includes many diverse habitats favoured by species that are favourable places for feeding, nesting, breeding, to take refuge, etc. The marsh is also habitat for other species (mainly birds are a first group of animals to be affected or can affect rice plantations).

 Table 8: Main animal species around Muvumba River

| Scientific name | Other name (French and | Vernacular name | Particular Status |
|---------------------|---------------------------|--------------------|-------------------|
| | English) | (Kinyarwanda name) | (CITES & IUCN) |
| Ardeacinerea | Héroncendré /Grey | Uruyongoyongo | |
| Heron | | | |
| Ciconiaciconia | Cigogne | Inyamanza | |
| | blanche/BlackWhite | | |
| | Stork | | |
| Balearicaregolosum | Gruecouronnée/ Grey | Umusambi | |
| | crowned Crane | | |
| Bostrychia hagadash | lbis hagedash/lbis hadada | Nyirabaraza | |
| Bubulcus ibis | Héron garde- | Inyange | |
| | boeuf/Cattle Egret | | |
| Motacillaaguimp | Bergeronnette | Inyamanza | |
| | pie/African Pied Wagtail | | |
| - | Anatidés(divers)/Anatidae | | |
| - | Paridés (divers)/ Paridae | | |
| - | Plocéidés(divers)/ | Isandi | A Weaver |

⁵³ Ministry of Environment, 2017. Environmental and social impact assessment for muvumba multipurpose dam project, Rwanda

| | Ploceidae/Weavers | | species protected by CITES: Ploceus cucullatus |
|---------------------|---------------------|--------------|---|
| Passer griseus | Grey-headed sparrow | lgishwi | |
| Colius striatus S | peckled mouse bird | Umusure | |
| Apus caffer | white-rumped swift | Intashya | |
| Streptopelia | Red-eyed dove | Inuma | |
| semitorquata | | | |
| Meropsoreobates | Cinnamon-chested | Umusamanzuki | |
| | beeeater | | |
| Clarias liocephalus | Clarias | Inshonzi | |

The fish species surveyed in the swamp is a species of the family of Claridae which is Clarias liocephalus (Inshonzi). There are many termite mounds on the outskirts of the marshlands.

3.2.7. Land use

Irrigated and agricultural wetlands (mainly for rice production) occupy considerable areas alongside the Muvumba River, particularly in the central and northeastern parts. The southern part of the catchment area is dominated by fields and numerous forest plantations. Moreover some areas has been degraded and other have been protected. The figure below depict those areas

Figure 27: Banks Of Muvumba River protected by trees



Source: Photo taken By SESMEC Ltd in February, 2021 in Nyagatare sector, Nyagatare cell and Nyagatare village

Figure 28: Protected areas of Muvumba River by dams



Source: Photo taken By SESMEC Ltd in February, 2021 in Tabagwe sector, Gitengure cell and Nshuri village

Figure 29: Degraded areas due to bricks making activities in vicinity of Muvumba River



Source: Photo taken By SESMEC Ltd in February, 2021 in Nyagatare sector, Barija cell and Barija village

In the Nyagatare district, numerous villages are located along the Muvumba River's banks. Almost all economic growth in the catchment is linked to water use, whether agriculture, livestock, industry, or related to providing drinking water to urban and rural areas. Different irrigation projects have been developed around Muvumba River as shown on the figure below.





Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus

Muvumba multipurpose dam project which is a governmental project was intended to construct a dam of 30.5 m high that impounds 35 million cubic meter of water in Karama, Gatunda and Rukomo sectors and. The project is planned to supply water for domestic use to Karangazi, Rwempasha and Nyagatare sectors. The dam will impound water to be used for domestic water supply, water for irrigation of 7380 ha (net command area) and water for 16 reservoirs for livestock watering production of annual annual energy of 5719 Mwh with installation capacity of 740 KW (370x2).

Figure 31: Rice plantation irrigated by Muvumba multipurpose dam



Source: Photo taken By SESMEC Ltd in February, 2021 in Rwempasha sector, Rutare cell and Rutare village

It will also contribute to the flood control. This project aimed to increase the productivity and commercialization of agriculture through the implementation of watershed management, water-harvesting in valley dams and hillside irrigation. The following is the land use change for 2010 and 2020.





Source: Prepared by SESMEC Ltd from National Updated Basemap, 2020

The total forested area covers 10% of the Muvumba catchment area, which is below the national average and below the national coverage 30.4%. Of this, about 20% is considered sparse forest, showing signs of tree felling or other forms of degradation. Approximately 90% of land use in the Muvumba catchment is related to agriculture (both seasonal and perennial crop farming, and livestock grazing represented by "bare soils" in Table 9 below).

| Class | Area (ha) | Percentage (%) |
|---------------------------|-----------|----------------|
| Forest | 12,233 | 8 |
| Spare forest | 2,475 | 2 |
| Open areas or grass | 44,147 | 28 |
| Agriculture (seasonal) | 75,286 | 48 |
| Agriculture (perennial) | 22,235 | 14 |
| Bare soil | 3 | 0 |
| Settlements and buildings | 261 | 0 |
| Water | 75 | 0 |
| Wetlands | 63 | 0 |
| TOTAL | 156,779 | 100 |

Table 9. Land use/ land cover classification for the Muvumba catchment⁵⁴

Other economic activities in the catchment include artisanal mining of tungsten, cassiterite and coltan, as well as quarrying⁵⁵. The predominance of agricultural land use, along with bare soils resulting from mining and quarrying, reflects the large impact of dense rural populations on the land, and, combined with high soil erosion risks associated with steep slopes, strongly contributes to sediment ingress into rivers such as the Muvumba.

 ⁵⁴ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).
 ⁵⁵ Idem

3.3. Savannah of the Nyagatare District, Eastern Province

The savannah of the Nyagatare District (and other parts of the Eastern Province) especially in Matimba, Rwimiyaga and Karangazi sectors are predominantly used for the grazing of livestock (such as cattle and goats). Deforestation to open up land for such agricultural practices combined with subsequent overgrazing, drought and wind erosion has resulted in severe landscape-level degradation of lowlands and savannah.

Figure 33: Different parts of Eastern Savannah in Nyagatare district

Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus

This has resulted in the limited availability of forage for livestock (which further compounds overgrazing), and large-scale soil loss which decreases the productive potential of the land. During the rain seasons (short and long), soil loss is further exacerbated, while runoff rates are high as a result of decreased infiltrability of the soils.

3.3.1. Topography and geomorphology of the study area

The eastern savannah (Matimba, Rwimiyaga and Karangazi sectors) are located in the eastern lowlands, with an altitude of 1,000–1,500 m asl. The area is dominated by round-topped hills as well as flatlands separated by valleys. While the topographical layout has potential for modern and mechanised agricultural farming, this is limited by the dominant granite basement aquifer, which results in low groundwater storage capacity and conductivity⁵⁶.

3.3.2. Geology and soils

The savannah of Nyagatare (Matimba, Rwimiyaga and Karangazi sectors) is covered by quartzite sand in form of non-gneissic, siliceous, granites, biotitic pegmatite, or muscovite. The most extensive soil types within this area are Xero-Ferrasols and Ferrasols known also as Xero-kaolisols and kaolisols respectively. These soils are met mainly in eastern warm and dry lowlands having monthly average temperature of above 20°C while annual mean precipitation turns between 740 mm and around 1000 mm.

⁵⁶ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).



Source: Prepared by SESMEC Ltd from National Updated Basemap, 2020

These climatic conditions are favourable to high alteration of soils leading to degradation, high accumulation of iron and aluminium sesquioxides which make the lateritic soils to be abundant in this region than the rest of the country. These soils are therefore of low fertility, acidic and prone to toxicity because of its aluminium content⁵⁷.

3.3.3. Climate

The mean annual precipitation in the Rwimiyaga Sector in which the Nyagatare savannah pilot site is situated is varying between 740 and 1000 mm. The two rainy seasons from March–May and September–December receive a total rainfall of 310 mm and 354 mm respectively. Between 1981–2017, there has been a decreasing trend in rainfall amounts in the first wet season (March–May) and an increasing trend in rainfall for the second wet season (September–December). For annual rainfall between 1961 and 2018, the period between 1991 and 2000 has been the driest. These observations showed a marked rainfall deficit in 1992, 1993, 1996, 1999 and 2000 with rainfall excesses in 1998 and 2001. The first dry season occurs from late May to early September, with the long dry season prolonged from the late May to the early

September. The average annual temperature oscillates between 18° C and 22° C and it is the highest across the country while the maximum average temperature was 27° C and minimum average temperature of 16° C.



Figure 34: Spatial variation of mean annual rainfall and temperature (1961-2016)

Source: The Third National Communication, 2018

A progressive increase in mean temperatures (minimum and maximum) is expected in coming year along with a slight increase in mean annual rainfall.

3.3.4. Climate change and variability and their variability

The Third National Communication reported an increase of between 1°C and 2°C over Eastern savannah in Nyagatare district with a slight increase in mean annual rainfall in coming years.



Figure 35: Spatial distribution of projected changes (per year) in mean rainfall (seasonal timescale) for 1994-2050

Furthermore, the wet conditions are expected in this region for the period of 1994-2050 (Figure above) with exception during short dry season where an decrease in mean monthly rainfall is expected to be seen.

⁵⁸ Government of Rwanda, (2018). Third National Communication, Kigali, Rwanda.



Figure 36. Projected change in the annual range in monthly rainfall (mm) from 2020–2099⁵⁹

Climate change projections indicate that the length of the dry season and temperatures in Rwanda will increase. Under a RCP8.5 scenario, the difference in rainfall between the wettest and driest months will increase by 118 mm between 2080–2099 compared with baseline values from 1986–2005 indicating elevated rainfall variability between seasons⁶⁰. This increased monthly rainfall variability is expected to be along with hotter temperatures which will result in higher evaporation rates.





 ⁵⁹ Projected change in the annual range in monthly rainfall (mm) for the Nyagatare savanna pilot site from 2020–2099 under a RCP8.5 scenario compared with historic values from 1986–2005, indicating the median and range values for an ensemble of global circulation models (GCMs).
 ⁶⁰ World Bank Group. 2020. Climate Change Knowledge Portal: Rwanda climate data projections. Available at: <u>https://climateknowledgeportal.worldbank.org/country/rwanda/climate-data-projections</u>#

projections#
 ⁶¹ Projected change in monthly temperature (°C) for the Nyagatare savanna pilot site from 2040–2059 under a RCP8.5 scenario compared with historic values from 1986–2005, indicating the median and range values for an ensemble of global circulation models (GCMs).



Figure 38. Projected change in monthly temperature (°C) from 2080–2099⁶²⁶³.

Source: World Bank Group. 2020

Monthly temperatures for the region are predicted to rise by $1.7-2^{\circ}C$ between 2040–2059 and $3.5 \,^{\circ}C - 4.5 \,^{\circ}C$ between 2080–2099 compared with baseline historic values. This will be particularly detrimental for the Eastern savannah in Nyagatare district which is already dry compared with the rest of Rwanda, exacerbating the degradation of savannas. Consequently, the agriculture-based livelihoods of many local farmers are at risk, as soil fertility and the availability of forage for livestock will continue to decrease. Without effective climate change adaptation in this region, livestock farmers are likely to lose their livelihoods, resulting in heightened poverty levels and further landscape degradation as they look for alternative forms of income generation.

The Nyagatare District area is also vulnerable to storm events with moderate gale force winds (52–72 km/hr) that have return periods of 5 or 10 years. These storm events cause damage to crops — particularly banana, sorghum and maize and buildings. In 2013 for example, storm events in Nyagatare resulted in six deaths, 16 injuries, 95 damaged or destroyed homes and 18 ha of affected crop lands. In addition, wind erosion results in large-scale soil loss which decreases the productive potential of the land⁶⁴. During the wet seasons (short and long), soil loss is further exacerbated, while runoff rates are high as a result of decreased infiltrability of the soils.

⁶² Projected change in monthly temperature (°C) for the Nyagatare savanna pilot site from 2080–2099 under a RCP8.5 scenario compared with historic values from 1986–2005, indicating the median and range values for an ensemble of global circulation models (GCMs).

⁶³ World Bank Group. 2020. Climate Change Knowledge Portal: Rwanda climate data projections. Available at: <u>https://climateknowledgeportal.worldbank.org/country/rwanda/climate-data-projections#</u>

⁶⁴ MIDIMAR. 2015. The national risk atlas of Rwanda

3.3.5. Hydrology

The eastern savannas are found within the Nile Basin65. Apart from the Akagera River which marks the border with Tanzania there are no other large perennial rivers. The only other notable river in the area is the Karangazi River, which is erratic and intermittent. This limited river network constitutes a considerable limitation with regards to water availability for people and animals.





Source: A map prepared by SESMEC Ltd from National Updated Basemap, 2020, Rwanda

The maximum daily water consumption for human and livestock population is projected to grow from the 2017 level of 24,000 m3/day to 37,700 m3/day by 2022 for the entire district66. This represents a \sim 36% increase in water usage, which — coupled with a climate change-induced increase in rainfall variability and a longer dry season — will reduce water availability in an area of the country that already displays water scarcity. As a result, agricultural and

⁶⁵ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).

⁶⁶ MoE. 2017. Rwanda Water and Forestry Authority Muvumba Multipurpose Dam Development Project. Available at: <u>https://esa.afdb.org/sites/default/files/RWANDA-</u>

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livestock productivity will be reduced, which will affect the health and livelihoods of local communities.

3.3.6. Biological characteristics

(i) Flora

The low hills mostly contain savanna vegetation, while dense forest patches are restricted to riverbanks⁶⁷. The Muvumba River and Akagera National Park are the main natural ecosystems found in the Nyagatare. The district also accounts for more than 30 marshlands⁶⁸.

The plant diversity of Nyagatare District is characteristic of lowland savannah vegetation (i.e. it is a tree-grass mosaic). Apart from crops dominated by large-scale rice cultivations in the wetlands and bean, maize and banana on the hills, natural vegetation consists predominantly of *Vachellia* (formerly the genus *Acacia*) tree species. The dominant grasses of the savannas are Red oat grass (*Themeda triandra*) and various thatching grass species (including *Hyparrhenia filipendula*⁶⁹). In the southeastern part of the Nyagatare District, the Akagera National Park conserves a savanna-forest ecosystem. The park hosts a high diversity of plants, including many threatened species such as *Blighia unijugata* (Umuturamugina in the local language), African sandlewood (*Osyris lanceolata*, locally known as Kabaruka), Gummy canthium (*Afrocanthium lactescens*, locally known as Umukondokondo) and knob wood (*Zanthoxylum chalybeum*, also known as Intareyirungu). The invasive lantana *Lantana camara* is also prevalent throughout the savannas in the district and has been linked to changing land use⁷⁰. Furthermore, the wetlands of the Nyagatare District are dominated by papyrus sedge (*Cyperus papyrus*) and flatsedge (*Cyperus latifolius*)⁷¹.

Figure 40: Savannah vegetation in Nyagatare district

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⁶⁷ MoE. 2017. Rwanda Water and Forestry Authority Muvumba Multipurpose Dam Development Project. Available at: <u>https://esa.afdb.org/sites/default/files/RWANDA-</u>

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⁶⁸ Ministry of Agriculture and Animal Resources. 2016. Rwanda Feeder Roads Development Project: Final Report. Nyagatare District.

⁶⁹ MoE. 2017. Rwanda Water and Forestry Authority Muvumba Multipurpose Dam Development Project. Available at: <u>https://esa.afdb.org/sites/default/files/RWANDA-</u> <u>MUVUMBA%20MULTIPURPOSE%20WATER%20RESOURCES%20DEVELOPMENT%20P</u>

⁷⁰ Wronski T, Bariyanga JD, Sun P, Plath, M. & Apio A. 2017. Pastoralism versus agriculturalism—how do altered land-use forms affect the spread of invasive plants in the degraded Mutara rangelands of north-eastern Rwanda? *Plants*. 6: 19.

⁷¹ MoE. 2017. Rwanda Water and Forestry Authority Muvumba Multipurpose Dam Development Project. Available at: <u>https://esa.afdb.org/sites/default/files/RWANDA-</u> <u>MUVUMBA%20MULTIPURPOSE%20WATER%20RESOURCES%20DEVELOPMENT%20P</u> ROGRAM%20PHASE1-ESIA-P-RW-EA0-015.pdf



Source: Photo taken by SESMEC Ltd during field visit, December, 2020

Under the 2016 'Rwanda Feeder Roads Development Project'⁷² numerous alien ruderal/plant species that favour disturbed areas were identified in the Nyagatare District. These include timber trees such as silk oak (*Grevillea robusta*, locally known as Gereveriya) and *Eucalyptus* sp. (Inturusu), shrubs such as *Senna spectabilis* (Gasiya) and fruit trees such as *Mangifera indica* (Imyembe) and *Persea americana* (Avoka). The same document identified indigenous tree species that included species of the genera *Vachellia, Euphorbia* and *Ficus*. The most common plant species found alongside roads in the Nyagatare District are listed below.

| No. | Plant species | Common/local name | Morphology |
|-----|--------------------------|-------------------|------------|
| I | Acanthus pubescens | lgitovu | Shrub |
| 2 | Achyranthes aspera | Umuhurura | Herb |
| 3 | Albizia gummifera | Umusebeya | Tree |
| 4 | Blumea brevipes | lgitabitabi | Herb |
| 5 | Carica papaya | Ірарауі | Tree |
| 6 | Casuarina equisetifolia | Filaho | Tree |
| 7 | Erythrina abyssinica | Umuko/Umurinzi | Tree |
| 8 | Eucalyptus sp. | Inturusu | Tree |
| 9 | Euphorbia tirucalli | Umuyenzi | Tree |
| 10 | Gomphocarpus physocarpus | Gasaho | Herb |
| 11 | Grevillea robusta | Gereveriya | Tree |
| 12 | Hygrophylla auriculata | Gangabukari | Herb |
| 13 | Indigofera errecta | Umusororo | Shrub |
| 14 | Kyllinga errecta | Uruvuya | Herb |
| 15 | Lantana camara | Umuhengeri | Shrub |
| 16 | Leonotis nepetifolia | lgicumucumu | Herb |
| 17 | Mangifera indica | Umwembe | Tree |
| 18 | Mikania cordata | Urugozi | Herb |
| 19 | Mimosa pigra | Umugeyo | Shrub |
| 20 | Ocimum suave | Umwenya | Herb |
| 21 | Oryza sativa | Umuceri | Herb |
| 22 | Pennisetm purpureum | Urubingo | Herb |

 Table 10. Most common plant species identified along roadsides in the Nyagatare District in the Rwanda

 Feeder Roads Development Project.

⁷² Ministry of Agriculture and Animal Resources. 2016. Rwanda Feeder Roads Development Project: Final Report. Nyagatare District.

| 23 | Persea americana | Avoka | Tree |
|----|--------------------------------|------------|-------|
| 24 | Polygonum setulosum | Igorogonzo | Herb |
| 25 | Psidium guajava | Ipera | Tree |
| 26 | Senna spectabilis | Gasiya | Shrub |
| 27 | Tetradenia riparia | Umuravumba | Shrub |
| 28 | Vernonia amygdalina | Umubirizi | Shrub |
| 29 | Vachellia (Acacia) kirkii | Umukinga | Tree |
| 30 | Vachellia (Acacia) polyacantha | Umugu | Tree |
| 31 | Vachellia (Acacia) sieberiana | Umunyinya | Tree |

The Nyagatare District also accommodates a large variety of birds, reptiles and amphibians⁷³. Most are located inside the Akagera National Park — which also hosts numerous endangered bird species such as shoebills (*Balaeniceps rex*, locally known as Munwarukweto), Southern ground-hornbills (*Bucorvus leadbeateri*, locally Ikigungumuka), Lappet-faced vultures (*Torgos tracheliotos*, locally Inkongoro) and Whiteheaded vultures (*Trigonoceps occipitalis*, locally Inkongoro) — but the savannas and grasslands outside the park also host considerable bird and large mammal diversity⁷⁴.

(ii) Fauna

Apart from domestic animals dominated by cows, goats, sheep, poultry, pigs etc, the area accommodates a huge diversified variety of birds such as birds of prey, guineafowl, partridges, heroes and so forth. The project area includes many diverse habitats favoured by species that are favourable places for feeding, nesting, breeding, to take refuge, etc. The marsh is also habitat for other species (mainly birds are a first group of animals to be affected or can affect rice plantations).

| Scientific name | Other name (French and | Vernacular name | |
|---------------------|--------------------------------|--------------------|--|
| | English) | (Kinyarwanda name) | |
| Ardeacinerea Heron | Héroncendré /Grey | Uruyongoyongo | |
| Ciconiaciconia | Cigogne blanche/BlackWhite | Inyamanza | |
| | Stork | | |
| Balearicaregolosum | Gruecouronnée/ Grey crowned | Umusambi | |
| | Crane | | |
| Bostrychia hagadash | Ibis hagedash/Ibis hadada | Nyirabaraza | |
| Bubulcus ibis | Héron garde-boeuf/Cattle Egret | Inyange | |
| Motacillaaguimp | Bergeronnette pie/African Pied | Inyamanza | |
| | Wagtail | | |
| - | Anatidés(divers)/Anatidae | | |
| - | Paridés (divers)/ Paridae | | |
| - | Plocéidés(divers)/ | Isandi | |
| | Ploceidae/Weavers | | |
| Passer griseus | Grey-headed sparrow | lgishwi | |
| Colius striatus S | peckled mouse bird | Umusure | |

| Table | 11: | Main | animal | species | in | savannah | region |
|--------|-----|---------|----------|---------|----|-------------|--------|
| I abie | | I Iaiii | aiiiiiai | species | | savailliail | region |

⁷³ Ministry of Agriculture and Animal Resources. 2016. Rwanda Feeder Roads Development Project: Final Report. Nyagatare District.

⁷⁴ Gatali C. 2013. Herbivory and biodiversity conservation of the savannah habitats in Akagera National Park, Rwanda. Doctoral thesis, Department of Biological and Environmental Sciences, University of Gothenburg.

| Apus caffer | white-rumped swift | Intashya |
|---------------------------|---------------------------|--------------|
| Streptopelia semitorquata | Red-eyed dove | Inuma |
| Meropsoreobates | Cinnamon-chested beeeater | Umusamanzuki |
| Clarias liocephalus | Clarias | Inshonzi |

3.3.7. Land use

Croplands comprise 68% of land cover in the Nyagatare District⁷⁵, though livestock grazing also constitutes a large proportion of the district's land use, particularly in the savannah regions⁷⁶. The forest cover is over 44,612 ha with 6,587 ha under agro-forestry in 2019 and 6.38 ha of forest were rehabilitated along with 926 ha wooded in 2019⁷⁷. Additionnaly, 2833 fruit trees were planted in the same year. Furthermore, 1900 ha were covered by progressive terraces in 2019 while 600 ha of progressive terrances were planned to be constructed in 2020⁷⁸.

The mean size of land cultivated per household in the Nyagatare District is 0.77 ha. Consequently, Nyagatare is among the seven districts in Rwanda that have a high percentage (66%) of households that cultivate between 0.75 and 0.9 ha of land⁷⁹. The main crops grown in Nyagatare include maize (35% of households), bush beans (13%), banana (13%) and cassava (11%). Other crops include banana, sorghum, rice, vegetables (mainly tomatoes and onion), sweet potatoes, soybean and groundnuts. Approximately 78% of the total production for key crops is marketed⁸⁰. Maize (70%) and beans (80%) are the key crops sold, representing 71.2% of the total marketed produce in the district of Nyagatare.

⁷⁵ Karamage F, Zhang C, Ndayisaba F, Shao H, Kayiranga A, Fang X, Nahayo L, Muhire Nyesheja E & Tian G. 2016. Extent of cropland and related soil erosion risk in Rwanda. *Sustainability*. 8: 609.

⁷⁶ Ministry of Agriculture and Animal Resources. 2016. Rwanda Feeder Roads Development Project: Final Report. Nyagatare District.

⁷⁷ District Development strategy, 2020

⁷⁸ Idem

⁷⁹ MoE. 2018. Muvumba Catchment Management Plan (2018–2024).

⁸⁰ Idem.

Figure 41: Land use in 2010 and 2020



Source: Prepared by SESMEC Ltd from National Updated Basemap, 2020

In addition to crops, livestock is another important source of income and food for agricultural households in Nyagatare. The livestock population of the district includes cattle (~199,000), goats (~182,000), chickens (~108,000), rabbits (~19,000), sheep (~18,000) and pigs (~6,000).

3.4. Nyandungu wetland

Nyandungu Wetland is located in two districts of Kigali City, Gasabo district (Kimironko, Remera, Ndera sectors), and Kicukiro district (Nyarugunga sector). The site covers a total area of 243.92 ha and a total perimeter of 30,650.48 meters⁸¹. Nyandungu wetland is bounded by the road Kigali-Kayonza (South), the road to the Adventist University (West), the road to Ndera (East).





Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus Nyandungu Wetland is drained by two streams: Mwanana and Kabagenda. Both flow into the Mulindi stream, a tributary of the Nyabarongo River.



Figure 43: Location of Nyandungu wetland

Source of data: Prepared by SESMEC Ltd from Kigali City Master Plan 2020-2050

⁸¹ Government of Rwanda, (2017). Official Gazette Nº 07/of 13/02/2017

3.4.1. Topography and geomorphology of Nyandungu wetland

Nyandungu Wetland is located in a low area of 1360 meters altitude and it is surrounded by by hills that reach at altitudes of 1,480 masl. The anthropic action has changed the landscape by various constructions. The site is flood-prone area and this is due to three main reasons: (i) it is low land which receives water from the densely populated surrounding hills (ii) the soil is clayey, (iii) the Mwanana river is narrow and it is often flooded in case of heavy rainfall.

3.4.2. Geomorphology, Geology and Soils

The main parent materials from which the soils of the Nyandungu Valley derived are: quartzite, schist, granite, alluvia and colluvia (Figures 9 and 10). Two main soil series (Nyamatebe and Rwotsa) occur in that area. The Nyamatebe soil belongs to the Taxonomic family of Fine, Mixed Isohyperthermic Cumulic Haplaquolls. These soils are developed from alluvial materials, their texture is clay, and they are yellow and present a Cambic development. They are poorly drained and deep and not limited by a gravel pack (REMA, 2012⁸²)

Their pedoclimate regime is aquic and/or isohyperthermic. The Rwotsa soil belongs to the family of Fine-silty, Mixed, Isothermic Aeric Umbric, Tropaquilts. These soils are developed from colluvium and alluvium materials, they are silty-clay, yellow, imperfectly drained, deep (non-limited by a gravel pack) and show a cambic development⁸³. The Rwotsa soil is found in audic isothermic pedoclimate regime. The following are the main types of soils according to their texture.

| Soil Type | Description | Location |
|-----------|--|--|
| | Silt-Sandy deposit of colluvium with dry grass | Ridge of the wetland on North side towards Masoro hill |
| | Sand soil, deposit of colluvium used for soil mined for the construction works | Ridge of the wetland on the North side towards Masoro hill |

| | Table 12: Details of Pedological | Survey at different locations i | n Nyandungu wetland |
|--|----------------------------------|---------------------------------|---------------------|
|--|----------------------------------|---------------------------------|---------------------|

⁸² REMA. 2012. Study for Establishing Urban Wetland Recreation and Eco-tourism Park in Nyandungu Valley, Kigali City (Rwanda): Final Report

⁸³ Tsinda, A, Ilunga, L.P, 2006

| | Silt-Clay soil, at 1.5m deep suitable clay are mined for the pots making and construction works | Close to swampy area | | |
|------------------------|--|--|--|--|
| Contract of the second | Sandy-Clay deposit of alluvial with bare soil | Ridge of the wetland toward the hillside | | |
| | Silt-Clay deposit of alluvial soil with bare soil | Ridge of the wetland toward the hillside | | |
| | Colluvium Silt-Sandy depot at the lower side of the SEFZ hill | Ridge of the wetland towards the hillside | | |
| | Silt-Clay at the wetland, the deposit of the fossil fluvial | Swampy soils | | |
| | Silt-sand deposit of alluvium soil with less vegetation | Ridge of the wetland used as footpath | | |
| | Gravel soil, imported for the road construction as the main access across the wetland | Main vehicular entrance to the wetland from South and North | | |
| | Silt-Clay deposit of alluvium | Closer the Swampy area | | |
| | Soil within Swampy area characterized by heavy saturated clay as deposit of fossil fluvial with heavy vegetation | Within Swampy area | | |

| Soil in the stream (river) is characterized by heavy undrained clay with deposit of the fossil fluvial | Within the stream area |
|--|----------------------------|
| Typical wetland soil deposit of fossil fluvial | Within the swampy areas |

It is worth noting that Nyandungu wetland has heterogeneous physical and chemical pedological characteristics⁸⁴. The soil characteristic gives a guideline for the zoning and landscaping design. The following map depicts the main types of soils according to FAO classification.



Figure 44: The main types of soils according to FAO classification of Nyandungu wetland

Source: Prepared by SESMEC Ltd from the National pedological map, Rwanda

The figure above shows presenting the main types of soils according to FAO classification reveals that the most of area extended between Ndera and Nyarugunga sectors are covered by mollic gleysol while the wetland parts located in Kimironko and Remera sectors are mostly covered by Humic Acrisols (Sombric.

⁸⁴ REMA and FONERWA. 2016. Nyandungu Urban Wetland Eco-tourism Park Full Project Document Cover Sheet.

3.4.3. Climate of Nyandungu wetland

Nyandungu wetland is characterized by a tropical wet and dry climate, which is modified by its high elevatio Its tropical climate is characterized by long wet seasons (Aw4) and relatively low temperatures as a consequence of its altitude (Tsinda, A, Ilunga, L.P, 2006). Its relatively low pluviometric annual module (between 1000-1300 mm) and clayey sandy soils suggest a relatively low runoff in spite of its impervious character subsequent to an uncontrolled urban development. The average temperature is 20°C with an average minimum of 16°C and an average maximum of 28°C.





Source: The Third National Communication, 2018

More than 75% of the annual rainfall occurs during the short rainy season (March to May) and the longer rainy season (September to December). Average rainfall during the short rainfall season is 360 mm and during the long rainy season is 338 mm85.

3.4.4. Climate change and variability and their impacts

Nyandungu wetland is often flooded during rainy seasons by the runoff from Kicukiro district (Nyarugunga sector), Gasabo district (Ndera and Kimironko sectors). Analysis of trends in mean temperatures for 1971-2018 revealed a progressive increase in minimum, mean and maximum annual temperatures throughout the years over Rwanda. The changes in mean rainfall were not significantly manifested through gradual increases or decreases, but through variability in frequency and intensity. The figure below shows a progressive increase in mean annual temperature.

⁸⁵ Ilunga, L., Muhire, I., Mbaragijima, C. (2004). Pluviometric seasons and rainfall origin in Rwanda, Geo-Eco-Trop, **28**, 1-2: 61-68



Figure 46: Variations in annual mean temperatures (in °C) at Kigali weather station

From the figures above, a progressive increase in annual minimum, average and maximum temperatures can be deducted at Kigali weather station. Moreover, the average increase of of around 1°C and 2.58 °C in annual minimum, mean and maximum temperatures was observed at Kanombe near to Nyandungu wetland (Muhire, *et al.*, 2016).

| Table 19. Total cumulative average mel case in temperatures (| | | | | | | 2010 | | | | |
|---|-------|-------|-------|------|------|------|--------|-------|------|------|------|
| January | Febr. | March | April | May | June | July | August | Sept. | Oct | Nov. | Dec. |
| 2.58 | 2.48 | 1.93 | 1.75 | 1.93 | 1.93 | 1.79 | 1.93 | 1.98 | I.84 | 1.75 | 2.21 |
| | | | | | | | | | | | |

Table 13: Total cumulative average increase in temperatures (°C) for 1971-2018

Source of data: Meteo Rwanda, 2019

The highest rise in annual mean temperature of 2.58 °C was seen at Kigali weather station for the period of 1971 to 2018 in January. This increase in temperature was alongside with high variability in mean annual rainfall as it can be seen on the figure below.



Figure 47: Rainfall variability (in mm) at Kanomber weather stations

The figure above show more fluctuations in mean annual rainfall for the period of 1961-2018

Source of data: Meteo Rwanda, 2019

Source of data: Meteo Rwanda, 2019

at Kigali weather station where the rainfall was varying between 680 and 1360 mm at Kigali weather station where the maximum rainfall was registered in 1978 with the minimum in 1992. This figure depicts insignificant changes in annual mean rainfall while much more strong storms and flooding episodes were observed recently over Nyandungu wetland. It can be concluded that changes in rainfall are much more observed in daily rainfall intensity and frequency over the areas surrounding Nyandungu wetland. Hence, the analysis of daily rainfall intensity is in call to come up with clear recommendations to deal with the observed floodings episodes. It is necessary mentioning that the dry conditions are expected over Nyandungu wetland as it can be depicted fron the figure below.





Source: Third National Communication, 2018 and Muhire et al., 2018

The figure above shows a general decrease in seasonal rainfall over Nyandungu wetland with exception during long rainy season while for the period of 1994-2050. Moreover, a progressive rise in temperatures is expected over the region as it is a case for other parts of the country..

3.4.5. Hydrology

Nyandungu valley is drained by two streams: Mwanana and Kabagenda. Both flow into the Mulindi stream, a tributary of the Nyabarongo River. The Mwanana Kabagenda system contributes to the Mugesera-Rweru freshwater lakes and wetland system that is a major contributor to the Nyabarongo wetland-river system which has national and international significance. The low Gravelius' indices as well as the centrifugal aspect of its hydrographic network suggest a relatively high rate of water concentration and peri-urban floods.

3.4.6. Biological characteristics of Nyandungu wetland

(i) Flora

The vegetation of the Nyandungu wetland is characterised by two types of vegetation: natural and anthropic vegetation. The natural vegetation is mainly growing in wetlands whereas the anthropic one is occurring in more or less dry areas. The natural vegetation is mainly found in the wetlands. The predominant species are papyrus and phragmites mauritianus. The remaining space is grassland used as a pasture for livestock. Some replanted trees such as filao, cassia spectabilis, grevilea robusta, euphorbia tirucali (umuyenzi), morus alba (iboberi) are also present in the area. There are three categories of flora: natural flora of the valley, fallow flora and exotic flora.

(a) Natural flora

- The marshland vegetation: papyrus cyperus (urufunzo); cyperus latifolius (urukangaga), phragmites mauritianus (imiseke), typha latifolia...
- Xerophytes trees: acacia hockii (umugenge), acacia abyssinica (umunyinya), euphorbia grantii (umudwedwe), etc.

Figure 49: Natural flora in Nyandungu wetland


(b) Fallow flora

- Bidens pilosa (inyabarasanya);
- Galisonga parviflora(kimari);
- A Rhynchelytrum repens (urwarikafundi);
- Clerodendrum rotundi (ikiziranyenzi);
- * Vernonia amygdalina (umubirizi),
- & Solanum abyssinum (umutobotobo),
- & Commelina bengalensis (uruteja),
- & Brachiaria brisantha (ivubwe),
- & Guizotia scabra (igishikashike),
- Leotonia nepetaefolia (igicumucumu)
- & Sida cordifolia (umucundura);
- * Tageta minuta (nyiramunukanabi); * Ocimum suave (umwenya);

(c) Exotic species

There are: cassia spectabilis, grevilea robusta, filao, morus alba (iboberi).

(iii) Fauna

In Nyandungu wetland, there are small mammal such as hares (oryctolagus cuniculus), hedgehogs, civettictis civetta (impimbi) and many birds. It is worth noting the presence of soil reptiles and soil fauna, especially termites and birds like:

- Falca abyssinica (agaca)
- Corvus albus (igikona)
- Milvus egyptius (sakabaka)
- Francolinus nobilis (inkware)
- * Numida meleagris (inkanga)
- Baleanica regulorum (umusambi)
- Bubulcus ibis (inyange).

There are also many varieties of ploceus. There is a probability to have Madagascar pond heron (a migratory bird) when the Nyandungu wetland will be restored.

Figure 50: Baleanica regulorum in Nyandungu wetland



3.4.7. Land use in Nyandundu wetland

Prior to the 1980s, the wetland was under the jurisdiction of the Ministry of Agriculture and Animal Resources, and some land within the complex was converted to sugar cane fields and to crop nurseries. In the 1980s and early 1990s the wetland was transferred to the Ministry of Defence and was used to train paratroops. Since 1995-2005 some private farmers used the land for agriculture and sand quarrying.

A coffee-washing station was also built within the Nyandungu wetland complex during this period. Then after, REMA has started rehabilitating and restoring the wetland. Currently, different activities are on-going for establishing Urban Wetland Recreation and Eco-tourism Park. This project is currently under implementation which will take into account the integration of culture, ecology and recreation aspects in the park and it will take into account City of Kigali Master Plan as shown below.





Source of data: Kigali City Master Plan 2020-2050

3.5. Shagasha tea factory and plantations, Rusizi District, Western Province

The Shagasha tea factory and surrounding plantations form part of the "Imbarutso" partnership model (initiated in 2012) between the Wood Foundation (jointly funded by the Gatsby Foundation) and around smallholder farmers gathered in 2 cooperatives known as "Villageois UMUCYAGI" and "COOPTHE". Imbarutso is designed to strengthen the

competitiveness of Rwanda's tea industry and ensure that smallholders benefit from the resulting growth.



Figure 52: Location of Shagasha Tea Estate and its surrounding

Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus

The villageois UMUCYAGI is composed of 4032 smallholder farmers and it grows the tea plantation on their own lands extended on 732 ha as reported by the president of the cooperative. They put together the production which is sold to the Shagasha Tea Factory. This cooperative operates in 10 sectors namely Giheke, Nkungu, Nyakarenzo, Mururu, Gihundwe and Kamembe sectors in Rusizi district and Shangi, Bushenge, Ruharambuga and Karengera which are located in Nyamashake district. The grown tea are arranged in 6/8 columns on 176 ha, in 31/8 columns on 220 ha while the baby sheets are grown on 132 ha. Additionnal 204 ha are covered by the tea plantation which are grown without respecting any order.

The COOPTHE is composed of 832 smallholder farmers and it grows the tea plantation on 530 ha in Ruharambuga sector of Nyamasheke district and Giheke, Nkungu, Mururu and Kamembe sectors of Rusizi district. The planted tea are arranged in 6/8 and 31/8 columns on 420 ha with baby sheets grown on 100 ha. The remaining 10 ha are covered by a very old tea plantation which are grown without respecting any order. The cooperative put together the production which is sold to the Shagasha Tea Factory and the cooperative members shares the income from the sells after paid all agricultural inputs provided by Shagasha Tea Factory. I t is worth noting that the first tea plantation of Shagasha Tea Factory dated from 1963.



Figure 53: Location of Shagasha Tea Estate and its surrounding to Kamembe

Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus

The figure above shows that shagasha Tea Factory is located in few kilometers from Kamembe city. However, the tea plantation is also found around the city as described above.

3.5.1. Topography and geomorphology

The Shagasha Tea Factory is located in coastal areas of Kivu Lake near to the Kamembe city has an altitude of around 1500 m and forms part of the African Rift Valley tectonic depression86. The Shagasha area appears to have a low slope percentage that mostly do not exceed 20, while the highest points of the area are in the western portion closer to Lake Kivu with areas above 40% slope category.

⁸⁶ Ministry of Agriculture and Animal Resources. 2009. Land husbandry, water harvesting and hillside irrigation (LWH) project.



Figure 54. Shagasha Tea Plantation and its topography

Source: Photos taken by SESMEC Ltd during field visit, December, 2020

In terms of soil, the predominant soil types are cambrisols and acrisols which are generally permeable and rich in iron. The soil is less acidic, with an average availability of clay. At some points on the shores of Lake Kivu, some phyllodes-derived soils, clay and sand with quartz crystals as well as other easily erodible type of soils exists. The soil of the area is generally fertile and several types of crops can be grown productively with appropriate agricultural practices in place.

Figure 55: The main types of soils according to FAO classification of Shagasha Tea Estate



Source: Prepared by SESMEC Ltd from National Update Basemap, 2020

Furthermore, There are also volcanic soils occupy are mainly localized in west on sides of Lake Kivu and they contribute highly to agricultural production of the country.

3.5.3. Climate at Shagasha tea Estate

The mean annual precipitation within the Giheke Sector in which the Shagasha Tea Factory is situated is \sim 1,329 mm mostly split across short and long wet seasons (435 mm and 565 mm respectively). This precipitation has shown a decline during both wet seasons between 1981–2017, and particularly the short wet season (March–May).





Source: The Third National Communication, 2018

Average annual temperatures within the Shagasha Tea Factory are between $18^{\circ}-22^{\circ}$ C. The average maximum temperature for the Giheke Sector is ~25°C, while the average minimum temperature is around 15° C⁸⁷. At present, the ideal temperatures for tea production in Rwanda are between 18–20°C, which are characteristic of altitudes between 1,600 and 2,200 masl. Such temperatures are prevailing in this in the southwest throughout the year This allows the tea to be harvested throughout the year.

3.5.4. Climate change and variability and their impacts

Analysis of trends in mean temperatures for 1971-2016 revealed a progressive increase in minimum, mean and maximum annual temperatures throughout the years over Rwanda. The increase in mean rainfall was also observed in the period of 1961-2016. The figure below shows a progressive increase in mean annual temperature.

⁸⁷ Ministry of Environment. 2018. Muvumba Catchment Management Plan (2018–2024).



Source of data: Meteo Rwanda, 2019

From the figures above, a progressive increase in annual minimum, average and maximum temperatures can be deducted at Kigali weather station. Moreover, the average increase of more than 1.0 °C in annual minimum, mean and maximum temperatures was observed in most parts of the country with exception in northern highlands where an arise in mean temperature was estimated at around 0.6 °C (Muhire, *et al.*, 2016).

| | - | | | - | | - | | • • | | | | |
|---------|------|-------|-------|-------|------|------|------|--------|-------|---------|-------|------|
| | Jan | Febr. | March | April | May | June | July | August | Sept. | October | Nov | Dec. |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Minimum | 1.15 | 0.87 | 0.74 | 0.69 | 0.87 | 0.78 | 1.15 | 1.06 | 1.43 | 0.78 | 0.64 | 0.69 |
| Maximum | 2.02 | 2.21 | 1.79 | 1.7 | 2.16 | 1.79 | 2.16 | 1.93 | 1.84 | 1.93 | 1.47 | 1.43 |
| Average | 1.56 | 1.7 | 1.43 | 1.84 | 1.66 | 1.47 | 1.84 | 1.66 | 1.79 | 1.33 | 1.104 | 1.43 |
| | | | | | | | | | | | | |

Table 14: Magnitude of changes in temperatures (°C) after 46 years (1971-2016)

Source: Third National Communication, 2018

The highest rise in annual mean temperature of 2.21 °C was seen in maximum temperature at Kamembe weather station for the period of 1971 to 2018 in February. This increase in temperature was alongside with high variability in mean annual rainfall tending to the decrease as it can be seen on the figure below.

Figure 57: Rainfall variability (in mm) at Kanombe weather station



Source: Meteo Rwanda, 2020

The above figure depicts high fluctuations in mean rainfall at Kamembe station for the period of 1961-2018. A dry period was seen for the period 1998-2005 while 2008-2014 was the wettest period. The mean rainfall of 1378.25 mm for the period 1961-2016 makes the region to be the wettest in Rwanda along with volcanic region as reported by Muhire *et al.*, 2015.





Source: Third National Communication, 2018 and Muhire et al., 2018

The figure above shows a slight increase in seasonal rainfall during long dry and short rainy seasons while a constant annual mean rainfall will be observed during long rainy and short dry season for the period of 1994-2050. Moreover, a progressive rise in temperatures is expected over Shagasha Tea Estate as it is a case across the country.

It is worth noting that periods of heavy rainfall lead to reduced soil fertility because of the associated erosion, flooding and landslides over Rusizi district. For instance, in 2012, flooding in Rusizi resulted in three deaths, 341 homes damaged or destroyed and affected 125 ha of

cropland⁸⁸. This pilot area also has a moderate to high susceptibility to landslides based on the steepness of slopes in the area and high rainfall amounts compared with most of the country.

Approximately 200–300 individuals in Rusizi are vulnerable to landslides related to moderate to very high slope susceptibility. Another climatic hazard is windstorms with gale force winds (72–79 km/hour) every 5 years and storms with strong gale force winds (79–100 km/hr) every 10 years⁸⁹. In 2013, windstorms in Rusizi resulted in one death, 199 damaged or destroyed homes and 235 ha of damaged cropland.

The most notable effect of climate change on tea is a rise in temperatures, which will affect the suitability of where tea is grown. Lower lying areas are predicted to become hotter, decreasing the productivity and quality of tea production. Regarding an increase in rainfall variability, projections indicate an increase in the frequency and intensity of heavy rainfall events, compounding problems such as soil erosion and fertiliser application mentioned above. In addition, the dry season is expected to lengthen, negatively affecting production (as mentioned above) and exacerbating the effect of the red spider mite. The effects of current and future climate change described above threaten not only Rwanda's tea industry and its potential for growth but also the related livelihoods of thousands of people. It is, therefore, essential that climate change adaptation interventions relative to the industry be trialled and upscaled in the future.

3.5.5. Hydrology

The Shagasha Tea Factory is located in the Lake Kivu catchment, which is a transboundary catchment with the DRC⁹⁰. This catchment consists of a number of smaller catchments that drain into Lake Kivu, which is the major water body in the area. One of the rivers identified is the Cyongoroka River which flows along the eastern boundary of the urban area.

⁸⁸ MIDIMAR. 2015. The national risk atlas of Rwanda.

⁸⁹ MIDIMAR. 2015. The national risk atlas of Rwanda.

⁹⁰ Rwanda Environment Management Authority. 2015. Rwanda: State of environment and outlook report 2015.

Figure 59: Hydrological map around Shagasha Tea Estate



The pilot area has a relatively large number of rivers and wetlands found within valleys and between hills which are mostly cultivated.

| SN | Name | Length in Meter | SN | Name | Length in Meter |
|----|------------|-----------------|----|--------------|-----------------|
| 1 | Ruganda | 5090.89158 | 65 | Ryamarurumba | 1193.168252 |
| 2 | Nyarungu | 1822.749702 | 66 | Kajabu | 790.484187 |
| 3 | Kabare | 891.967428 | 67 | Kamabuye | 1112.172064 |
| 4 | Katabuvuga | 954.502311 | 68 | Miziira | 357.534748 |
| 5 | Rugomero | 4437.299526 | 69 | Nyaruhondo | 1879.468893 |
| 6 | Mwaga | 798.377932 | 70 | Kiziba | 5443.695981 |
| 7 | Nyamabuye | 2946.438498 | 71 | Rwamivugo | 3295.269687 |
| 8 | Gasumo | 1551.046742 | 72 | Murindi | 626.091339 |
| 9 | Kamabuye | 1840.213018 | 73 | Gasuma | 3479.082716 |
| 10 | Gisuma | 212.085565 | 74 | Nyakayuya | 1212.625296 |
| 11 | Rusizi | 10021.19697 | 75 | Mukata | 1014.116132 |
| 12 | Gahana | 1727.596924 | 76 | Matyazo | 1400.320447 |
| 13 | Nyamazi | 2899.375428 | 77 | Matyazo | 12225.8076 |
| 14 | Gitaba | 722.51795 | 78 | Nyamunkaba | 1124.397115 |
| 15 | Kigabiro | 1507.848648 | 79 | Nkongoro | 3128.595407 |
| 16 | Mabuve | 2250.460144 | 80 | Cvangirwe | 3.064625 |

| | | | | | - | ~ . | |
|-----------|------------|---------|--------|-------|--------|----------|----------------|
| Toble 15. | The longth | of main | rivora | found | oround | Shogocho | too plantation |
| Table 13. | I HE ICHYU | vi mam | IIVEIS | Tonna | arvunu | Shagasha | |
| | · · • | | | | | | |

| 17 | Kanyirangore | 808.841119 | 81 | Runyangwe | 2440.618462 |
|----|--------------|-------------|-----|-------------|-------------|
| 18 | Nyagatongo | 638.380269 | 82 | Nyacuyaga | 824.192807 |
| 19 | Nyagashenyi | 2584.277537 | 83 | Macokoro | 1037.057248 |
| 20 | Kagende | 763.705717 | 84 | Kagimbu | 2414.767416 |
| 21 | Shangazi | 2182.452545 | 85 | Rwamuhirwa | 2254.457514 |
| 22 | Nyakarenzwa | 1001.28657 | 86 | Kaninda | 739.003946 |
| 23 | Rwibira | 860.952969 | 87 | Nyagahembe | 1102.415509 |
| 24 | Ruabwanduru | 1383.52763 | 88 | Kadoboli | 705.48022 |
| 25 | Kabugu | 2086.418029 | 89 | Rubeho | 1848.103113 |
| 26 | Kaneli | 2366.707851 | 90 | Kabulindi | 2232.770494 |
| 27 | Kamigisha | 1442.812739 | 91 | Nyirabikari | 3028.913541 |
| 28 | | 640.827094 | 92 | Nyamabuye | 2088.451758 |
| 29 | Rubyiro | 11284.25761 | 93 | Cyogo | 2915.619905 |
| 30 | Nyamanziba | 6269.464692 | 94 | Gaseke | 1595.49513 |
| 31 | Gikombe | 1176.981477 | 95 | Kadasomwa | 1440.868325 |
| 32 | Rumuna | 1091.560331 | 96 | Nyarudeli | 1651.414185 |
| 33 | Susa | 891.024954 | 97 | Gisheke | 931.174393 |
| 34 | Kankenke | 4565.023989 | 98 | Kabingo | 1684.133602 |
| 35 | Butabagire | 1796.294152 | 99 | Nyamahembe | 8406.494806 |
| 36 | Rushakamba | 2223.208279 | 100 | Nkomane | 1564.172181 |
| 37 | Cyunyu | 9377.088315 | 101 | Nyamutiro | 3656.763776 |
| 38 | Gisuma | 114.483652 | 102 | Cyarukoza | 2304.563529 |
| 39 | Gasuma | 3604.757282 | 103 | Gakangaga | 547.582849 |
| 40 | Rugaja | 2144.616635 | 104 | Gihundwe | 3505.474078 |
| 41 | Nyabiganga | 1666.664839 | 105 | Mburamazi | 5959.353637 |
| 42 | Nyabyunyu | 4029.465854 | 106 | Kajagamba | 10367.33613 |
| 43 | Nyarutovu | 7467.726941 | 107 | Kijambo | 1241.183483 |
| 44 | Njambwe | 8933.154946 | 108 | Kijabwe | 2008.142621 |
| 45 | Kamatende | 4519.814026 | 109 | Rusayo | 2069.687945 |
| 46 | Mashoroza | 1932.328364 | 110 | Kamabuye | 3079.193778 |
| 47 | Nyamuko | 984.901406 | 111 | Ryabahunga | 950.070343 |
| 48 | Ruzibanduru | 701.356179 | 112 | Karukubita | 1426.144758 |
| 49 | Kabingo | 1736.740752 | 113 | Nyabwinshi | 4737.95246 |
| 50 | Nyakabunda | 8238.475181 | 114 | Nyamateke | 1326.812008 |
| 51 | Gaseke | 1500.709579 | 115 | Nyirangogo | 1480.65424 |
| 52 | Gatandara | 2075.269323 | 116 | Nyakagezi | 1487.616392 |
| 53 | | 1610.898067 | 117 | Kaburandwe | 3904.240129 |
| 54 | Rwonga | 4935.270722 | 118 | Kabisigo | 6336.203272 |
| 55 | Gafuka | 101.835329 | 119 | Gishyuhira | 1265.15504 |
| 56 | Gatindo | 1870.950571 | 120 | Rubondwa | 3098.376055 |
| 57 | Kijabwe | 2860.487013 | 121 | Busesa | 3307.45611 |
| 58 | Mulirwa | 796.182754 | 122 | Nyambura | 4731.849544 |

| 59 | Ntondwe | 2908.68576 | 123 | Nyamugali | 2656.124465 |
|----|--------------|-------------|-----|------------|-------------|
| 60 |) Nyagahembe | 534.067583 | 124 | Nzikwa | 1056.423343 |
| 61 | Kabazigura | 897.237096 | 125 | Gatindo | 1266.446278 |
| 62 | 2 Cyongoroka | 4770.04161 | 126 | Cyongoroka | 2923.839388 |
| 63 | 3 Nyagahanga | 8886.053447 | 127 | Cyongoroka | 13291.04782 |
| 64 | Kayogoro | 1003.117792 | | | |

It can be depicted from the table above that Shagasha Tea plantation is surrounded with a good number of rivers (127) which exit toward Kivu Lake. This facilitates the tea plantation to have enough water throughout the year.

3.5.6. Biological characteristics

The major ecological systems in the Shagasha area are the Shagasha Natural Forest and Kivu Lake. The remainder of the area is occupied by tea plantations, agricultural land and woodlots/planted forest. The Shagasha Forest is a six-hectare, isolated montane forest at an altitude of 1,950 masl.

The forest is located in a depression near the Shagasha Tea Factory, and is a secondary forest dominated by tree species such as river macaranga (*Macaranga kilimandscharica*) and false assegai (*Maesa lanceolata*). Some primary tree species, such as forest newtonia (*Newtonia buchannani*) and dwarf umbrella tree (*Strombosia schefflera*), are still present particularly along a stream that crosses the forest. There is also a swamp located in the centre of the forest. The forest belongs to one of the Shagasha tea farmers' cooperatives (COOPTHE Shagasha) and it has been largely protected from deforestation because it harbours water sources (the stream and swamp) that supply almost all the water used in the factory. Despite this, some people have started cultivating in the northern part of the central swamp.

Shagasha Forest is also characterised by native tree species such as woodland waterberry (*Syzygium guineense*), peacock flower (*Albizia gummifera*), *Dichaetanthera corymbose* and forest fever tree (*Anthocleista grandiflora*). These species in turn provide habitat for numerous epiphytes such as orchids, mosses, ferns and lichens. Despite its small size, Shagasha Forest is similar to Nyungwe Forest, and supports a rich floral diversity and harbours some endangered species, including L'Hoest's monkey (*Allochrocebus lhoesti*), which is also found in the eastern side of Nyungwe forest.

According to local communities, there is also a small population of silver monkeys (*Cercopithecus dogetii*) in the Shagasha Forest. These primates are very isolated from other groups found in Nyungwe Forest and require special attention for their protection to avoid genetic drift.

3.5.7. Land use

In the Rusizi district where the Shagasha Tea Factory is located, around 75% of land is dedicated to agricultural production dominated by tea plantation⁹¹. Figure 60: Tea Plantation around Shagasha Tea Estate

⁹¹ GoR. EICV3 District Profile: Rusizi.



Source of data: 2020 Google Earth, US Dept of State Geographer, Image 2021 CNES/Airbus

Around the Shagasha Tea Factory is primarily grown tea which is a particularly valuable crop because of its considerable export value and contribution to around 20% of Rwanda's total exports.



Figure 61: Land use in 2020

Source: Prepared by SESMEC Ltd from National Update Basemap, 2020

The figure above presents the land use of 2020 over10 sectors namely Giheke, Nkungu, Nyakarenzo, Mururu, Gihundwe and Kamembe sectors in Rusizi district and Shangi, Bushenge, Ruharambuga and Karengera which are located in Nyamashake district on which the tea plantation used by Shagasha Tea Factory are grown. It is worth noting that shagasha Tea Estate occupies 1462 ha⁹² equivalent to 3.06% of the total areas 47,741 ha reserved for agricultural activities in Rusizi district. This shows that the tea plantation plays a key role in the economy of the country.

Furthermore, 16,183 ha were covered by agroforestry with 2125 fruit trees planted in 2018/2019 along with 6 ha wooded in the same period across Rusizi district.

4. SOCIO-ECONOMIC ANALYSIS OF HOUSEHOLDS AT PILOT SITES

The section below provides the findings of the survey from the field on a number of indicators, which include demographic and socio-economic characteristics of respondents, accessibility and use of energy and water in households; the accessibility to health services, food security, agricultural practices along with the climate change and their impacts as well as adaptation options used by smallholder farmers in the study area.

4.1. Demographic characteristics of respondents and household heads

4.1.1. Demographic characteristics of respondents

The distribution of respondents by sex, age, education and occupation are presented in table below.

| | Nyandungu | Ibanda-Makela | Muvumba | Shagasha | Eastern Savanna | Average |
|--------------------|---------------|---------------|----------------|----------|-----------------|---------|
| Sex of household | head | | | | | |
| Male | 73.1% | 79.7% | 68.1% | 77.8% | 84.6% | 76.1% |
| Female | 26.9% | 20.3% | 31. 9 % | 22.2% | 15.4% | 23.9% |
| Age group of hou | sehold head | | | | | |
| <= 25 | 7.7% | 5.1% | 1.1% | 3.7% | 1.5% | 3.8% |
| 26-35 | 23.1% | 26.6% | 9.6% | 18.5% | 10.8% | 17.6% |
| 36- 45 | 30.8% | 21.5% | 24.5% | 17.3% | 29.2% | 24.4% |
| 46 - 55 | 19.2% | 16.5% | 31. 9 % | 25.9% | 24.6% | 23.9% |
| 56 - 65 | 10.3% | 19.0% | 16.0% | 22.2% | 23.1% | 17.9% |
| 66+ | 9.0% | 11.4% | 17.0% | 12.3% | 10.8% | 12.3% |
| Education level of | f household h | nead | | | | |
| None | 5.1% | 49.4% | 51.1% | 27.2% | 40.0% | 35.0% |
| Primary | 43.6% | 36.7% | 38.3% | 43.2% | 44.6% | 41.1% |
| Junior High School | 6.4% | 8.9% | 8.5% | 12.3% | 7.7% | 8.8% |
| Higher school | 21.8% | 3.8% | 2.1% | 9.9% | 7.7% | 8.8% |
| University | 23.1% | 1.3% | 0.0% | 7.4% | 0.0% | 6.3% |
| Can HHH read an | nd write | | - | | | |
| Yes | 94.9% | 68.4% | 53.2% | 74.1% | 72.3% | 71.8% |

Table 16: Socio-demographic characteristics of household heads

 92 The information provided by the managers of COOPTHE and the Villageois UMUCYAGI cooperatives

| No | 5.1% | 29.1% | 42.6% | 24.7% | 23.1% | 25.7% |
|---------------|------|-------|-------|-------|-------|-------|
| Can read only | 0.0% | 2.5% | 4.3% | 1.2% | 4.6% | 2.5% |

Source: Baseline survey, December, 2020 (n=397)

The table above depicts that more males (76.1%) compared to females (23.9%) are heading households the highest number of them (24.4%) belongs to the age group of between 36 to 45 years age followed by those in 46 to 55 years age group while those aged between 26 and 35 years represent 17.6%. Thus, the majority of household head is aged between 25 and 55 years. Those with less than 25 years are less represented (3.8%) as they are relatively unlikely to be married at these ages while those belonging to old age group (above 66 years) are very few in number (12.3%) as it is a case at national level (NISR, 2019⁹³).

It was revealed that 71.8% of household heads have reading ability though 35% did not go to school with 41.1% who completed primary school level and 17.6% completed secondary school studies. Moreover, the highest percentage (94.9%) of household heads with reading ability was found around Nyandungu wetland while the lowest percentage (53.2%) were seen around Muvumba River. Though the percentage of those who completed university is low (6.3%), the percentage of respondents from areas around Nyandungu wetland is very high (23.1%) compared to other pilot sites like Eastern savannah and around Muvumba River where there is no respondents who holds university degree.





Source: Baseline survey, December, 2020

The above pyramid is wide at the base, narrowing rapidly as it reaches the upper age limits. This is a common shape indicating a population with high fertility and high mortality. Thus, the same shape is seen at national level though a decrease in population growth rate from 2.6%

⁹³ National Institute of Statistics of Rwanda, (2019). The annual report, Kigali, Rwanda

in 2012 to 2.35% in 2018 was registered but it is still high compare to current world population growth rate of 1.2% (NISR, 2019⁹⁴).



Figure 63: Number of family members of respondents

Figure 64: Number of family members of respondents (n=397)

The study revealed that the number of family members varying between one (1) and eleven (11) with the majority of families having between 4 and 6 members. The largest families with more than 7 members (33.8) were seen in Eastern Savannah contrary to the areas around Muvumba River where there is 18.1% of families with more than 7 members. The figure below shows the average number of family members at pilot sites.



The average household size of 5 people at project intervention is above to the national average of 4.2 people as reported by NISR in 2019⁹⁵.

4.1.2. Professional characteristics of household head

When a high percentage of working population is largely or entirely dependent upon rain-fed

⁹⁴ National Institute of Statistics of Rwanda, (2019). The annual report, Kigali, Rwanda

⁹⁵ National Institute of Statistics of Rwanda, (2019). The annual report, Kigali, Rwanda.

agriculture for their livelihoods, there is a form a disproportionately high vulnerability to the impact of climate change. The table below presents the professional occupations of household heads in the study area, as reported by survey respondents.

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Average |
|-----------------------|---------------|---------|---------|----------|---------|---------|
| | | Makela | | | Savanna | |
| Main occupation | | | | | | |
| Farmer | 15.4% | 89.9% | 93.6% | 75.3% | 78.5% | 71.3% |
| Artisan | 7.7% | 1.3% | 0.0% | 4.9% | 3.1% | 3.3% |
| Commerce/Transport | 12.8% | 1.3% | 0.0% | 3.7% | 3.1% | 4.0% |
| Civil servant | 10.3% | 1.3% | 1.1% | 8.6% | 1.5% | 4.5% |
| Private Employee | 30.8% | 3.8% | 3.2% | 3.7% | 6.2% | 9.3% |
| None | 23.1% | 2.5% | 2.1% | 3.7% | 7.7% | 7.6% |
| Ubudehe category 2020 | of respondent | S | ^ | ^ | | |
| | | | | | | |
| CATI | 9.0% | 15.2% | 10.6% | 4.9% | 6.2% | 9.3% |
| CAT2 | 42.3% | 48.1% | 50.0% | 39.5% | 63.1% | 48.1% |
| CAT3 | 47.4% | 35.4% | 38.3% | 54.3% | 30.8% | 41.6% |
| CAT4 | 1.3% | 1.3% | 1.1% | 1.2% | 0.0% | 1.0% |

Table 17: The main occupation of household head by gender

Source: Baseline survey, December, 2020

The table above shows that the majority of household heads (more than 71.3%) is engaged in farming activities based on rain-fed agriculture as reported by respondents during the FGDs. This percentage is higher than national average of 54% reported in EICV 5 in 2018 though it is 15.4% around Nyandungu wetland. A small percentage 4% of household heads is engaged in commercial and transport activities with 4.5% and 9.3% being civil servant and private employee respectively. These two sectors occupy the highest percentage (30.8% for private employee and 10.3% for civil servant) for the areas surrounding Nyandungu weltland It is clear that households of around project intervention areas depend mainly on farming for their livelihood. Therefore, they are probably vulnerable to negative impacts of climate change. Thus, any change in frequency and intensity of rainfall impact negatively on their livelihood.

4.2. Ownership of properties

4.2.1. Homestead characteristics

The analysis of house ownership is necessary to understand better the level of development of households in a given area. Such information may also help in estimating the household expenses; for instance, a household renting a house is spending much more than the ones living in their own houses.

Figure 65: House ownership



Source: Baseline survey, December, 2020

Notwistanding that only 55.1% of respondents from around Nyandungu wetland, the majority of household heads (above 80%) live in their own houses at project intervention areas against 15.1% who do not own a house in the same areas. All houses are roofed by iron sheets as confirmed by the respondents. To have such high number of household heads having their own houses is a good indicator that the majority of the population live in their own houses which imply that the money they would spend on rent can be saved for meaningful investments. The table below indicates the building materials used for walls and foundation.

| | Nyandungu | lbanda- Makela | Muvumba | Eastern Savanna | Shagasha | Total |
|--------------------|--------------|-------------------|---------|--------------------|----------|-------|
| Materials used on | the walls | | | | | |
| Baked clay bricks | 20.9% | 3. 9 % | 1.1% | 6.8% | 16.7% | 8.3% |
| Adobe bricks | 67.4% | 93.4% | 98.9% | 91.5% | 0.0% | 73.0% |
| Cement blocks | 9.3% | 0.0% | 0.0% | 1.7% | 0.0% | I.5% |
| Wood | 0.0% | 0.0% | 0.0% | 0.0% | 28.8% | 5.6% |
| Trees | 2.3% | 2.6% | 0.0% | 0.0% | 54.5% | 11.6% |
| Materials used for | r foundation | | | | | |
| None | 18.6% | 2.6% | 7.5% | 3.4% | 50.0% | 15.4% |
| Adobe bricks | 20.9% | 30.3% | 64.5% | 35.6% | 1.5% | 33.8% |
| Baked clay bricks | 2.3% | 1.3% | 0.0% | 3.4% | 1.5% | I.5% |
| Stones | 58.1% | 64.5% | 28.0% | 57.6% | 28.8% | 45.4% |
| Other | 0.0% | 1.3% | 0.0% | 0.0% | 18.2% | 3.9% |

| Table 18: | Materials | used on | the walls | and foundation |
|-----------|------------------|---------|-----------|----------------|
| | | | | |

Source: Baseline survey, December, 2020

The table above shows that most of houses constructed in adobe bricks on the walls in all pilot sites except Shagasha Tea Estate have a foundation of either stones or adobe bricks. This gives a good indication that not much of the forest trees are cleared for construction purposes. However, houses constructed with adobe bricks should be well protected against rainfall especially those without foundation otherwise they may be damaged during rainy seasons. The majority of houses around Shagasha Tea Estate are constructed either in trees or wood on the walls without a foundation with only 28.8% have a foundation. This use of trees and wood in this area requires high demand for timber for construction purpose which may lead to the high rate of deforestation resulting into different consequences like high soil erosion, low rate of CO_2 absorption among others. Therefore, NAP project should put much more effort in protecting the existing forest and in afforestation programmes. It is important

highlighting that the constructed houses have different number of rooms to accommodate family members as shown below.





Source: Baseline survey, December, 2020

The figure above shows that the number of rooms in the house are varying between one (2) and nine (11) for project beneficiaries respondents but the majority possess the houses of 3 to 5 rooms including sitting room. This implies that there is congestion at household level as far as it was seen earlier that the average family size is 5 people at project intervention areas while the mean number of rooms in the house are 4 rooms including sitting room, hence not every family member can have his/her own room. The figure below presents the possessed equipment in the house.

| | Nyandungu | lbanda- Makela | Muvumba | Eastern Savanna | Shagasha | Total |
|--------------|-----------|-------------------|---------|--------------------|----------|-------|
| Benches only | 2.3% | 3.9% | 7.5% | 0.0% | 10.6% | 5.3% |
| Chairs | 97.7% | 94.7% | 89.2% | 84.7% | 84.8% | 89.9% |
| Sofa | 44.2% | 1.3% | 9.7% | 35.6% | 12.1% | 17.2% |
| Beds | 95.3% | 43.4% | 41.9% | 67.8% | 84.8% | 62.0% |
| Mattress | 69.8% | 71.1% | 82.8% | 98.3% | 68.2% | 78.3% |
| Cupboard | 74.4% | 6.6% | 14.0% | 28.8% | 30.3% | 25.8% |
| Table | 95.3% | 53.9% | 58.1% | 89.8% | 74.2% | 70.6% |
| Other | 0.0% | 0.0% | 0.0% | 0.0% | 1.5% | 0.3% |

Source: Baseline survey, December, 2020

The table above reveals that the majority of household project beneficiaries possess chairs (89.9%), matresses (78.3%), table (70.6%) and beds (62%). Additionnaly, 25.8% and 14.6% do have cupboard and Sofa respectively with 5.3% possessing only benches. These percentages depict that the majority of households do have the basic equipment in their houses. When the respondents asked about the possession of toilets, the provided feedbacks were

summarized in figure below.

Table 20: Quality of latrine

| | Nyandungu | lbanda- Makela | Muvumba | Eastern Savanna | Shagasha | Total |
|----------------------------------|-----------|-------------------|---------|--------------------|----------|----------------|
| None | 1.3% | 3.8% | 1.1% | 0.0% | 0.0% | 1.3% |
| Non covered latrine | 3.8% | 5.1% | 3.2% | 3.1% | 6.2% | 4.3% |
| Covered latrine but not cimented | 21.8% | 84.8% | 89.4% | 72.3% | 82.7% | 71.0% |
| Covered latrine and cimented | 56.4% | 6.3% | 6.4% | 21.5% | 8.6% | 1 9 .1% |
| Modern flashing latrine | 16.7% | 0.0% | 0.0% | 3.1% | 2.5% | 4.3% |

Source: Baseline survey, December, 2020

The baseline study shows that the majority of households (71%) possess the covered latrine which are not cemented while 19.1% of households have covered latrine and cimented with 4.3% who have modern flashing latrine. 4.3% have non-covered latrine while 1.3% do not have any latrine. The highest percentage of covered latrine and cemented (56.4%) and modern flashing latrine (16.7%) were seen in areas around Nyandungu wetland compared to other project intervention sites. When respondents were asked about the location of their houses and causes of damages experienced on their houses, the feedback which they gave was reported in figure below.

| Table 21: | Location | of a house a | and cau | ses of | damages | experienced | on the | house |
|-----------|----------|--------------|---------|--------|---------|-------------|--------|-------|
| | | | | | | | | |

| | Nyandungu wetland | lbanda- Makela | Muvumba River | Eastern Savannah | Shagasha | Average |
|--|----------------------|-------------------|------------------|---------------------|----------|---------|
| Location of a house | | | | | | |
| Flat areas without any floods or landslides | 97.4% | 98.7% | 95.7% | 92.3% | 93.8% | 95.7% |
| In less than 50 meters from the river or wetland | 1.3% | 1.3% | 4.3% | 4.6% | 2.5% | 2.8% |
| In high-risk zone (hilly and sloppy areas) | 1.3% | 0.0% | 0.0% | 3.1% | 3.7% | ۱.5% |
| Causes of damages exp | erienced on t | he house i | n I2 past mo | ounths | | |
| Flooding | 0.0% | 2.6% | 1.1% | 3.4% | 0.0% | ۱.5% |
| Heavy rains | 27. 9 % | 14.5% | 17.2% | I 6. 9 % | 31.8% | 20.8% |
| Landslides | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Strong winds | 14.0% | 18.4% | I 2. 9 % | 3.4% | 16.7% | 13.4% |
| Other | 2.3% | 0.0% | 0.0% | 0.0% | 33.3% | 6.8% |

in the 12 past months

Source: Baseline survey, December, 2020

The table above informs that more than 92% of houses are located in safe flat areas without any floods or landslides at all project intervention reas. More houses located in less than 50 meters from the river or wetland are found near to Muvumba River (4.3%) and in Eastren Savannah (4.6%). There are also 3.7%, 3.1% and 1.3% of households who declared to settle in high risk zone. Though these latter two groups are still very few in number as conformed also by KII and FGD members, they should be resettled in safer areas rather than remaining in high risk zones. The heavy rainfall and strong winds were pointed out to have caused damages of houses as declared by an average of 20.8% and 13.4% respondents respectively. Flooding episodes were also said to have damaged houses around ibanda-Makela forest (2.6%), in Eastern Savannah (3.4%) and around muvumba river (1.1%). Therefore, the most appropriate adaptation measures are in call to save other houses of being damages by heavy rains, strong winds and floods. The figure below show the damaged houses by various agents.

4.2.2. Land ownership and mode of operations

With reference to the Land Tenure Regularization Program, a person is known as the land owner when he/she has land certificate of a specific pierce of land on which his/her name is registered. In case of legally married wife and husband both of them have to be registered in land certificate. The figure below shows the status of land ownership in project intervention areas.





Source: Baseline survey, December 2020

Figure above shows that an average of 80.1% of households do own land against 19.9% who do not own land. Only 38.5% of respondents living around Nyandungu wetland confirmed to possess their own houses. This low percentage is linked with the respect of Master Plan while constructing a house in this area. This requires a lot of money which is not available for most of households as confirmed also by the FGDs and KI members. The average sizes of owned lands are summarized in figure below



Figure 68: Location of farmlands

The majority of lands (85.2%) are located on hillside followed with those located in marshland

Source: Baseline survey, December 2020

(4.2%). The biggest of farmlands located in marshlands were seen around Muvumba River (33.7%). There is also a small percentage of farmlands which were confirmed to be located in floody (6%) and steep slope (4.1%) areas. These farms need special protection to reduce the risks of being eroded. It is important to highlight that to have agricultural fields in marshland constitutes an advantage as they are exploited throughout the year including dry period (June – September), corresponding with the agricultural season C, while the hillside is only cultivated during rainy seasons corresponding to A and B agricultural seasons.





The figure above shows that food crop farming is done by 83% compared to cash crop farming of especially coffee and tea which occupies only 1.6% while livestock engage 16% of households. 7.9% and 13.2% confirmed to have forests and Napier grasses which contribute in various ways in dealing with adverse impacts of climate change. The dominance of the rainfed farming as the main income for the majority of households put their livelihood at risk as any change in frequency and intensity of rainfall impacts negatively on crop productivity, then after caused the food shortage. The figure below informs about the possession of kitchen **Figure 70: Possession of kitchen garden**



Source: Baseline survey, December 2020

Source: Baseline survey, December 2020

It has been reported that 70.5% of project beneficiary households possess kitchen gardens. This is a good indication that a large number of people may get vegetable from their gardens to complete their daily meals. With regard to the integration of land use consolidation program the feedback from households was reported in figure below.



Figure 71: Households with land intergrated in land use consolidation program

Source: Baseline survey, December 2020

The figure above shows that the promoted land use consolidation program by the government of Rwanda, was less implemented at project intervention areas as only 2.2% of households have their land put is that program. The highest number (5.3%) of households who have their land integrated in land use consolidation program were seen around Ibanda-Makela forest while the remaining sites have less than 2% of households who have the land in that program. Therefore, more sensitization of the households is needed to attract them to put their lands in land use consolidation program.

4.2.3. Main sources of household income

According to EICV 5 published in 2018, about 54% of the Rwandan working population is engaged in farming activities. This farming is mainly dominated by food crops namely: bananas, which occupy more than a third of the country's farmland, potatoes, beans, rice, sweet potatoes, cassava, wheat and maize. Coffee and tea are the major cash crops for export. Animals raised in Rwanda include cows, goats, sheep, pigs, chicken, and rabbits, with geographical variation in the relative importance of each. The industry occupied 16% of working population while around 30% was engaged in services (NISR, 2019). The figure below shows the main sources of household income

| | Nyandungu | Ibanda- | Muvumba | Eastern | Shagasha | Average |
|-----------------------|-----------|---------|---------|---------|----------|---------|
| | | Makela | | Savanna | | |
| Food crops farming | 11.5% | 89.9% | 95.7% | 96.9% | 81.5% | 75.3% |
| Cash crops farming | 0.0% | 1.3% | 0.0% | 3.1% | 2.5% | 1.3% |
| Business | 24.4% | 10.1% | 2.1% | 3.1% | 1.2% | 8.1% |
| Artisan | 6.4% | 2.5% | 0.0% | 0.0% | 6.2% | 3.0% |
| Part time employment | 43.6% | 64.6% | 33.0% | 12.3% | 34.6% | 38.3% |
| Permanent job | 25.6% | 1.3% | 2.1% | 3.1% | 12.3% | 8.8% |
| Renting property | 6.4% | 2.5% | 0.0% | ۱.5% | 2.5% | 2.5% |
| Retirement allowances | 0.0% | 0.0% | 1.1% | 3.1% | 1.2% | 1.0% |
| Gifts /remittances | 2.6% | 5.1% | 0.0% | ۱.5% | 2.5% | 2.3% |
| Mining and queries | 1.3% | 1.3% | 0.0% | 3.1% | 0.0% | 1.0% |
| Animal Husbandry and | 2.6% | 0.0% | 4.3% | 26.2% | 28.4% | 11.6% |
| Production | | | | | | |
| Any other | 1.3% | 8.9% | 1.1% | 3.1% | 1.2% | 3.0% |

Source: Baseline survey, December 2020

The majority of households reported farming activities as their main occupation as declared by more than 88% at Ibanda-Makela, Muvumba river, Eastern savannah sites with 81.5 at Shangasha and 11.5% at around Nyandungu wetland. Part time employement took the second position in generating income for respondents especially around Ibanda – Makela forest (64.6%) and Nyandungu wetland (43.6%). Parmanent jobs (8.8%) and business (8.1%) come after in generating income for for the households. Animal husbandry and production along with artisan play also a determinant roles in contribution to the income generation for households. The contribution of the remaining professional occupation is very limited as each occupies less than 3% of respondents. Moreover, this figure depicts that the respondents might be engaged in different income generation activities at the same time.



Figure 72: Household income per month for the past 12 months

Source: Baseline survey, December 2020

The figure above reveals that between 63% and 70% of households located in Ibanda-Makela., Muvumba river and eastern Savannah earn less than 30,000 Rwf monthly while those who earn such amount are 42% and 34.6% around Nyandungu wetland and shagasha tea estate. The second group in proportion earn between 30,000 Rwf and 100,000 Rwf and only less than 10% at all project sites except around Nyandungu earn more than 100,000 Rwf. This shows that more support and projects are welcomed to increase the households' income generaly and improve their welfare particularly. The animals mainly reared at project sites are presented in the figure below.

| | Nyandungu | lbanda- Makela | Muvumba | Eastern Savanna | Shagasha | Overall |
|---------|-----------|-------------------|---------|--------------------|----------|---------|
| Cow | 3.8% | 8.9% | 20.2% | 52.3% | 48.1% | 25.7% |
| Pig | 0.0% | 12.7% | 7.4% | 3.1% | 32.1% | 11.3% |
| Goat | 5.1% | 44.3% | 27.7% | 32.3% | 12.3% | 24.2% |
| Sheep | 0.0% | 0.0% | 5.3% | 3.1% | 12.3% | 4.3% |
| Chicken | 3.8% | 15.2% | 16.0% | 21.5% | 17.3% | 14.6% |
| Duck | 0.0% | 1.3% | 4.3% | I.5% | 0.0% | I.5% |
| Rabbit | 0.0% | 5.1% | 1.1% | 3.1% | 7.4% | 3.3% |

Table 23. The mean average of reared domestic animals per household

Source: Baseline survey, December 2020

The figure above depicts that cows, pigs, goats, sheep, hen/chicken, duck and rabbit are the most reared animals at all project sites. The highest percentage of households rearing cows was seen in Eastern Savannah (52.3%) and around Shagasha tea estate (48.1%) while the goat are highly reared around Ibanda-Makela forest (44.3%) with pig being much more around shagasha tea estate (32.1%). The highest rate of cow possession was facilitated by the adoption of 'One cow per poor family program'' or Girinka introduced by the Government of Rwanda in 2006. In this program, a farmer was given an in-calf heifer and was obliged to pass on to the first female offspring to another program beneficiary who was selected by local administration authorities and validated by MINAGRI/RAB (Sindayayigaya et al., 2014⁹⁶). The commonly used

⁹⁶ Sindayigaya, S., Nyongesa, L.K., Adu, A.M.W., 2014. Statistical Model for Poverty Estimation with Assessmentof One-Cow-One Family program in Rwanda, International Journal of Statistics and Systems, Volume 9, Number 2, P 119-145.

| | Nyandungu | Ibanda- Makela | Muvumba | Eastern Savanna | Shagasha | Overall |
|-----------------------------------|-----------|-------------------|---------|--------------------|----------|---------|
| Call the veterinary | 63.6% | 67.4% | 68.8% | 84.4% | 91.8% | 78.4% |
| Using veterinary pharmacetic | 27.3% | 16.3% | 31.3% | 22.2% | 4.9% | 18.3% |
| Traditional medicine | 9.1% | 0.0% | 0.0% | 0.0% | 1.6% | 1.0% |
| Take the animal to the veterinary | 0.0% | 11.6% | 4.2% | 0.0% | 0.0% | 3.4% |

veterinary services by households are here below represented. Table 24: Commonly used veterinary services by households

Source: Baseline survey, December 2020

Irrespective having reared an animal, the respondents declared to call the veterinary at a rate of 78.4% against around 18.3% of respondents who confirmed to have used veterinary pharmacetic drugs without any contact with veterinary the animal to the veterinary. 1% and 3.4% of respondents across the project sites said that they use traditional medicine and take the animal to the veterinary respectively do nothing when their animals fall sick. The practice that puts the lives of animals at risk should be discouraged. There is also artificial insemination for animal breeding which is done by paraveterinary and veterinary staffs to improve the quality of animals as declared during FGD.

4.3. Household financial assets and savings

The status of savings, taking loans and credits, and memberships of cooperatives, may give an idea of the standard of living and socio-economic development of a given community. It is in that view that those aspects were studied, and findings are presented in figures below.



Figure 73: Household members with a bank account

The baseline study shows that between 40% and 57% of households have atleast a family member with a bank account. The highest percentage of households with members with a bank account was seen around Nyandungu wetland. The sensitization to possess bank account or the use of mobile money by each household should be improved as it has been proven to be effective especially during lock down resulting from COVID-19 expension. Furthermore, the possession of bank account and use of mobile money facilitate safer money transaction. The most used banking institutions were investigated and reported in figure below.

Source: Baseline survey, December 2020

| | Nyandungu | Ibanda- Makela | Muvumba | Eastern Savanna | Shagasha | Average |
|-------------------|-----------|-------------------|---------|--------------------|----------|---------|
| Umwalimu SACCO | 6.8% | 3.0% | 0.0% | 3.4% | 25.6% | 8.2% |
| Umurenge SACCO | 20.5% | 87.9% | 73.7% | 44.8% | 59.0% | 55.7% |
| BPR | 13.6% | 6.1% | 13.2% | 13.8% | 15.4% | 12.6% |
| Bank of Kigali | 34.1% | 3.0% | 21.1% | 20.7% | 10.3% | 18.6% |
| Duterimbere | 4.5% | 0.0% | 2.6% | 10.3% | 0.0% | 3.3% |
| Mobile money | 38.6% | 3.0% | 2.6% | 20.7% | 12.8% | 16.4% |

Table 25: Main banking institutions

Source: Baseline survey, December 2020

NAP project is expected to provide jobs to the beneficiary households and provide other support in terms of money, the information on main banking institutions operating in the area was seen useful to be investigated as they will facilitate money transactions during project implementation. It was revealed that Umurenge SACCO is the most utilized banking institution at most of project sites with exception in areas surrounding Nyandungu wetland where Mobile money is the most used with 38.6% followed by Bank of Kigali by 34.1%). The most use of Umurenge SACCO can be attributed to the easy accessibility to this cooperative (SACCO) compared to the banks. Though BPR is the oldest banking institutions in the area, this bank has fewer members (13%) compare to Umurenge SACCO. Umwalimu SACCO is also used at the low rate as it doesn't have any member in the households surrounding Muvumba River but it has 25.6% in the households surrounding Shangasha Tea Estate. The responses on loan taking are presented in figure below.





Source: Baseline survey, December 2020

This study informed that only 6.4% and 7.6% of those holding accounts in Ibanda-Makela and Muvumba River sites have taken loans/debt respectively. The percentage of loan taking increased up to 20% and 22.2% at Eastern Savannah and Shangasha Tea Estate sites to become 33.3% with households staying around Nyandungu wetland. These percentages in loan taking are still lower than 38% reported by the World Bank study in 2012 after conducting a credit market survey in Rwanda. This can be supported by the fact that the credit market in Rwanda is relatively low, with 40% of households having applied for loans in the previous years up to 2016 as reported by NISR, 2016 (NISR, 2016).

Some district and sector officials declared that many households still fear to take loans because of not having safer and sustainable income which can help them pay back the received loans. Other officials said that some households are not skilled enough to plan and implement a project which can sustainably generate money to pay back the received loans. In response to this problem, GoR has promoted cooperatives and associations which may help many households to manage collectively developmental projects. Thus, awareness compaigns on these existing opportunities are highly needed. The tontine and cooperative memberships are depicted in the figure below.



Figure 75: Household members belonging to tontine and cooperative

Source: Baseline survey, December 2020

The study revealed that 47% of project beneficiaries and 50.3% control group respondents confirmed to have at least a family member who belongs to the tontine or cooperative. However, only 15.4% and 9.6% of beneficiary and control group respondents respectively have confirmed to have a family member belonging to the cooperative. Therefore, the remaining are only members of tontines.

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Overall |
|---------------------------|-----------|---------|---------|----------|---------|---------|
| | | Makela | | | Savanna | |
| Tree nurseries/growers | | | | | | |
| One or more males | 0.0% | 6.3% | 0.0% | 0.0% | 0.0% | 1.3% |
| One or more famales | 0.0% | 2.5% | 1.1% | 0.0% | 0.0% | 0.8% |
| Bee keeping | · | | | | | |
| One or more males | 0.0% | 5.1% | 5.3% | 1.2% | 9.2% | 4.0% |
| One or more famales | 0.0% | 3.8% | 3.2% | 1.2% | 1.5% | 2.0% |
| Agricultural cooperatives | | | | | | |
| One or more males | 0.0% | 10.1% | 4.3% | 1.2% | 1.5% | 3.5% |
| One or more famales | 0.0% | 3.8% | 4.3% | 2.5% | 1.5% | 2.5% |
| Tontine | · | | · | · | | |
| One or more males | 28.6% | 65.5% | 32.7% | 32.6% | 20.0% | 39.2% |
| One or more famales | 71.4% | 34.5% | 67.3% | 67.4% | 80.0% | 60.8% |

| Table 26: Family | / member | belonging | to the | cooperatives |
|------------------|-----------------|-------------|--------|--------------|
| | | DCIUIIgilig | | cooperatives |

Source: Baseline survey, December 2020

The respondents declared to have atleast a family member in agricultural cooperative and bee keeping at a rate of 6%, against 2.1% belonging to the tree nurseries/growers. However, 100% of the respondents declared to belong to a tontine. Therefore, tontine have much more participation than the cooperatives.

4.4. Access to health services

GoR has promoted different health insurance schemes. The most affordable health insurance known as "Mutuelle de Santé" has had a significant impact on improving the standards of living and community health in Rwanda, by enabling the largest segment of the population to gain access to preventive, curative, rehabilitative and palliative health services. This "Mutuelle de Santé" scheme has also been credited with mitigating the catastrophic out-of-pocket expenses on health care and promoted the culture of seeking early treatment, consequently reducing the burden of health bills on households and minimizing the use of unorthodox treatment respectively. The possession of a health insurance scheme by households under investigation is presented in the figure below.



Figure 76: Possessed health insurance scheme

The study revealed that more than 80% of investigated households possess an activated "Mutuelle de Santé" with the remaining households having access to another health insurance scheme (e.g., RSSB, MMI, CORAR, MEDIPLAN, others) available in Rwanda. The substantial percentage of households with RRSB and MMI were seen only in areas surrounding Nyandungu wetland and Shagasha tea estate. The high rate of membership to "Mutuelle de Santé" has also been motivated by the decision of Government of Rwanda to move it to Rwanda Social Security Board in order to improve its efficiency and augment access across the country. Since then, the local communities are very happy with this health insurance scheme as it was scaled up to cover any type of needed medical treatment (EICV 5, 2018) which was also confirmed during FGDs. As the Third National Communication reported that there are a number of sickness/illeness linked with climate change and variability. The information on main sickness/illness which affected recently household members in the area of the study was investigated and reported in figure below.

Source: Baseline survey, December 2020





Source: Baseline survey, December 2020

The figure above depicts that the majority of households pointed out malaria and hot/cold stress to be the most experienced sikness at all project sites especially around Nyandungu wetland and Ibanda-Makela forest. These both dominating sickness in the intervention areas may be results from climate change and variability. Those who suffered from diarrhea and pneumonia were 10.3% and 6.3% respectively in project intervention. The figure below describes how these sickness/illnesses were treated.







The figure above revealed that the majority of family members (more than 88%) who got sick/ill in investigated areas were treated at a health center, with less than 4% who were either treated traditionally or did not get any medication for all project sites except Nyandungu wetland which accounts around 11.3%. It is necessary mentioning that the information on skiness/illness treated area gives an idea on the level of socio-economic development of a given society as most of time a traditional society uses traditional medical treatement while. The accessibility to health centers is shown in figure below.





Source: Baseline survey, December 2020

The figure above reveals that the majority of respondents (70%) declared that the one way travel time to their local health centre is less than an hour with a negligeable percentage (less than 3%) which said that they use more than two hours to reach to the health centre. Though the majority have good access to the health centers, there is still a small proportion of households who struggle to get to health treatment areas. The interviewees in FGDs mentioned poor road connectivity to the health centers, especially during rainy periods as the most challenging issues to deal with.

4.5. Food security

According to FAO (2001), food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (that is, without resorting to emergency food supplies, scavenging, stealing, or other coping strategies). In reference to the abovementioned dimensions, the present study focused on the number of meals a day per households, composition of meals and availability of meals throughout the year.



Figure 80: Number of meals per day

Source: Baseline survey, December 2020

A considerable percentage of households varying between 54.4% and 62.8% at Ibanda-Makela forest, Muvumba and Shakaga tea estate reported to eat once day while the majority of households (72.3%) in eastern savannah and around Nyandungu wetland (47.4%). Only 25%, 6.2% and less than 4% from around Nyandungu wetland, eastern savannah and other sites respectively are secured in terms of food access as they are able to eat three times or more per day. When respondents asked in FGDs whether they eat once and/or twice a day due to the shortage of meals, they confirmed it. The households who have access to one meal and those without hope of getting a daily meal should be supported to provide them food to survive.



Figure 81: The most important meal of a day

Source: Baseline survey, December 2020

The majority of respondents (between 69 and 87% at all project sites and 55.1% around Nyandungu wetland) reported to consider supper as a daily important meal, against around 25% of households who reported lunch as the important meal of a day in the same areas. Few respondents (less than 3%) have confirmed to have access to the morning meal. The respondents were also asked about the main composition of the meal. The responses given are summarized in the figure below.

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Average |
|----------------|-----------|---------|---------|----------|---------|---------|
| | | Makela | | | Savanna | |
| Maize | 89.7% | 83.5% | 85.1% | 58.0% | 84.6% | 80.1% |
| Sorghum | 24.4% | 46.8% | 25.5% | 27.2% | 38.5% | 32.0% |
| Beans | 97.4% | 97.5% | 97.9% | 100.0% | 98.5% | 98.2% |
| Rice | 88.5% | 21.5% | 18.1% | 38.3% | 46.2% | 41.3% |
| Cassava | 65.4% | 77.2% | 64.9% | 86.4% | 75.4% | 73.6% |
| Sweet Potato | 67.9% | 57.0% | 63.8% | 97.5% | 63.1% | 70.0% |
| Irish Potatoes | 87.2% | 57.0% | 41.5% | 65.4% | 43.1% | 58.7% |
| Vegetables | 97.4% | 67.1% | 55.3% | 96.3% | 61.5% | 75.3% |
| Fruits | 46.2% | 17.7% | 10.6% | 39.5% | 13.8% | 25.4% |
| Others | 17.9% | 3.8% | 5.3% | 16.0% | 15.4% | 11.3% |

Table 27: The main composition of the meal

Source: Baseline survey, December 2020

The most commonly consumed food is composed of beans for most of respondents (more than 97%) followed by maize and vegetables as confirnmed by 80.1% and 75.3% of respondents on average Moreover, sweet potato and cassava are common consumed meal in Shangasha tea estate site as reported by 97.5% and 86.4% respectively. Other consumed foods include Irish potatoes, rice,

sorghum and fruits, while other non-specified consumed foods represented 11.3% in project sites. This shows that the households consume crops which are commonly grown in the area (NISR, 2019⁹⁷).



Figure 82: Received assistance in terms of food or money from the government or other institution

The highest number of households who confirmed to have been supported in terms of food or money was seen around Shangasha Tea Estate (44.4%) followed by Ibanda-Makela site (25.3%) while 12.8% and 9.6% of households were supported from around Nyandungu and Muvumba River. When asked in FGDs the reason behind of such high percentage at these sites. They replied that the majority were supported during lock down period due to COVID-19 pendemic. The other households said that they managed to cope with the food shortage period by reducing number and quantity of meals. Moreover, the experienced starving period did not cause any death. The following figure illustrates the main causes of food shortage.

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Overall |
|-------------------------------|-----------|---------|---------|----------|---------|---------|
| | | Makela | | | Savanna | |
| Poor crop production due to | 0.0% | 55.0% | 22.2% | 19.4% | 0.0% | 26.7% |
| rain shortage | | | | | | |
| Heavy rains | 0.0% | 20.0% | 55.6% | 86.1% | 0.0% | 53.3% |
| Late onset of rains | 0.0% | 60.0% | 55.6% | 22.2% | 0.0% | 33.3% |
| Early on set of rains | 0.0% | 5.0% | 22.2% | I 3.9% | 0.0% | 10.7% |
| Early offset of rains | 0.0% | 50.0% | 11.1% | 11.1% | 0.0% | 20.0% |
| Late of set of rains | 0.0% | 20.0% | 0.0% | 25.0% | 0.0% | 17.3% |
| Lack of irrigation facilities | 0.0% | 60.0% | 33.3% | 11.1% | 0.0% | 25.3% |
| Crops diseases and pests | 0.0% | 45.0% | 33.3% | 25.0% | 0.0% | 28.0% |
| Low capacity to have access | 0.0% | 45.0% | 44.4% | 16.7% | 0.0% | 25.3% |
| to agricultural inputs | | | | | | |
| Unemployment | 100.0% | 15.0% | 22.2% | 41.7% | 0.0% | 40.0% |

| Table 26: Main causes of food shortage in the past 12 months | Table | 28: Main | causes of food | shortage in | the past | l 2 months |
|--|--------------|----------|----------------|-------------|----------|------------|
|--|--------------|----------|----------------|-------------|----------|------------|

Source: Baseline survey, December 2020

The figure above shows the important impacts of climate change on food security, with poor crop productivity due to rain shortage, changes in rains on/offset and heavy rains being reported as the main causes of experienced food shortage in the areas under investigation. The heavy rains have been reported to take a lead in causing food shortage as declared by 55.6% and 86.1% around Muvumba

Source: Baseline survey, December 2020

⁹⁷ National Institute of Statistics of Rwanda, (2019). The annual report, Kigali, Rwanda

River and Shagasha tea estate respectively, followed by an late onset of rains as confirmed by 55.6% of respondents of around Muvumba River. The poor crop production due to rain shortage (dry spells) was also mentioned to have caused food shortage as declared by 55% of respondents from around Ibanda-Makela forest.. The other causes were reported by small number of interviewees as it can be depicted from the table above.

4.6. Access to basic facilities and infrastructure

The access to clean water for households is one of the indicators of wellbeing of a population of a given area. In that regard, the information on access to basic facilities and infrastructure by project intervention and control group households was gathered and presented in the figure below.

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Overall | | |
|---|-----------|---------|---------|----------|---------|---------|--|--|
| | | Makela | | | Savanna | | | |
| The main source of water for domestic use | | | | | | | | |
| Inside the house or within the compound | 61.5% | 5.1% | 7.4% | 17.3% | 18.5% | 21.4% | | |
| Public source of water | 20.5% | 67.1% | 17.0% | 71.6% | 66.2% | 46.9% | | |
| Rain water | 9.0% | 21.5% | 3.2% | 13.6% | ۱.5% | 9.8% | | |
| Dam/river/spring | 7.7% | 34.2% | 75.5% | 16.0% | 29.2% | 34.3% | | |
| Other | 12.8% | 0.0% | 6.4% | 0.0% | 0.0% | 4.0% | | |
| Availability of tank or any other tools used for rain water | 11.5% | 32.9% | 9.6% | 4.9% | 16.9% | 14.9% | | |
| Availability of Means of cleaning water | 82.1% | 69.6% | 61.7% | 63.0% | 76.9% | 70.0% | | |
| Means of cleaning water | | | | | | | | |
| Boil | 82.8% | 100.0% | 75.9% | 90.2% | 84.0% | 86.3% | | |
| Distil | 0.0% | 0.0% | 1.7% | 3.9% | 4.0% | 1.8% | | |
| Use sur'eau | 9.4% | 0.0% | 3.4% | 2.0% | 0.0% | 3.2% | | |
| Other | 7.8% | 0.0% | 0.0% | 0.0% | 8.0% | 3.2% | | |
| Do not treat | 0.0% | 0.0% | 19.0% | 3.9% | 4.0% | 5.4% | | |
| Responsible for getting domestic water | | | | | | | | |
| Husband | 5.1% | 16.5% | 16.0% | 12.3% | 10.8% | 12.3% | | |
| Wife | 52.6% | 50.6% | 37.2% | 29.6% | 36.9% | 41.3% | | |
| Children | 52.6% | 62.0% | 64.9% | 65.4% | 75.4% | 63.7% | | |
| Time of getting domestic water | | | | | | | | |
| Less than ten minutes | 79.5% | 54.4% | 21.3% | 60.5% | 67.7% | 54.9% | | |
| Between 10 and 30 minutes | 9.0% | 39.2% | 60.6% | 37.0% | 29.2% | 36.3% | | |
| Between 30 and 1 hour | 11.5% | 6.3% | 14.9% | 2.5% | 3.1% | 8.1% | | |
| More than an hour | 0.0% | 0.0% | 3.2% | 0.0% | 0.0% | 0.8% | | |

Figure 83: Water and sanitation

Source: Baseline survey, December 2020

The figure above indicates that more between 66% and 72% of respondents from Ibanda-Makela, Shagasha tea estate and eastern savannah get water from public source while 61.5% of around Nyandungu households have water inside the house or within compound and 75.5% of around Muvumba River households fetch water from dam/river/spring. This percentage is higher than the findings reported in Muvumba Catchment plan 2018-2024 where it has been mentioned that about a half of the population settled in Muvumba catchment uses dirty water from streams, dams, valleys or swamps and thus do not have access to safe and reliable supplies of water for productive and domestic uses (Ministry of Environment, 2018).

It is worth noting that access to water is not regular even to those who said that they fetch water from public source, especially during dry seasons as reported by the respondents during FGD and KII in all project sites. In this case, people have to fetch unsafe water from dam, rivers and springs, this may potentially impact on public health through widespread diseases. Therefore, the development of alternatives like harvesting rainwater should be among the priority of NAP project to save project

beneficiary from using unsafe water. Moreover, it was good news to hear that between 60% and 80% of households at project sites have means of cleaning water to drink and they have common practice of boiling it.

It was reported that the responsibility to fetch water is hand of children and women at most of project sites. This high involvement of children in fetching water for home use may lead to child abuse if under age (16 years old) children are also included. There is also negative impacts upon women and children through taking them away from essential household duties and their education to go to fetch water especially for those who walk in one way more than 30 minutes to get water though are fewer in number as shown in figure above. The average number of jerry-cans used per day sources vary per family as shown in the figure below.



Figure 84: Average quantity of water used (jerry-cans of 20 I) per day

The figure above reveals that households in area of project intervention use an average of 3.23 jerrycans of water per day. The above results show that the project intervention households use an average 64.6 litres (1 jerry-can = 20 litres) a day. For an average of 5 people by family as reported above are far below the quantity of 50 litres per person and per day recommended by UN (Institute of water for Africa, 2016). Therefore, more water for domestic uses are needed to reach to the quantity recommended by UN. main source of energy for cooking was investigated and the results were presented in figure below.





Source: Baseline survey, December 2020

Source: Baseline survey, December 2020
Regarding energy used for cooking, the vast majority, around 90% of respondents from Ibanda-Makela, Shagasha and Eastern savannah reported that they use firewood, with 84.6% of households around Nyandungu who confirmed to use charcoal. 63.8% and 35.1% of respondents from around Muvumba River confirmed to use firewood and straws respectively for cooking. Only 2.6% of respondents from around Nyandungu declared using electricity wth 21.8% from the same area who said that they use gaz for cooking while the rate of using electricity and gaz for cooking in other project sites is very low. This high rate of using of firewood and charcoal indicates a possibility of a high rate of deforestation, depending on the extent of current reforestation efforts. This results are almost the same as what has been reported in Muvumba Catchment plan 2018-2024 where it was highlighted that 82% of households use firewood to cook meals, while the use of alternative energy sources, like biogas and improved cook stoves is still limited (Ministry of Environment, 2018⁹⁸). Below there are the main mode used for cooking.





Source: Baseline survey, December 2020

A large number of households (between 53% and 84%) confirmed using improved stoves for cooking against 20% and 58% who still use traditional stoves at project sites. There is a very low percentage of households who confirmed to use electrical and gas stroves especially those from eastern savannah and around Nyandungu. The use of traditional stoves requires a lot of firewood which also contributes to deforestation. The main sources of energy used for lightening in houses are presented in the figure below.

⁹⁸ Ministry, of Environment, (2018). Muvumba Catchment plan 2018-2024. IWRM programme Rwanda, Kigali, Rwanda





The figure above shows that the majority of households of around Nyandungu wetland (91%) and Shangasha tea estate (63%) have access to centrally generated grid electricity while the majority of households from around Ibanda-Makela forest (55.7%) and Muvumba River (60.6%) use batteries to enlight their homes. Morever solar energy is the most used in eastern savanna as reported by 52.3%. This exemplifies the desperate need for the development of widespread renewable energy sources based on an appropriate scale and level of technology. As households have insufficient access to electricity to light their house, they acquired other alternatives like the use of kerosene, wood and candle as mentioned by a very small proportion of respondents.

This data is in line with the cumulative connectivity rate of Rwandan households (52.8%), including 38.5% connected to the national grid and 14.3% accessing through off-grid systems (mainly solar), as reported in December 2019. During the elaboration of the EDPRS II, GoR took a clear policy decision to diversify the sources of electricity from traditional dominant grid to include even off-grid connections. Subsequently, households far away from the planned national grid coverage have been encouraged to use alternatively cheaper connections such as Mini-grids and Solar Photovoltaics (PVs) to reduce the cost of access to electricity whilst relieving constraints on historical government subsidies⁹⁹.

| | Nyandungu | Ibanda- Makela | Muvumba | Shagasha | Eastern Savanna | Total | | | | |
|-------------------------------|-----------|-------------------|---------|----------|--------------------|-------|--|--|--|--|
| Bus stop or taxi | | | | | | | | | | |
| Less than 30 minutes | 69.2% | 41.8% | 39.4% | 70.4% | 24.6% | 49.6% | | | | |
| Between 30 minutes and 1 hour | 29.5% | 35.4% | 25.5% | 28.4% | 56.9% | 34.0% | | | | |
| Between I hour and 2 hours | 1.3% | 17.7% | 25.5% | 1.2% | 18.5% | 13.1% | | | | |
| More than an 2 hours | 0.0% | 5.1% | 9.6% | 0.0% | 0.0% | 3.3% | | | | |
| Primary school | | | | | | | | | | |
| Less than 30 minutes | 93.6% | 92.4% | 38.3% | 67.9% | 52.3% | 68.3% | | | | |
| Between 30 minutes and 1 hour | 2.6% | 6.3% | 38.3% | 30.9% | 43.1% | 24.2% | | | | |

Table 29: Time taken to get access to the basic infrastructure

99 https://www.reg.rw/what-we-do/access/2019

| Between 1 hour and 2 hours | 0.0% | 1.3% | 20.2% | 1.2% | 3.1% | 5.8% | | | | | |
|-------------------------------|----------------|-------|-------|---------------|-------|-------|--|--|--|--|--|
| More than an 2 hours | 0.0% | 0.0% | 3.2% | 0.0% | 0.0% | 0.8% | | | | | |
| l do not know | 3.8% | 0.0% | 0.0% | 0.0% | 1.5% | 1.0% | | | | | |
| Health centre | | | | | | | | | | | |
| Less than 30 minutes | 50.0% | 41.8% | 41.5% | 69 .1% | 27.7% | 46.6% | | | | | |
| Between 30 minutes and 1 hour | 26. 9 % | 50.6% | 45.7% | 28.4% | 63.1% | 42.3% | | | | | |
| Between 1 hour and 2 hours | 20.5% | 7.6% | 9.6% | 2.5% | 9.2% | 9.8% | | | | | |
| More than an 2 hours | 2.6% | 0.0% | 3.2% | 0.0% | 0.0% | 1.3% | | | | | |
| Main market for food products | | | | | | | | | | | |
| Less than 30 minutes | 23.1% | 1.3% | 9.6% | 19.8% | 4.6% | 11.8% | | | | | |
| Between 30 minutes and 1 hour | 20.5% | 0.0% | 12.8% | 12.3% | 47.7% | 17.4% | | | | | |
| Between 1 hour and 2 hours | 52.6% | 7.6% | 52.1% | 60.5% | 24.6% | 40.6% | | | | | |
| More than an 2 hours | 2.6% | 91.1% | 25.5% | 7.4% | 23.1% | 30.0% | | | | | |
| l do not know | 1.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.3% | | | | | |
| Main market for animal produ | ıcts | | | | | | | | | | |
| Less than 30 minutes | 17.9% | 1.3% | 9.6% | 14.8% | 3.1% | 9.6% | | | | | |
| Between 30 minutes and 1 hour | 6.4% | 0.0% | 8.5% | 35.8% | 36.9% | 16.6% | | | | | |
| Between 1 hour and 2 hours | 38.5% | 1.3% | 55.3% | 46.9% | 26.2% | 34.8% | | | | | |
| More than an 2 hours | 1.3% | 97.5% | 26.6% | 2.5% | 26.2% | 30.7% | | | | | |
| l do not know | 35.9% | 0.0% | 0.0% | 0.0% | 7.7% | 8.3% | | | | | |
| The closest all-weather road | | | | | | | | | | | |
| Less than 30 minutes | 76.9% | 0.0% | 31.9% | 67.9% | 24.6% | 40.6% | | | | | |
| Between 30 minutes and 1 hour | 21.8% | 1.3% | 9.6% | 28.4% | 47.7% | 20.4% | | | | | |
| Between 1 hour and 2 hours | 1.3% | 2.5% | 8.5% | 3.7% | 16.9% | 6.3% | | | | | |
| More than an 2 hours | 0.0% | 96.2% | 50.0% | 0.0% | 10.8% | 32.7% | | | | | |
| | | | | | | | | | | | |

The table above shows that it takes less than one hour to reach primary schools, health centers and all weather roads for the majority of project beneficiary respondents while it takes one hour and above to reach bus stop or taxi, main market for food and animal products as reported by the majority of households. This reveals a good access to basic services like primary school, health centers and all weather roads. However, there is the need to improve the access to a bus stop or taxi, food and animal products markets.



Figure 88: Ownership of means of transport

Source: Baseline survey, December 2020

The majority of respondents from around Nyandungu wetland (50%) and Shangasha tea estate (67.9%) have confirmed that they do not possess any means of transport while 41.8%, 36.2% and 33.8% of households from around Ibanda-Makela forest, Muvumba River, and eastern savannah have a bike, and between 1.1% and 4.6% of beneficiary in project sites are in possession of motorcycles. The possession rate of car is general very low in all sites under investigation as none of household has a car from around Ibanda-Makela forest and eastern savannah while there 14.1% of households from around Nyandungu wetland with 2.5% and 1.1% from around Shangasha tea estate and Muvumba River respectively. This shows that the households are still poor in means of transport, which may hunder the flow to or from the market.





The assessment of ownership of means of communication reveals that more than 80% of beneficiary households do possess mobile phone except around Muvumba River where there are 64.9%. Additionnal between 46% and 64.1%) of beneficiary households have a radio while the possession of television is higher for the households settled around Nyandungu (57.7%) and lower for households from around Muvumba River (4.3%) and being 6.3% around Ibanda-Makela forest to increase up to 17.3% and 29.2% for the households from around Shangasha tea estate and eastern savannah respectively. The possession of computer and internet can be tangibly seen from around Nyandungu households. It is worth mentioning that the mobile phone ownership rate for such rural areas is very satisfactory. This suggests that these mobile phones could be used to inform households timely on market prices (MINAGRI e-Soko) and help in received wether/climate information along with early warning messages. In the same way, they can be also used as a tool to mobilize farmers in extension services and campaigns (mulching, pruning operations, fertilization and pesticides application, harvesting periods).

Source: Baseline survey, December 2020

5. CLIMATE CHANGE - RESILIENT TECHNOLOGIES AND PRACTICES

Although Rwanda had an economic growth of around 8 % per year over the past five years and poverty levels are decreasing, Rwanda is still facing significant challenges in adapting to climate change, meeting food demands and developing sustainably. Devastating series of disasters experienced in the past three years that have killed hundreds of people, wounded many more and damaged basic infrastructures and crops (<u>https://www.gfdrr.org/en/rwanda</u>)¹⁰⁰ became an additional stressor to the ability of Rwanda to deal with the adverse effects of climate change and a challenge to the Rwanda's vision of becoming a developed, climate-resilient and low-carbon economy by 2050¹⁰¹.

Moreover, the first step toward reaching that vision has been the development and implementation of the first Green Growth and Climate Resilience Strategy (GGCRS). It focuses on: (i) achieving energy security and a low-carbon energy supply that supports the development of green industry and services; (ii) achieving sustainable land use and water resource management that results in food security, appropriate urban development and preservation of biodiversity and ecosystem services; and (iii) achieving social protection and disaster risk reduction to reduce vulnerability to climate change impacts¹⁰².

In the same line, Rwanda has reviewed the environmental and climate change policy in 2019 to guide in implementation of the Green Growth and Climate Resilience Strategy (GGCRS) developed in 2011, NST1 developed for 2017-2024, Agenda 2030, African Agenda 2063 and EAC agenda. Furthermore, different adaptation measures were proposed in NAMA, NAPA, Technology Needs Assessment in Agriculture and Energy undertaken in 2012, National communication (NC) published in 2005, 2012 and 2018, Nationally Determined Contribution (NDC) published in May 2020.

Despite the above mentioned initiatives and the development of an institutional and policyenabling environment for climate change adaptation, the mainstreaming of climate change adaptation into medium- to long-term planning remains limited in Rwanda, there are still some limitations to medium- to long-term climate change adaptation in Rwanda. Therefore, strengthening climate Resilience of rural communities in Ibanda-Makela forest, Muvumba River, Eastern Savannah in Nyagatare district, Nyandungu wetland Shagasha Tea Estate sites is among the priority of NAP. Hence, prio study of the perception of local community on climate change and variability was conducted and the findindings presented in following paragraphs.

¹⁰⁰ https://www.gfdrr.org/en/rwanda

¹⁰¹ GOR, 2011

¹⁰² Idem

5.1. Perception of local community on Climate change and variability

Changes in mean temperatures, rainfall frequency and intensity have negative impacts not only on physical environment but also on human activities. Therefore, it is important to assess whether the local communities are aware of such changes in climate. The perceptions of respondents on changes in mean temperatures and rainfalls are presented below.

| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average | | | |
|---|-----------------------|-------------------|---------|----------|--------------------|---------|--|--|--|
| How has the temperature bee | en changing in last l | 2 months? | | | | | | | |
| Much hotter | 46.2% | 32. 9 % | 44.7% | 24.7% | 55.4% | 40.3% | | | |
| hotter | 17.9% | 40.5% | 29.8% | 8.6% | 32.3% | 25.7% | | | |
| No change/same | 10.3% | 7.6% | 11.7% | 2.5% | 4.6% | 7.6% | | | |
| Cooler | 14.1% | 19.0% | 13.8% | 19.8% | 7.7% | 15.1% | | | |
| Much cold | 11.5% | 0.0% | 0.0% | 44.4% | 0.0% | 11.3% | | | |
| How has the rainfall been changing in last 12 months? | | | | | | | | | |
| Much more | 61.5% | 19.0% | 51.1% | 97.5% | 44.6% | 55.2% | | | |
| Small amount more | 11.5% | 35.4% | 31.9% | 0.0% | 29.2% | 21.7% | | | |
| No change/same | 3.8% | 10.1% | 9.6% | 0.0% | 15.4% | 7.6% | | | |
| Small amount less | 19.2% | 29.1% | 7.4% | 1.2% | 10.8% | 13.4% | | | |
| Much less | 3.8% | 6.3% | 0.0% | 1.2% | 0.0% | 2.3% | | | |
| How has the rainfall onset bee | en changing in last l | 2 months? | | | | | | | |
| Early onset | 55.1% | 6.3% | 7.4% | 65.4% | 4.6% | 28.0% | | | |
| Late onset | 21.8% | 92.4% | 84.0% | 23.5% | 86.2% | 61.5% | | | |
| No change/same | 23.1% | 1.3% | 8.5% | 11.1% | 9.2% | 10.6% | | | |
| How has the rainy period been | n changing in last 12 | months? | | | | | | | |
| Became shorter | 29.5% | 36.7% | 24.5% | 19.8% | 41.5% | 29.7% | | | |
| No change/same | 70.5% | 63.3% | 75.5% | 80.2% | 58.5% | 70.3% | | | |

 Table 30: Perception of respondents on Climate change and variability

Source: Baseline survey, December 2020

The figure above shows that more than 65% of beneficiary households are aware that project sites have experienced an increase in temperature throughout the years with 26.4% who said that they noticed the decrease in temperature while 7.6% did not see any change in mean temperature. This view of 65% of respondents is fitting with findings published in Third National Communication where it was highlighted that the progressive increase in temperature was observed across the country since 1971 to 2017 (Republic of Rwanda, 2018)¹⁰³. Furthermore, the majority of respondents (76.9%) reported an increase in mean rainfall and a late onset (61.5%) while the eastern part of Rwanda including Muvumba River, Eastern Savannah and Ibanda-Makela sites along with Nyandungu wetland were reported to became gradually warmer with westen part including Shangasha Tea Estate becoming wetter (Republic of Rwanda, 2018). Thus, the majority of respondents might have reported a rise in mean rainfall based on a number of flooding episodes observed recently around Muvumba River, and Nyandungu wetland though they were occasional. Therefore, there is a need to avail accurate and detailed information on climate change and variability to the local community.

It is clear that the rainfall onset affects the cropping period either positively or negatively. When the rainfall is received earlier than the normal time, it attracts the farmers to grow crops immediately after receiving the rainfall, while the late rainfall onset leads to the late crop growing and reduced agricultural season and poor crop productivity. The perceptions of respondents on rainy period was analyzed and 70% of respondents across project sites

¹⁰³ Republic of Rwanda, (2018). Third National Communication, Kigali, Rwanda.

confirmed that there is no change observed while the Third National Communication report reported a reduced rainy period since 1961 to 2017 (Republic of Rwanda, 2018). Therefore, the early warning message on onset and offset of rainfall along with rainy days should be available to the local community to take stock to the adverse impacts they may cause.

| Rank | Nyandungu | Ibanda-Makela | Muvumba | Shagasha | Eastern | Average |
|------|-----------|---------------|---------|----------|---------|---------|
| 0 | 11.5% | 13.9% | 13.8% | 16.0% | 12.3% | 13.6% |
| 1 | 15.4% | 27.8% | 14.9% | 13.6% | 13.8% | 17.1% |
| 2 | 43.6% | 50.6% | 66.0% | 30.9% | 64.6% | 51.1% |
| 3 | 10.3% | 6.3% | 4.3% | 18.5% | 6.2% | 9.1% |
| 4 | 19.2% | 1.3% | 1.1% | 21.0% | 3.1% | 9.1% |

Table 31: Level of understanding climate change by local community

Source: Baseline survey, December 2020

Based on the question asked about climate change, the ranking was made to assess the level of understanding climate change by the local community. Thus, 51.1% of respondents scored 50% to asked questions while 9.1% scored 75% and 100% respectively. This shows that 69.3% of respondents scored more than 50% to the asked questions related to the climate change. This percentage is high though the target should be to improve the knowledge of the all local communities with the matter related to the climate change. When the local communities asked about the main causes of climate change, the feedback they provided was summarized in the figure below.

Table 32: Understanding the main causes of climate change

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Average |
|-------------------|-----------|---------|---------|----------|---------|---------|
| | | Makela | | | Savanna | |
| Not sure | 44.9% | 39.2% | 45.7% | 54.3% | 44.6% | 45.8% |
| Natural causes | 38.5% | 51.9% | 45.7% | 38.3% | 35.4% | 42.3% |
| Human activities | 34.6% | 32.9% | 22.3% | 25.9% | 33.8% | 29.5% |
| Human and natural | 29.5% | 21.5% | 8.5% | 29.6% | 12.3% | 20.2% |
| causes | | | | | | |

Source: Baseline survey, December 2020

The figure above reveals that the highest percentage of respondents (45.8%) provided the wrong answers to the possible causes of climate change while 42.3% of respondents across project sites are aware of natural factors which may cause climate change. Poor awareness on the causes of climate changes was seen at Shagasha respondents (54.3%) while the respondents from Ibanda-Makela forest site ara much better in knowing natural causes which may behind climate change and respondents from around Nyandungu wetland are much better in knowing the contribution of human activities in cuasing climate change. Hence, more trainings and information sharing system to NAP beneficiaries should be enhanced to improve their knowledge in terms of causes of climate change. When respondents asked about the frequency in talking about climate change, the feedback provided was summarized in table below.

Table 33: Frequency in talking about climate change

| • • | | | • | | | | | | |
|---|-----------|-------------------|---------|----------|--------------------|---------|--|--|--|
| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average | | | |
| Frequency in talking about climate change | | | | | | | | | |
| Never | 23.1% | 8.9% | 12.8% | 9.9% | 10.8% | 13.1% | | | |
| Sometimes (once a week) | 53.8% | 67.1% | 64.9% | 59.3% | 63.1% | 61.7% | | | |
| Often (more than once a week) | 23.1% | 24.1% | 22.3% | 30.9% | 26.2% | 25.2% | | | |
| Talking about climate change with | | | | | | | | | |
| family and friends | 75.6% | 82.3% | 83.0% | 61.7% | 75.4% | 75.8% | | | |

| Co-workers | 3.8% | 7.6% | 8.5% | 1.2% | 12.3% | 6.5% |
|-----------------------------------|-------|-------|------|-------|-------|-------|
| User groups and community leaders | 20.5% | 10.1% | 8.5% | 37.0% | 12.3% | 17.6% |

The table above informs that more than 61.7% of respondents across project sites talk about climate change at least once a week with 25.2% who are talking oftenly about climate change while 13.1% said that they have never had any discussion about climate change. Furthemore, the majority of respondents (75.8%) from project sites confirmed that they had most of the times the talk on climate change with either friends or family members with 17.6% and 6.5% who said that they had discussions on climate change with user groups/community leaders and co-workers respectively.

5.2. Perception of local community on the impacts of climate change and variability

The occurrence of more extreme weather events (e.g., droughts, strong winds, thunder storms with lightning and floods), and fluctuations of seasonal rainfall patterns, duration and intensity, have inevitably immediate impacts not only on physical environment but also on human properties and health (Mary and Majule, 2009)104. However, such adverse effects are perceived differently by households. Therefore, the awareness and perception of local community on the impacts of climate change on in the areas under investigation were undertaken and findings were presented in figures below.

¹⁰⁴ Mary, A.L. and Majule, A.E., (2009). Impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas of Tanzania: the case of Manyoni district in Singida region, Tanzania. African Journal of Environmental Science and Technology, 3(8):206-218.



Figure 90: Awareness to the adverse effects of climate change

Source: Baseline survey, December 2020

The figure above indicates that between 65.4% and 84.8 of NAP beneficiary households confirmed to be aware of adverse effects of climate change. The highest level of awareness on the adverse effects of climate change was seen from around Ibanda-Makela households (84.8%) while the lowest was seen around Nyandungu wetland (65.4%). Long dry spells and droughts were mentioned among the most to affect the farmers especially during long dry season (June-September).

| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average |
|----------------------------------|-----------|-------------------|---------|----------|--------------------|---------|
| Poor agricultural productivity | 21.8% | 78.5% | 78.7% | 85.2% | 73.8% | 68.0% |
| Destroying crops | 20.5% | 60.8% | 75.5% | 84.0% | 63.1% | 61.5% |
| Erosion | 37.2% | 24.1% | 36.2% | 79.0% | 29.2% | 41.6% |
| Flooding | 23.1% | 20.3% | 62.8% | 34.6% | 40.0% | 37.0% |
| Destruction of family properties | 35.9% | 24.1% | 28.7% | 50.6% | 13.8% | 31.2% |
| Causes people's death | 14.1% | 2.5% | 2.1% | 11.1% | 0.0% | 6.0% |
| Any other | 2.6% | 0.0% | 0.0% | 3.7% | 0.0% | 1.3% |

Table 34: Perception of local community on the effects of dry spells in the past 12 months

Source: Baseline survey, December 2020

The table above revealed that 68% of beneficiary respondents confirmed to have experienced poor agricultural productivity due to dry spells while 61.5% of respondents confirmed to have seen their crops being destroyed by the same cause. The soil erosion was much seen around Shangasha tea estate as confirmed by 79% of respondents while the flooding eposides were reported by 62.8% of respondents from around Ibanda-Makela forest. Moreover, the respondents from around Nyandungu wetland are very few (14.1%-37.2%) to have seen the adverse effects of dry spells in past 12 months. The following table captures the perception of local community on the effects of flooding episodes in the past 12 months.

Table 35: Perception of local community on the effects of flooding episodes inthe past 12 months

| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average |
|---|-----------|-------------------|---------|----------|--------------------|---------|
| Poor agricultural productivity | 54.5% | 93.3% | 100.0% | 100.0% | 100.0% | 95.5% |
| Destroying crops | 63.6% | 100.0% | 100.0% | 92.3% | 100.0% | 96.8% |
| The increase of the level of rivers water | 54.5% | 86.7% | 97.1% | 100.0% | 100.0% | 93.0% |
| Rivers water pollution | 54.5% | 76.7% | 75.4% | 84.6% | 73.5% | 74.5% |
| Increase of diseases | 63.6% | 63.3% | 69.6% | 46.2% | 32.4% | 58.0% |
| Destruction of family properties | 63.6% | 66.7% | 68.1% | 53.8% | 61.8% | 65.0% |

| Destruction of bridges | 54.5% | 76.7% | 59.4% | 84.6% | 29.4% | 58.0% |
|------------------------|-------|-------|-------|-------|-------|-------|
| Destruction of roads | 54.5% | 83.3% | 59.4% | 84.6% | 41.2% | 61.8% |
| People's death | 27.3% | 30.0% | 20.3% | 7.7% | 11.8% | 19.7% |

The study revealed that the majority of respondents (93%-100%) from all projects sites except those from around Nyandungu wetland (54.5%) reported to have experienced flooding episodes which destroyed crops leading to poor agricultural productivity. Furthermore, the same percentage of respondents confirmed to have seen the level of rivers increased. The participants in FGDs reported to have experienced more intense storms (daily rainfall) which caused floods, landslides, soil erosion and other associated impacts. The greater percentage of households (around 60%) across the project sites has confirmed that flooding episodes caused also the destruction of family properties, bridges and roads while 19.7% of respondents said floods to have caused people's death. The situation about the effects of strong winds is reported in table below.

Table 36: Perception of local community on the effects of strong winds in thepast 12 months

| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average | | |
|--|-----------|-------------------|---------|----------|--------------------|---------|--|--|
| Consequences resulted from occurred strong winds in last 12 months | | | | | | | | |
| Destruction of crops | 35.7% | 77.4% | 90.0% | 50.0% | 52.4% | 68.8% | | |
| Destruction of family properties | 71.4% | 96.2% | 87.5% | 46.2% | 85.7% | 81.8% | | |
| Destruction of trees | 35.7% | 45.3% | 62.5% | 73.1% | 28.6% | 51.3% | | |
| People's death | 0.0% | l. 9 % | 5.0% | 0.0% | 4.8% | 2.6% | | |

Source: Baseline survey, December 2020

From the figure above, the majority of respondents (81.8%) across the project sites have confirmed to have seen adverse effects of strong winds which destroyed family properties have reported the occurrences of strong winds in past year.

Table 37: Perception of local community on the effects of thunder storms withlightning in the past 12 months

| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average |
|----------------------------------|-----------|-------------------|---------|----------|--------------------|--------------|
| Destruction of crops | 0.0% | 16.7% | 16.7% | 13.3% | 0.0% | . 9 % |
| Destruction of family properties | 16.7% | 58.3% | 33.3% | 13.3% | 100.0% | 35.7% |
| Destruction of trees | 0.0% | 41.7% | 50.0% | 33.3% | 33.3% | 33.3% |
| People's death | 0.0% | 8.3% | 33.3% | 0.0% | 0.0% | 7.1% |
| Any other | 0.0% | 8.3% | 0.0% | 0.0% | 0.0% | 2.4% |

Source: Baseline survey, December 2020

Based on the information gathered, 35.7% and 33.3% of beneficiary households reported to have experienced severe thunder storms with lightning which led to the destruction of family properties and trees respectively. People'death caused by thunder storms with lightning was also reported around Muvumba River and Ibanda-Makela forest by 33.3% and 8.3% of respondents respectively. 16.7% respondents from the later two sites have also confirmed the destruction of crops by the thunder storms combined with lightning.

5.3. Adaptation measures to climate change by the local communities

Climate change and the more frequent occurrence of extreme climatic events are a reality and the situation are very likely to worsen in the future as reported in Third National Communication (Republic of Rwanda, 2018). Within the context of increasing rural population and reduction in average landholdings (NISR, 2019), it is clear that the pressure on the subsistence agricultural sector and livelihoods of small farmers is very acute. Developing and enhancing a climate change adaptation for the study area should be among

the priority for NAP. Thus, the assessment of available adaptation measures along with the adaptive capacity of households in Project sites was undertaken in order to evaluate the local capacity to deal with the effects of climate change in the area, and recommend the appropriate measures to be undertaken based on the reality of the area. Hence, this study explored the situation about access to weather/climate information in the area under investigation and findings are summarized in the figure below.

| | Nyandungu | Ibanda- | Muvumb | Shagasha | Eastern | Averag |
|--------------|----------------|--------------|--------|----------|---------|--------|
| | | Makela | a | | Savann | е |
| | | | | | a | |
| No access | 11.5% | 5.1% | 8.5% | 2.5% | 3.1% | 6.3% |
| Radio | 66.7% | 60.8% | 61.7% | 65.4% | 75.4% | 65.5% |
| Mobile phone | 25.6% | 32.9% | 16.0% | 32.1% | 12.3% | 23.9% |
| Television | 51.3% | 3.8% | 4.3% | 11.1% | 26.2% | 18.4% |
| Journals | 1.3% | 0.0% | 0.0% | 1.2% | 0.0% | 0.5% |
| Meetings | 17. 9 % | I 3.9% | 10.6% | 46.9% | 6.2% | 19.4% |
| Other | 0.0% | 2.5% | 3.2% | 2.5% | ۱.5% | 2.0% |

Table 38: Access to weather/climate information in the past 12 months

Source: Baseline survey, December 2020

It was revealed that 65.5% respondents confirmed to receive weather/climate information through radio, and 23.9% of respondents through mobile phone. 19.4% and 18.4% are informed about weather/climate information by meetings and television respectively with a small proportion of households (less than 2%) who obtains it from journals. Additionally, 2% of respondents confirm to have received weather information from other sources like Field Farmers Schools (FFS) as confirmed in FGDs and KIIs. The highest percentage of respondents who confirmed to have received weather/climate information through radio and television were seen in eastern savannah site and around Nyandungu wetland respectively while meetings helped more Shangasha respondents (46.9%) to have access to the weather/climate information. Nonetheless, a very low percentage of households (6.3%) declared not to have access to weather/climate information, it is very good to hear that the majority of project beneficiaries confirmed to have access to weather/climate information. Moreover, It was also important to assess whether households were trained about the use of weather information during last 12 months and then the findings were reported in the figure below.

weather/climate information during last 12 months

Muvumba

Figure 91: Received technical advice/training related to the use of weather/climate information during last 12 months

Source: Baseline survey, December 2020

Ibanda-Makela

Nyandungu

The highest respondents who confirmed to have been advised/trained to use weather information was seen around Shagasha tea estate (39.5%) followed by Ibanda-Makela forest site. The remaining sites have between 10% and 16% of respondents who said that they have been advised/trained in using wather/climate information. This shows that there is still room to provide more support to farmers to integrate weather information in their daily activities and to take stock to the effects of climate change and weather variability. When asked about the sources of trained/advises in FGDs, the majority mentioned schools, meetings with local leaders, Radio and television as the main source of the information about the use of weather/climate information. The respondents were also asked about the received trainings related to the adaptation measures to climate change and the feedback provided was summarized in table below.

Shagasha

Eastern Savanna

Overall

| · · · · · · | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Overall |
|----------------------------------|-----------|--------------|---------|----------|---------|---------|
| | | Makela | | | Savanna | |
| Small-scale irrigation | 1.3% | 2.5% | 3.2% | 6.2% | 1.5% | 3.0% |
| Tree nursery | 0.0% | 3.8% | 5.3% | 11.1% | 7.7% | 5.5% |
| Rainwater collecting/harvesting | 9.0% | 6.3% | 11.7% | 24.7% | 12.3% | 12.8% |
| Improved grain drying, storage | 0.0% | 11.4% | 12.8% | 7.4% | 9.2% | 8.3% |
| Improved seed preservation | 1.3% | I 3.9% | 20.2% | 28.4% | 15.4% | 16.1% |
| Mulching of soils | 1.3% | 8.9 % | 10.6% | 9.9% | 3.1% | 7.1% |
| Inter-cropping methods | 2.6% | 13.9% | 25.5% | 48.1% | 24.6% | 23.2% |
| Tree planting | 10.3% | 15.2% | 28.7% | 49.4% | 26.2% | 26.2% |
| Pest and weed control | 2.6% | 16.5% | 23.4% | 44.4% | 20.0% | 21.7% |
| Use of organic manure | 5.1% | 21.5% | 28.7% | 54.3% | 29.2% | 28.0% |
| Domestic animal treatments | 1.3% | 16.5% | 27.7% | 40.7% | 23.1% | 22.2% |
| Terracing and slope maintenance | 0.0% | 15.2% | ۱6.0% | 6.2% | 7.7% | 9.3% |
| Crop rotation | 1.3% | 21.5% | 28.7% | 51.9% | 26.2% | 26.2% |
| Mixing trees with crops | 1.3% | 17.7% | 28.7% | 53.1% | 23.1% | 25.2% |
| Accounting and improved business | 0.0% | 19.0% | 21.3% | 25.9% | 18.5% | 17.1% |
| management for farming | | | | | | |
| None among them | 6.4% | 0.0% | 0.0% | 0.0% | 0.0% | 1.3% |

Table 39: Received trainings related to adaptation measures to climate change inthe past 12 months

In reference to the figure above, households from around Shangasha tea estate and Muvumba River sites have a greater proportion to have received trainings related to adaptation measures to climate change in the past 12 months compared to remaining sites while Nyandundu wetland sites is poorely trained in the same aspects. It is necessary mentioning that most of such trainings were made by Field Farmers Schools (FFS) as confirmed by the Key Informants at district level. The trainings was on the following: small-scale irrigation, tree nursery, rainwater harvesting technologies, improved grain drying and storage, improved seed preservation, mulching of soils, inter-cropping methods, tree planting, pest and weed control, use of organic manure, domestic animal treatments, terracing and slope maintenance, crop rotation, mixing trees with crops, and accounting and improved business management. It was portrayed from the figure above that the participation rate in such training is still low, which suggests that NAP should be organized much more trainings related to adaptation measures to climate change and encourage farmers' participation. This will help the households to improve their capacity to deal with adverse impacts of climate change and variability.

| | | | | 0 | | |
|--|-----------|-------------------|---------|----------|--------------------|---------|
| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average |
| Enough knowledge on climate change and their impacts | 2.6% | 7.6% | 2.1% | 0.0% | 3.1% | 3.0% |
| Financial capacity | 0.0% | 2.5% | 1.1% | 0.0% | 1.5% | 1.0% |
| Availability of timely weather/climate information | 15.4% | 15.2% | 17.0% | 1.2% | 16.9% | 13.1% |
| Governmental/non- governmental support | 0.0% | 25.3% | 9.6% | 1.2% | 12.3% | 9.6% |
| Availability irrigation schemes and water channels | 1.3% | 5.1% | 4.3% | 1.2% | 0.0% | 2.5% |
| Availability of basic infrastructure | 12.8% | 12.7% | 6.4% | 7.4% | 0.0% | 8.1% |

| Table 40: Capac | ity to deal with | impacts of clim | nate change and | l variability |
|-----------------|------------------|-----------------|-----------------|---------------|
|-----------------|------------------|-----------------|-----------------|---------------|

Source: Baseline survey, December 2020

The table above depicts a poor capacity of local communities at project sites to deal with adverse impacts of climate change as the highest capacity 13.1% in average was seen in availability of timely weather/climate information to take stock of forecasted weather conditions. 9.6% confirmed to have received governmental/non-governmental support helping to develop climate resilient technologies with 8.1% who confirmed the availability of basic infrastructure helping to deal with adverse impacts of climate change. Only 3% and 1% in average said to have enough knowledge on climate change and their impacts and financial capacity respectively. The availability of irrigation schemes and water channels was said by 2.5% only. This reveals that local community at project sites needs much more to be helped to improve its capacity to deal with impacts of climate change and variability. The figure below shows adopted climate resilient technologies by households in the past 12 months.

| | Nyandungu | lbanda- Makela | Muvumba | Shagasha | Eastern Savanna | Average |
|---|-----------|-------------------|---------|----------|--------------------|---------|
| Protection of housing infrastructure against lightening | 25.6% | 5.1% | 2.1% | 27.2% | 16.9% | 14.9% |
| Rain water harvesting and utilization | 15.4% | 49.4% | 34.0% | 29.6% | 41.5% | 33.8% |
| Household waste water management | 30.8% | 58.2% | 35.1% | 39.5% | 46.2% | 41.6% |
| Use of alternative sources of cooking other than biomass energy | 10.3% | 2.5% | 9.6% | 2.5% | 4.6% | 6.0% |
| Development of irrigation scheme | 6.4% | 2.5% | 4.3% | 6.2% | 9.2% | 5.5% |
| Crop rotation | 7.7% | 59.5% | 48.9% | 74.1% | 67.7% | 51.1% |
| Adoption of crop varieties/improved seeds | 7.7% | 55.7% | 42.6% | 70.4% | 55.4% | 46.1% |

Table 41: Adopted climate resilient technologies in the past 12 months

Source: Baseline survey, December 2020

A key focus of the NAP project is to transform existing practices into high resilient practices embedded within communities and enabling them to continue adapting to future climate variability and further change beyond the lifetime of the project. By doing so, the livelihood of local communities in the project intervention area will be improved. The adopted climate resilient technologies with a high rate across all project sites was crop rotation as reported by between 48.9% and 74.1% of respondents with exception in around Nyandundu wetland (7.7%). The adoption of crop varieties/improved seeds is on the second position at all project sites except Nyandungu wetland while the waste water management and rain water harvesting and utilization come to the third (41.3%) and fourth (33.8%) position respectively in being adopted by households across the project sites. The remaining mentioned climate resilient technologies including: protection of housing infrastructure against lightening, use of alternative sources of cooking other than biomass energy and development of irrigation scheme were less adopted as less than 15% of households in average have adopted them.





Source: Baseline survey, December 2020

The study revealed that the households from around Shangasha tea estate are better in possession of forests and trees as confirmed by 27.6% while eastern savannah is poorly positioned in possession of forest and trees. It was reported in Muvumba Catchment Plan 2018-2024 that total forested area covers 23% of the Muvumba catchment area, which is below the national average 30.4% (Ministry of

Environment, 2019105). From this, about one third is considered degraded, i.e. shows signs of tree falling or other forms of degradation (Ministry of Environment, 2019). Efforts are required to increase both the area of land covered by forest and to improve the management of existing (and new) forest areas. As better forest management is needed, the membership to the Forest Management Units was investigated and the feedbacks were summarized in figure below.



Figure 93: Membership to the Forest Management Units

Source: Baseline survey, December 2020

The figure above reveals that a negligeable percentage of households (less than 3.5%) at project sites have atleast a member in Forest Management Unit for better maintenance of existing forests and participate in afforestation program. This percentage is very low, therefore a call is made to the NAP to take into account this aspect during the implementation period of NAP activities.



Figure 94: Terraces in farmland in past 12 months

Notwithstanding that one of the most effective method to deal with soil erosion in Rwanda include terraces but the adoption rate of both radical and progressive terraces at project sites is very low which imply the need to construct more terraces to deal with soil erosion seen in different parts of study area. With this end, the respondents were asked whether there are aware of erosion control practices and the feedback the provided was summarized in figure below.

¹⁰⁵ Ministry of Environment, 2019. Forest cover mapping report, Kigali, Rwanda.



Figure 95: Awareness on erosion control practices

Source: Baseline survey, December 2020

Awareness of erosion control practices is one of the most important step in increasing climate resilience in agriculture and human settlements. The study recvealed a very high awareness among all project beneficiaries (between 78% and 96.5%)). However, NAP is targeting an increase in knowledge and capacity of local communities in dealing with the adverse effects of climate change including soil erosion. This goes hand in hand with improved agricultural practices like planting agro-forestry trees, increasing soil fertility, constructing progressive and radical terraces, constructing water canals). In this regard, A key informant made a call for exploiting effectively the available land, developing irrigation in both hillside and marshlands, developing rain water harvest technologies, developing green cover, using selected seeds and reducing tree-cutting, in order to reduce the adverse impacts of climate change including soil erosion. Then, the respondents were asked whether there are aware of the above mentioned among others improved soil practices and the feedback they gave was reported in following figure.





Source: Baseline survey, December 2020

The study findings impressed on the awareness of the respondents about improved soil practices where between 54% and 83% of respondents confirmed that they are aware of improved soil practices to be used in their farm. However, their adoption rate is very low as shown in previous tables and figures. Hence, the intervention is much more needed in improving household capacity to implement various improved soil practices to increase agricultural productivity.



Figure 97: Family members received agricultural inputs in last 12 months

Source: Baseline survey, December 2020

The agricultural inputs provided were received by 35.8%% of the households at Shagasha tea estate site compared to between 3.8% and 10.6% received in other project sites. The percentage in using agricultural inputs is higher at Shagasha tea estate compared to other sites as they are used mainly growing tea. Furthemore, the FDGs and KIIs in Rusizi district said than the farmers are given agricultural inputs to paid back from the harvested tea which makes the access to them easier. Thus, the appropriate strategies should be taken to help farmers from others sites to have access to the agricultural inputs in easy way. When the respondents asked about the visit they had by extension services/agents, the feedback they provided was reported in table below.

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Overall |
|---------------------------|-----------|---------|---------|----------|---------|---------|
| | | Makela | | | Savanna | |
| Project service provide | r staff | | | | | |
| Never | 69.2% | 58.2% | 66.0% | 85.2% | 73.8% | 70.3% |
| Once a week | 0.0% | 2.5% | 3.2% | 0.0% | 0.0% | 1.3% |
| Once a month | 0.0% | 11.4% | 4.3% | 8.6% | 3.1% | 5.5% |
| Every 2 months or more | 1.3% | 5.1% | 8.5% | 6.2% | 9.2% | 6.0% |
| l don't know | 29.5% | 22.8% | 18.1% | 0.0% | 13.8% | 16.9% |
| District agronomist | | | | | | |
| Never | 66.7% | 57.0% | 68.1% | 91.4% | 76.9% | 71.8% |
| Once a week | 0.0% | 1.3% | 1.1% | 0.0% | 0.0% | 0.5% |
| Once a month | 0.0% | 11.4% | 5.3% | 2.5% | 3.1% | 4.5% |
| Every 2 months or more | 1.3% | 7.6% | 13.8% | 4.9% | 9.2% | 7.6% |
| l don't know | 32.1% | 22.8% | 11.7% | 1.2% | 10.8% | 15.6% |
| District veterinary offic | er | | | | | |
| Never | 65.4% | 63.3% | 66.0% | 91.4% | 70.8% | 71.3% |
| Once a week | 0.0% | 0.0% | 2.1% | 0.0% | 1.5% | 0.8% |
| Once a month | 0.0% | 6.3% | 5.3% | 1.2% | 4.6% | 3.5% |
| Every 2 months or more | I.3% | 8.9% | 16.0% | 3.7% | 12.3% | 8.6% |
| l don't know | 33.3% | 21.5% | 10.6% | 3.7% | 10.8% | 15.9% |
| District Cooperative of | ficer | | | | | |
| Never | 62.8% | 63.3% | 63.8% | 88.9% | 72.3% | 70.0% |
| Once a week | 0.0% | 1.3% | 0.0% | 0.0% | 0.0% | 0.3% |
| Once a month | 0.0% | 6.3% | 6.4% | 2.5% | 3.1% | 3.8% |
| Every 2 months or more | 1.3% | 6.3% | 18.1% | 1.2% | 10.8% | 7.8% |
| l don't know | 35.9% | 22.8% | 11.7% | 7.4% | 13.8% | 18.1% |
| Sector agronomist | | | | | | |

Table 42: Visit by extension services/agents

| Never | 61.5% | 25.3% | 29.8% | 43.2% | 33.8% | 38.5% |
|--------------------------|-------|-------|----------------|-------|-------|-------|
| Once a week | 0.0% | 7.6% | 1.1% | 1.2% | 1.5% | 2.3% |
| Once a month | 3.8% | 19.0% | 20.2% | 22.2% | 12.3% | 15.9% |
| Every 2 months or more | 1.3% | 26.6% | 39.4% | 27.2% | 44.6% | 27.7% |
| l don't know | 33.3% | 21.5% | 9.6% | 6.2% | 7.7% | 15.6% |
| Sector veterinary office | er | | | | | |
| Never | 60.3% | 29.1% | 31. 9 % | 39.5% | 33.8% | 38.8% |
| Once a week | 0.0% | 3.8% | 5.3% | 2.5% | 9.2% | 4.0% |
| Once a month | 0.0% | 22.8% | 24.5% | 24.7% | 16.9% | 18.1% |
| Every 2 months or more | 1.3% | 22.8% | 28.7% | 27.2% | 32.3% | 22.4% |
| l don't know | 38.5% | 21.5% | 9.6% | 6.2% | 7.7% | 16.6% |
| Sector Cooperative off | icer | | | | | |
| Never | 57.7% | 48.1% | 41.5% | 53.1% | 47.7% | 49.4% |
| Once a week | 0.0% | 1.3% | 1.1% | 3.7% | 3.1% | 1.8% |
| Once a month | 1.3% | 17.7% | 17.0% | 16.0% | 12.3% | 13.1% |
| Every 2 months or more | 1.3% | 8.9% | 18.1% | 13.6% | 20.0% | 12.3% |
| l don't know | 39.7% | 24.1% | 22.3% | 13.6% | 16.9% | 23.4% |
| Other visit | | | | | | |
| Never | 15.4% | 20.3% | 21.3% | 29.6% | 20.0% | 21.4% |
| Once a week | 0.0% | 2.5% | 2.1% | 1.2% | 12.3% | 3.3% |
| Once a month | 0.0% | 5.1% | 23.4% | 4.9% | 15.4% | 10.1% |
| Every 2 months or more | 1.3% | 3.8% | 4.3% | 4.9% | 6.2% | 4.0% |
| l don't know | 83.3% | 68.4% | 48.9% | 59.3% | 46.2% | 61.2% |
| - | | | | | | |

The majority of respondents declared that they have never visited by project service provider staff, district agronomist, district veterinary officer, district Cooperative officer as reported by 70.3%, 71.8%, 71.3% and 70.0% respectively. The visit by extension services/agents from sector level is higher than that done by agents from district level. Atleast between 10% and 20% of respondents confirmed to have been visited by extension services/agents from sector level once a month. Moreover, much more connection between farmers and extension services/agents is highly needed in process of building the capacity of households in dealing with adverse impacts of climate change. The following table informs about the awareness of local community on appropriate adaptation measures to be undertaken to deal with climate change effects.

Table 43: Awareness on appropriate adaptation measures to be undertaken todeal with climate change effects

| | Nyandungu | Ibanda- | Muvumba | Shagasha | Eastern | Overall |
|---|-----------|---------|---------------|---------------|---------|---------|
| | | Makela | | | Savanna | |
| Planting trees | 70.5% | 98.7% | 98.9 % | 86.4% | 95.4% | 90.2% |
| Radical terraces | 46.2% | 96.2% | 78.7% | 65.4% | 73.8% | 72.3% |
| Progressive terraces | 56.4% | 96.2% | 96.8% | 93.8% | 81.5% | 85.6% |
| Rainwater harvesting | 83.3% | 96.2% | 97.9% | 91.4% | 92.3% | 92.4% |
| Growing selected seeds | 52.6% | 91.1% | 96.8% | 9 0.1% | 95.4% | 85.4% |
| Integration of weather/climate information in agricultural activities | 65.4% | 94.9% | 95.7% | 87.7% | 90.8% | 87.2% |
| Irrigation | 48.7% | 77.2% | 68.1% | 74.1% | 70.8% | 67.8% |
| Plant diseases and pest control | 50.0% | 92.4% | 92.6% | 88.9 % | 90.8% | 83.1% |
| Multi-cropping | 43.6% | 48.1% | 39.4% | 56.8% | 41.5% | 45.8% |

Source: Baseline survey, December 2020

It was encouraging to hear that the majority of respondents (more than 80%) are aware of the appropriate adaptation measures to be undertaken to deal with climate change effects, with the exception of irrigation and multi-cropping where the percentage of respondents to report them was less than 70%. The awareness of beneficiaries is higher on planting trees, rainwater harvesting. Though the households declared to have awareness on various adaptation measures to deal with adverse effects of climate change and variability but the adoption rate is still low as mentioned above because they do not yet have enough infrastructures which may help them to implement such measures as confirmed in FGDs and KIIs.

5.4. Adaptive capacity to climate change at the central government

5.4.1. Financial budget in use for environmental and climate change activities

The National Fund for Environment (FONERWA/Rwanda Green Fund) was created in May 2012, with the mission to mobilize and manage resources to be used in financing environmental and climate change activities. The primary source of FONERWA financing is bilateral Development Partners who can capitalize the Fund in the short-term and long-term and the secondary source is domestic capitalization from the Government of Rwanda.

In its role as resource mobilization climate change fund and engine for green growth, FONERWA funds climate change adaptation and mitigation projects as well as any other project that aligns with Rwanda's green economy targets. Majority of climate finance, is monitored through this fund and through the Financial Management System of the Ministry of Finance and Economic Planning.

Moreover, the allocated budget by the Government of Rwanda is not enough to fund all prioritized all preventive and reactive adaptation actions from household to national scale. Furthermore, Bilateral and Multilateral Grants are essential to build resilience to climate change while the primary source of funding for disaster responses come from the local administrations (districts) in affected areas. When the magnitude of the situation overwhelmed the districts capacity to cope with, the second source is next highest level of administration above the affected areas but most of the time those governmental institutions are not well prepared to respond financially to the disasters of high magnitude.

Table 44: Environment and climate change expenditures and total expendituresin central government institutions

| Government | Total environment | Total expenditures | Percentage (%) |
|--------------|--------------------|--------------------|----------------|
| institutions | and climate change | (Rwf) | |
| | expenditures(Rwf) | | |
| MINAGRI | 4,424,486,691 | 6,496,845,065 | 68.10% |
| MINEDUC | 109,233,398 | 14,306,724,937 | 0.76% |

| MINEMA | 364,029,819 | 1,299,276,354 | 28.02% |
|--|----------------|----------------|---------|
| MoE | 382,470,585 | 382,470,585 | 100.00% |
| Meteo Rwanda | 952,212,640 | 952,212,640 | 100.00% |
| RAB | 19,995,494,850 | 33.955,675,040 | 58.9% |
| Rwanda Land Management and use Authority | 1,017,825,000 | 1,017,825,000 | 100.00% |
| Rwanda Water and Forestry Authority | 3,389,695,000 | 3,389,695,000 | 100.00% |
| FONERWA | 500,000,000 | 500,000,000 | 100.00% |

Source: REMA 2019

These figures above show the environment and climate changes expenditures of different central government institutions of 2017-2018. That rain-fed agriculture is the mainstay of livelihoods of the population of Rwanda is not in doubt but it is frequently adversely affected by climate fluctuations along with their adverse effects. On the flip side, floods, soil erosion and landslides that destroyed basic infrastructures, caused people's death, crop failure, water shortage, electricity cut-off among others were recently reported in different parts of the country (Ministry of environment, 2018). Thus, more financial supports are highly need to curb the above mentioned adverse effects of climate change. The figure below reveals that the budget allocated to environmental and climate change activities have slightly increased throughout the years. Below there is environment and climate change expenditures and total expenditures in districts where NAP project will be implementated.

| Districts | Environment and climate change expenditures | Total expenditures | Percentage |
|-----------|---|--------------------|------------|
| Kirehe | 851,847,302 | 8,822,760,679 | 9.66% |
| Nyagatare | 634,223,790 | 13,061,276,369 | 4.86% |
| Gasabo | 219,534,988 | 9,151,682,537 | 2.40% |
| Kicukiro | 409,866,629 | 7,458,092,307 | 5.50% |
| Rusizi | 466,794,559 | 12,507,634,094 | 3.73% |
| Total | 2,582,267,268 | 51,001,445,986 | 5.06% |

Table 45: Environment and climate change expenditures and total expendituresin Districts

Source: Rema 2019

The figure above indicates that the selected districts in 2017/2018 were given the total budget of around 51 billion Rfw and only 2.5 billion Rfw (around 5% of their total budget) were allocated to environmental activities while the Rwanda's sensitivity to climate change was assessed as high and its adaptive capacity low in a national study on climate vulnerability (REMA, 2019). Thus, more financial funds are needed to deal with negative impacts of ongoing climate change. Furthermore, various governmental institutions have allocated some money from their annual budget as it can be depicted from the figure below.



Figure 98: Budget allocated (% of national budget) to the environmental and climate change activities

Source of data: REMA, 2019

The figure above depicts a slight increase of the budget allocated to the environmental and climate change activities from the national budget expenditures from only 0.4% in 2009 to 2.9% in 2017/18. However, reference to the recent adverse effects of climate change impacts across the country, this allocation of 2.9% of the national executed budget in 20017/2018 (53,677,285,654 Rwf) is still too small to cope with the impacts on the ground. Recently a vulnerability index study carried out by REMA (2019) indicated an increase in vulnerability index from 0.424 in 2015 to 0.489 in 2019. This is an indication that Rwanda needs to take measures including addition of mitigation and adaptation activities and increased budget in sectors' and districts' plans if Rwanda is to achieve a sustainable development as enshrined in her medium and long terms plan. The table below shows the planed budget to be used for the period of 2018-2024.

Table 46: Environmental and Natural Resources sector strategic plan 2018-2024cost by outcome

| S/N | OUTCOME | COST (RWF) |
|-----|--|-----------------|
| I | Increased sustainability and profitability of forests | 31,356,000,000 |
| 2 | Integrated and sustainable water resources management to maximize reliable, efficient and productive investments | 260,783,980,000 |

| 3 | Integrated and sustainable land management to maximize reliable, efficient and productive investments | 10,715,615,800 |
|-------|---|-----------------|
| 4 | Enhanced reliability of weather and climate services and products for Rwanda's socio-economic development | 11,554,280,000 |
| 5 | Enhanced Environmental management and resilience to climate change | 32,366,242,611 |
| 6 | Vibrant, efficient and responsible mining spurring sustainable economic development | 54,666,000,000 |
| TOTAL | | 401,442,118,411 |

Source of data: GoR, 2019.

The table above shows that executed budget for environmental and climate change activities in 2017/2018 equals to 13.37% (53,677,285,654 Rwf) of the amount planned to be used (401,442,118,411 Rwf) in 6 years (2018-2024). This depicts a good will to improve interventions in environmental and climate change activities.

Apart from the above mentioned budget from the government of Rwanda, the country also accessed to the external financial support. According to MINECOFIN, from 2012 to June 2018, a sum of USD 109,630,444 in external development finance was mobilized to include resources from DfID, KFW, UNDP, the World Bank, the Climate and Development Knowledge Network (CDKN), Adaptation Fund, Green Climate Fund (GCF), Least Developed Countries Fund (LDCF), AfDB and the Global Green Growth Institute (GGGI). USD 33,232,670 of this total amount was mobilized in 2017/18 (all from GCF) (MINECOFIN, 2019). Moreover, FONERWA reported to have mobilized USD 127,763,110,124 since 2013 to 2020 as detailed in the table below.

| SN | Source of funds | GBP or Euro | Amount (FRW) | Amount (USD |
|-------|---|-------------|-----------------|-------------|
| Ι | DFID grant (GBP) | 22,560,000 | 25,343,904,000 | 37,161,150 |
| 2 | KFW grant | 6,700,000 | 6,293,779,000 | 8,978,287 |
| 3 | UNDP | | 3,475,203,292 | 5,095,606 |
| 4 | World Bank | | 1,244,473,704 | I,500,000 |
| 5 | CDKN grant (leveraging) | 360,000 | 404,424,000 | 592,997 |
| 6 | GoR contribution | | 4,747,598,356 | 6,961,288 |
| 7 | Adaptation fund grant (leveraging) | | 6,939,900,000 | 9,900,000 |
| 8 | GCF NDA support and PPF (leveraging) | | I,227,600,000 | I,800,000 |
| 9 | LDCF/AfDB (leveraging) | | 5,732,038,818 | 8,404,749 |
| 10 | Projects Match financing | | 9,798,222,127 | 14,366,895 |
| 11 | BRD | | 1,714,284,710 | 2,513,614 |
| 12 | GGGI (GBP) | 1800000 | 2,022,120,000 | 2,964,985 |
| 13 | GCF GRANT | | 28,151,274,117 | 32,794,442 |
| 14 | KFW grant. Feasibility study (GCP Kigali) | 2,200,000 | 2,641,408,000 | 2,948,000 |
| 15 | SIDA(SEK) | 39,000,000 | 3,942,400,000 | 4,400,000 |
| 16 | UNDP | | 3,942,400,000 | 4,400,000 |
| 17 | KFW grant (EURO) | 7,000,000 | 8,404,480,000 | 9,380,000 |
| 18 | DFID grant (GBP) | 2,000,000 | 2,956,800,000 | 3,300,000 |
| 19 | Projects Match financing | | 8,780,800,000 | 9,800,000 |
| Grand | Total | 61,620,000 | 127,763,110,124 | 167,262,013 |

Table 4: List indicating the resource mobilization for 2013-2019

Source of data: FONERWA, 2020

The Global Environment Facility (GEF) is a mechanism for international cooperation for the purpose of providing new, and additional, grant and concessional funding to meet the agreed incremental costs of measure to achieve agreed global environmental benefits. It is a financial mechanism established to protect the global environment and promote sustainable development. Rwanda is a beneficiary of GEF funding.

5.4. 2. Education, trainings and public awareness

The conservation and protecting the environment is one of the pillars to sustainable development. The researches on environment can be of paramount role since they would help in better understanding the existing environmental problems and adverse impacts of climate change to be able to address them. Research findings and other environmental and climate change information may be communicated through formal, non- formal and informal education, trainings and workshops or conferences/meetings. Since 2006, REMA has been involving schools in environment protection activities to equip the youth with necessary skills that would enable them to ensure a sustainable future for our country. Environmental clubs have been established in primary, secondary and higher learning Institution

The Department of Environmental Education and Mainstreaming (DEEM) in REMA is working with Rwanda Education Board (REB) to facilitate the implementation of environment and climate change topics mainstreamed in the Competence Based Curriculum (CBC) through teaching and learning process. Teachers from secondary schools were trained together with the teachers from Technical and Vocational Education Training (TVET) schools. Training manuals were developed to facilitate the training of teachers. In 2019, REB and stakeholders developed teacher guide and student textbooks with environment and climate change topics mainstreamed in the competence-based curriculum for Teacher Training Colleges (TTCs). The TTC curriculum was revised to align it to the Competence-Based Curriculum for basic education to prepare teachers who are competent and confident to implement CBC. It is within this context, REMA worked together with REB to mainstream ECC in the curriculum of TTCs.

In 2018, REMA trained students from higher Learning Institutions to mainstream environment and climate change and sustainable management of natural resources. Other trainings on mainstreaming environment and climate change targeted cooperatives of farmers, District planners, environmental committees at sector level, religious based organizations, Customs Officer and other law enforcement agents, District Officials in charge of youth, sport and cultural, civil society organizations and other stakeholders.

REMA developed monitoring and evaluation checklists for assessing the level of greening initiatives in schools, environmental clubs activities to ensure that they are active and provide technical support. Furthermore, informal education programs were developed to raise environment and climate change awareness through competitions, debate, public lectures, field tours and training workshops and climate change in media reporting. Association for Journalists who report regularly on environment and climate change was created.

On 5th June every year, Rwanda joins the World to celebrate the World Environment Day (WED). The whole week is dedicated to activities aimed at raising awareness on environmental sustainability and building resilience to climate change. To engage actively the youth in celebration of this event, REMA organized competitions of green projects with innovations and the winners are awarded. The competitions targeted youth entrepreneurs, journalists with best report on environment and climate change, students in HLIs, private sectors and districts.

Last June 2019, one journalist, three students, three districts, three private companies and youth entrepreneurs were awarded while in 2020 only 5 youth entrepreneurs received their awards. Also, REMA organized football tournament between 4 districts (Rubavu, Rutsiro, Ngororero and Nyabihu district) and awarded the winner team. This tournament was an opportunity to raise awareness for the surrounding community on the protection of Gishwati-Mukura National Park and sustainable livelihood.

REMA through DEEM tried to raise awareness on environment and climate change for a high number of people. To ensure sustainability, there is a need to increase the number of teachers trained on topics mainstreamed in new competence based curriculum. More teacher training manuals based on different levels are needed and their disseminations in schools. There is a need to engage more the students and lecturers from higher to reorient their research in climate change resilience and environment. Awarding best practices and green projects should be a continuous programme. The level of engaging community around protected areas and natural forests in

5.4.3 Institutional capacity in dealing with climate change

Verified through scoring methodologies developed by the TAMD and PPCR and adapted from the GEFSec - AMAT (2014)¹⁰⁶.

The indicator is based on five-step criteria of capacity assessment of targeted governmental institutions (expressed in grades: Table 43-48)

1. Are the stakeholders aware of the current and expected impacts of climate change and have access to accurate climate information?

¹⁰⁶ Adapted from TAMD (2013) and PPCR (2014) scorecard indicators.

2. Do the stakeholders have the capacity to access adaptation funding?

3. Do the stakeholders have the capacity to plan for and implement CCA approaches?

4. Do the stakeholders have access to proven EbA methods that are specific to Rwanda's various biophysical environments

5. Is there evidence of adequate institutional capacities for the continuous monitoring and reviewing of and learning from adaptation initiatives?

The study conducted an assessment on the ability and preparedness of the targetted governmental institutions (16) to implement NAP process, below is the status of undertaken trainings related to climate change by 16 invistageted institutions. The grading of institutions in trainings was 0 if it never did any trainings, 1 if it rarely did trainings, 2 if it did trainings sometimes, 3 if it did trainings frequently and 4 if it did trainings very frequently.

Table 47: Training or staff capacity building programs in dealing with adverse impacts of climate change at institutional level

| Institutions | TRAININGS | | | | | |
|--|-----------|------------|---------------|--------------|-------------------------|---------|
| | never = 0 | rarely = I | sometimes = 2 | frequent = 3 | very frequent = 4 | grading |
| MINECOFIN | | | Х | | | 2 |
| MINEDUC | | | | X | | 3 |
| MINAGRI | | | Х | | | 2 |
| MINALOC | | | Х | | | 2 |
| MINEMA | | Х | | | | I |
| MOE | | | | X | | 3 |
| MININFRA | | | | X | | 3 |
| RDB | | | | X | | 3 |
| METEO | | Х | | | | I |
| FONERWA | | Х | | | | I |
| RWANDA MINES, PETROLEUM&GAS BOARD | X | | | | | 0 |
| RLMUA | Х | | | | | 0 |
| RWANDA FOREST AUTHORITY | Х | | | | | 0 |
| RWANDA WATER AUTHORITY | Х | | | | | 0 |
| RWANDA ENVIRONMENT MANAGEMENT AUTHORITY | | | X | | | 2 |

| RWANDA | | Х | | 2 |
|--------------|--|---|--|---|
| AGRICULTURAL | | | | |
| BOARD | | | | |

The table above shows the performance of institutions as regards training or capacity building program in dealing with adverse impacts of climate change, score 3 was attained by MINEDUC, MOE, MINIFRA and RDB, followed by 2 which was attainedby MINECOFIN, MINALOC and MINAGRI. MINEMA managed to get 1 and so was FONERWA and the remaining like RWANDA MINES, PETROLEUM&GAS BOARD, RLMUA, RWANDA FOREST AUTHORITY and RWANDA WATER AUTHORITY earned 0 because they never did any training however RWANDA WATER AUTHORITY gave a reason that they have not yet organised such trainings because there are still new, the institution was legally formed in February 2020.

Table 48: The best climate change adaptation measures that could be applied in Rwanda

| S/N | INSTITUTION | Climate Change Adaptation | GRADING |
|-----|-------------|--|---------|
| | | Measures | |
| | | NONE = 0; LITTLE = 1; SOME = | |
| | | 2; MOST = 3; VERY HIGH = 4 | |
| 1 | MINECOFIN | Plan well land use; | 3 |
| | | Prioritize climate resistant | |
| | | crops | |
| | | Put in place afforestation | |
| | | program; | |
| | | especially in dry areas | |
| 2 | MINEDUC | Improve monitoring air | 2 |
| 2 | | quality and air pollution: | 2 |
| | | Put in place afforestation | |
| | | program; | |
| | | Develop irrigation systems | |
| | | especially in dry areas | |
| 3 | MINAGRI | Plant trees | 3 |
| | | Put in place agroforestry | |
| | | Anti-erosion activities Bivers protection | |
| | | Promote irrigation technics | |
| | | Pasturages protection | |
| | | Promote the water storage | |
| | | system | |
| 4 | MINALOC | Afforestation | 2 |
| | | Radical terraces must be | |
| | | applicable to reduce land | |
| | | Slides Plantation of hamboos | |
| | | around river flows | |
| 5 | MINEMA | Afforestation: | 1 |
| _ | | Soil erosion prevention | |
| | | techniques | |
| 6 | MOE | Develop rain water | 2 |
| | | harvesting technology; | |
| | | Use drainages so that water | |
| | | may not destroy | |
| | | Government should urge | |
| | | residents to use other | |
| | | sources of energy such as gas | |
| | | instead of firewood | |
| 7 | MININFRA | Build sustainable | 3 |
| | | infrastructure such as water | |
| | | and drainage system that | |

| | | contribute to the reduction of roads destroyed by floods; Work closely with the government to relocate residents living in high risk zones; Plant trees where houses were erected to prevent | |
|----|---|--|---|
| | | erosion and landslides | |
| 8 | RDB | Sensitize people to understand very well the concept of climate change; Support the community to plant more trees Initiative of incoming generating activities Develop activities that attract tourists | 3 |
| 9 | METEO | Plant trees Make radical terraces; Construction of a protection wall on rivers; Irrigation methods | 3 |
| 10 | FONERWA | All administrative organs should own the initiative with a lot of efforts being invested in by the private sector and civil society so as to supplement the government in combating the impacts of climate change | 1 |
| 11 | RWANDA MINES, PETROLEUM&GAS BOARD | Use new alternatives of impact mining techniques by preventing vertical digging of a hill to instead dig horizontally since this prevents landslides on the hill during heavy rains; Capacity building on building flood defense; Creation of awareness on adapting building codes to future climate change conditions | 2 |
| 12 | RLMUA | Afforestation, and other soil erosion prevention techniques; Plan how land will be used for the whole country | 1 |

| 13 | RWANDA FOREST | Put more efforts on forests | 1 |
|----|---------------|---|---|
| | AUTHORITY | protection and tree planting; | |
| | | Protect lakes and rivers | |
| 14 | RWANDA WATER | Water shed management; | 1 |
| | AUTHORITY | Increase availability of water | |
| | | to the place with low rain fall | |
| | | by increasing storage of | |
| | | water and water transfer | |
| 15 | REMA | | 0 |
| 16 | RAB | To increase the mechanism of | 3 |
| | | irrigation especially in eastern | |
| | | province | |
| | | I o make terraces especially in hilleide encee | |
| | | niliside areas | |
| | | Anorestation within the whole | |
| | | To build houses in high risk | |
| | | zones which are resilience on | |
| | | climate change and if possible to | |
| | | shift people from that place | |
| | | | |

Source: Baseline survey, December 2020

The table above shows the best climate change adaptation measures that could be applied in Rwanda by the interviewed institution, the grading was according to the mentioned activities. Apparently there is no institution that was graded zero because all of the them had some activities done. A minimum of two activities was allocated a point, 3 activities 2 points more than 3 activities were allocated 3 points, none got 4 which is the maximum in this context.

There was need to find out whether there existed any budget allocated to activities related to environment and climate change which is well elaborated in paracfraph 5.4.1. Financial budget in use for environmental and climate change activities.

| Table 49: Measu | res to build | capacity to | o deal with | the impact | s of climate | change |
|--------------------|---------------|-------------|-------------|------------|---------------|--------|
| i abic 47. i icasu | 1 C3 CO Dulla | capacity to | o ucai with | the impact | 5 of chillace | change |

| S/N | INSTITUTION | Measures to build capacity to deal with | GRADING |
|-----|-------------|---|-------------|
| | | the impacts of climate change | NONE = $0;$ |
| | | | LITTLE = I; |
| | | | SOME = 2; |
| | | | MOST = 3 |
| | | | VERY HIGH = |
| | | | 4 |
| 1 | MINECOFIN | Need to be trained regularly on environment and climate change; Also need to be having study tours to areas mostly affected by the | 2 |
| | | impacts of climate change | 2 |
| 2 | | dioxide testing in our project called | 2 |
| | | climate observatory project | |

| | | Also need to plant trees in those | |
|----|---------------|--|---|
| | | areas with high air pollution so that | |
| | | the oxygen from the trees may | |
| | | outnumber the carbon dioxide | |
| | | emitted in the air | |
| 3 | MINAGRI | Increase capacity building: | 3 |
| 5 | | Increase financial capacity: | 5 |
| | | Increase resources mobilization | |
| | | Increasing budget | |
| | | Awaranoss on climato chango | 2 |
| 4 | | negative impacts: | 2 |
| | | Collaboration between institutions | |
| 5 | | | 2 |
| 5 | MINEMA | Capacity building; | 2 |
| | | Enforcement of laws RIAM to train | |
| | | more staff of government | |
| | | institutions because climate change | |
| | | is a cross cutting theme | |
| 6 | MOE | Need to put in place a platform that | 2 |
| | | brings together all public and private | |
| | | sector organs in combating the | |
| | | effects of climate change | |
| | | Elaborating projects combating the | |
| | | effects of climate change because | |
| | | there is support from donors | |
| 7 | MININFRA | Need more trainings | 2 |
| | | Also need additional staff in charge | |
| | | of climate changes | |
| 8 | RDB | Support in developing income | 2 |
| | | generating activities; | |
| | | Anti erosion activities | |
| 9 | METEO | Capacity building | 3 |
| | | Resources mobilization | |
| | | Availability of enough budget | |
| 10 | FONERWA | Organising trainings on a regular | 1 |
| | | basis | |
| 11 | RWANDA MINES, | Capacity building should be done | 1 |
| | PETROLEUM&GAS | through the multiplication of | |
| | | training sessions on how we ought | |
| | DUARD | to combat the effects of climate | |
| | | change | |
| 12 | RLMUA | Staff training | 3 |
| | | Hiring an expert in climate change | |
| | | Increase collaboration with REMA | |
| | | and Ministry of environment | |
| 13 | RWANDA | To plan many climate change | 1 |
| | FOREST | activities and get support from MoE | |
| | | and others | |
| | | | |

| 14 | RWANDA WATER AUTHORITY | Need mobilisation for all of our workers Also need capacity building on flood management, water monitoring and location | 2 |
|----|------------------------------|--|---|
| 15 | REMA | Trainining on conducting climate risk assessments; Developing long term adaptation strategies; Resources mobilisation | 3 |
| 16 | RAB | To provide regular trainings to build our capacity To help us in implementing projects related with environment and climate change | 2 |

The table above shows measures to build capacity to deal with the impacts of climate change by the interviewed institution, the grading was according to the mentioned activities. Apparently there is no institution that was graded zero because all of the them had some activities done. A minimum of one activity was allocated a point, 2 activities 2 points 3 and 4; 3 activities were allocated 3 points and none got maximum which is 4 in this context

Table 50: Staff trained in aspects related to climate change (percentage to the
total staff)

| S/N | INSTITUTION | Staff trained in aspects related to | GRADING None = |
|-----|-------------|---|--------------------------|
| | | climate change | 0; Unsatisfactory = I |
| | | | (1- 25%); Medium = 2 |
| | | | (26 – 50%); |
| | | | Satisfactory = $3(51 - $ |
| | | | 75%), Excellent: 4 |
| | | | (75% and above) |
| 1 | MINECOFIN | 15% of staff were trained. This is | |
| | | because before any planning process, the | |
| | | NDP expert trains/ gives a lecture on | |
| | | environment as well as climate change | |
| 2 | MINEDUC | four technicians and one Chief Scientist who | 1 |
| | | deals with data analysis. There is also | |
| | | Collaboration with students from the | |
| | | masters studies on climate change At | |
| | | ministerial level therefore, we are three (3) | |
| | | employees among all staff members working | |
| | | at this ministry whose number ranges | |
| | | between 150 and 200 | |
| 3 | MINAGRI | 5 workers who have been trained in | 1 |
| | | total of 65 (7.6%) | |
| 4 | MINALOC | 7 out of 70 which is 10% | 1 |

| 5 | MINEMA | 5 employees out of a total of 50 (10%) | 1 |
|----|---|---|---|
| 6 | MOE | six (6) were formally trained among 41 employees (14.6%), but even the remaining ones have information about climate change effects since we sometimes explain this during the aforementioned initiative of explaining things in front of fellow workmates whereby everyone explains what falls within their tasks | 1 |
| 7 | MININFRA | 25 out of 80 which is 31% were trained | 2 |
| 8 | RDB | 90% are trained but 30% have advanced skills | 4 |
| 9 | METEO | No employee was trained | 0 |
| 10 | FONERWA | 3 out of 25 which is 12% | 1 |
| 11 | RWANDA MINES, PETROLEUM& GAS BOARD | 15 out of 85 which is 17.6% | 1 |
| 12 | RLMUA | No employee was trained | 0 |
| 13 | RWANDA FOREST AUTHORITY | No employee was trained | 0 |
| 14 | RWANDA WATER AUTHORITY | No employee was trained | 0 |
| 15 | REMA | 90% | 4 |
| 16 | RAB | 5% | 1 |

Institutions were asked whether they had any staff trained in aspects related to climate change? (percentage to the total staff). The grading was according to the percentages of staff who received training in the institutions. Those institutions that did not train any staff got 0, Unsatisfactory = 1 (1- 25%); Medium = 2 (26 - 50%); Satisfactory = 3 (51 - 75%), Excellent: 4 (75% and above). Apparently there are some institutions that were graded zero because they did not have any of their staff trained other grades can be viewed in the table above.

Table 51: What to do to improve the institutional capacities to deal with adverse impacts of climate change

| S/N | INSTITUTION | What to do to improve the institutional capacities to | GRADING |
|-----|-------------|---|-------------|
| | | deal with adverse impacts of climate change | NONE = 0; |
| | | | LITTLE = I; |
| | | | SOME = 2: |
| | | | MOST = 3 |
| | | | |
| | | | |
| | | | 4 |
| 1 | MINECOFIN | There is need to organize institutional trainings; | 3 |
| | | together and elaborate projects meant for weakening the | |
| | | impacts of climate change. | |
| | | Projects need to be studied and implemented with | |
| | | institutions working together | |
| 2 | MINEDUC | To establish a website on which every information | 2 |
| | | regarding the protection of environment is posted | |
| | | alongside the information on confronting the impacts of | |
| | | To onable averyone to easily have information via the | |
| | | website | |
| 3 | MINAGRI | Enforce climate change related laws | 1 |
| 1 | | Canacity building | 3 |
| - | | Mentorship | 5 |
| | | Regular monitoring | |
| | | Study visits | |
| | | Peer learning | |
| 5 | MINEMA | Train senior management staff of all government | 2 |
| | | Institutions on climate change | |
| 6 | MOF | Availing enough budget for climate change | 2 |
| 0 | TIOL | so that both public and private sector can have technical | 2 |
| | | knowledge related to climate change and get to know | |
| | | how to implement projects related to climate change | |
| | | There should also be strategies to train various | |
| | | individuals on environment and climate change and if | |
| | | possible this can be introduced in schools | |
| 7 | MININFRA | There is need for awareness campaigns to be organized | 2 |
| | | so that those who conduct projects on soil may do so | |
| | | not destroyed | |
| | | Hiring inspectors to monitor the environmental impact | |
| | | of some projects | |
| 8 | RDB | Increasing awareness of responsible people at all levels; | 3 |
| | | Encourage public transport instead of individual | |
| | | transport development; | |
| 0 | METEO | Frequent mobilization of people Focus on key institutions such as PTDA for Transport | 3 |
| 7 | | MINISANTE for health MINAGRI for agriculture | 5 |
| | | Each institution should appoint a focus staff for climate | |
| | | change domain. | |
| | | Increase the collaboration among institutions | |

| 10 | FONERWA | There should be effective knowledge sharing mechanism by introducing something like a platform which disseminates information in such a way that everyone can easily get information pertaining to climate change. There is need to organize mobilization campaigns at private institutions and among residents in general to teach them the benefits of protecting the environment and how they should play their role in combating the impacts resulting from climate change | 2 |
|----|------------------------------|---|---|
| 11 | RWANDA | There is need to train all those institutions to equip them | 1 |
| | MINES, | with skills to confront the effects of climate change as | |
| | PETROLEUM& | so that when rain fall reduced they may have water to use | |
| | GAS BOARD | and irrigate crops during dry season to keep their plants healthy | |
| 12 | RLMUA | Enforcement of laws and policies related to climate change or environment protection Awareness of institutions collaboration(NGO, Private and Public institutions) Align environment protection laws to new planning and land management | 3 |
| 13 | RWANDA | Increase capacity building; | 2 |
| | FOREST | Collaboration among institutions | |
| | AUTHORITY | | |
| 14 | RWANDA WATER AUTHORITY | To increase partners on sector of environment and climate change; Increase trainings on institutions related with environment and climate change; Building strong collabolation between national level institutions and local government even with citizens to deal with climate change | 2 |
| 15 | REMA | Research and evidence based long term planning | 1 |
| 16 | RAB | To organize training sessions for them on climate change so that both public and private sector can have technical knowledge related to climate change. To provide people who only deal with environment and climate change and build their strong capacity and make supervision on them to check if those activities are working well To provide motivations like competition between institutions both private and public to check which institution is providing good measures to protect environment and fight against the consequences caused by climate change to be awarded at national level | 2 |

The table above shows what the institutions have to do to improve the institutional capacities to deal with adverse impacts of climate change, the grading was according to the mentioned activities. Apparently there is no institution that was graded zero because all of the them had some activities proposed. A minimum of one activity was allocated a point, 2 activities 2 points
3 and more than 3 activities were allocated 3 points more than 5 activities were allocated 4 which is the maximum.

| S/N | INSTITUTION | Points in different aspects that were interviewed | TOTAL GRADS OUT OF 20 | I = (0 - 10%); 2 = (11 - 20%); 3 = (21 - 30%); 4 = (31 - 40%); 5 = (41 - 50%); 6 = (51 - 60%); 7 = (61 - 70%); |
|-----|----------------------------|---|-----------------------------|--|
| | | 2 - 2 - 2 - 1 - 2 - 1 | F F 9/ | 8 = (71 - 80%); 9 = (81 - 90%); 10 = (91 - 100%) |
| I | | 2+3+2+1+3-11 | 55% | 0 |
| 2 | MINEDUC | 3 + 2 + 2 + 1 + 2 = 10 | 50% | 5 |
| 3 | MINAGRI | 2 + 3 + 3 + 1 + 1 = 10 | 50% | 5 |
| 4 | MINALOC | 2 + 2 + 2 + 1 + 3= 10 | 50% | 5 |
| 5 | MINEMA | + + 2 + + 2 = 7 | 35% | 4 |
| 6 | MOE | 3 + 2 + 2 + 1 + 2 = 10 | 50% | 5 |
| 7 | MININFRA | 3 + 3 + 2 + 2 + 2 = 12 | 60% | 6 |
| 8 | RDB | 3 + 3 + 2 + 4 + 3 = 15 | 75% | 8 |
| 9 | METEO | + 3 + 3 + 0 + 3 = 10 | 50% | 5 |
| 10 | FONERWA | + + + +2 = 6 | 30% | 3 |
| | RWANDA MINES, | 0 + 2 + 1 + 1 + 1 = 5 | 25% | 3 |
| | PETROLEUM&GAS | | | |
| | BOARD | | | |
| 12 | RLMUA | 0 + 1 + 3 + 0 + 3 = 7 | 35% | 4 |
| 13 | RWANDA FOREST AUTHORITY | 0 + 1 + 1 + 0 + 2 = 4 | 25% | 3 |
| 14 | RWANDA WATER AUTHORITY | 0 + 1 + 2 + 0 + 2 = 5 | 25% | 3 |
| 15 | REMA | 2+0+3+4+1=10 | 50% | 5 |
| 16 | RAB | 2 + 3 + 2 + 1 + 2 = 10 | 50% | 5 |

Table 52: A summary of institutional grades on climate change

Source: Baseline survey, December 2020

The table above gives the summary of the scores allocated to different institutions where I = (0 - 10%); 2 = (11 - 20%); 3 = (21 - 30%); 4 = (31 - 40%); 5 = (41 - 50%); 6 = (51 - 60%); 7 = (61 - 70%); 8 = (71 - 80%); 9 = (81 - 90%) and 10 = (91 - 100%). It is observable that RDB was accorded the highest score with 8 followed by MININFRA and MINECOFIN with 6, MINEDUC, MINAGRI, MINALOC, MOE, METEO, REMA and RAB with a score of 5, MINEMA and RLMUA with a score of 4, lastly FONERWA, Rwanda Forest Authority and Rwanda Water Authority had a score of 3.

6. ASSESSMENT OF PROJECT INDICATORS

Indicator assessment

Assessment of the original project indicators was conducted. The results of this assessment was used to inform the development of amended indicators in this baseline report, all baselines were amended to zero values. In this methodology, only the activities of the projects are measured and the targets cannot be met through the interventions of other initiatives. The indicator is therefore specific. However, as the baseline value is zero it does not capture the activities of other initiatives. This information is summarised in the text below each amended indicator to prevent a duplication of efforts and provide more information on the current conditions on the ground. Thus, the text below each indicator is important to understand the baseline situation for each indicator.

Outcome I: Technical and institutional capacity for the NAP process in Rwanda strengthened using up-to-date climate information.

<u>Proposed Outcome 1 indicator</u>: Increase in adaptation planning capacities among national staff across sectors, districts- and catchment-level committees and senior high school teachers in the four catchments targeted by the project.

| Indicator | | Baseline | Target | Comments | Means of verification and tracking progress |
|-----------|---|---|---|---|--|
| Original | I.I NAP technical working group (TWG) established | - Rio convention Committee; - Technical committee on Clean Development Mechanism; Global Environment Committee | Members of the TWG should include staff from METEO Rwanda, RDB, RLMUA, relevant ministries and departments (e.g., MINAGRI and REMA), and catchment committees (associated with the four catchments) under project, and district water user associations (WUAs). | Baseline updated | Physical examination and progress reports |
| Amended | NAP technical working group (TWG) established and operational | 0 working group established. | I NAP technical working group established and operational. | The NAP Technical Working Group should be upadated. | Minutes of meetings |

Activity: 1.1 NAP technical working group (TWG) established

A NAP technical working group (TWG) will be set up under the proposed project to oversee the development of climate risk assessments, adaptation planning and climate change mainstreaming in four catchments in Rwanda. The TWG will comprise representatives from: i) METEO Rwanda; ii) relevant ministries and departments – such as MINAGRI and REMA; iii) district water user associations (WUAs) and catchment committees (from districts representative of the four catchments) formed under the NDC adaptation priority action of establishing a national integrated water resource management (IWRM) framework; and iv) relevant authorities, CSOs and NGOs from the four catchments¹⁰⁷. Selection of the four catchments was based on the location of five EbA pilot sites representative of the country's different biophysical conditions – under the project's long-term research programme (LTRP of Output 2.3). These pilot sites were selected during the PPG phase based on multiple criteria related to vulnerability – including poverty and the presence of climate and non-climate related threats.

| Indicator | | Baseline | Target | Comments | Means of |
|-----------|---|--|---|--|--|
| | | | | | and tracking |
| | | | | | progress |
| Original | 1.2 Downscaled catchment- level climate projections for Rwanda developed Downscaled climatic projections for the four catchments generated. Staff trained to downscale climatic projections for the four catchments | 0 downscaled climatic projections for the four catchments generated. ✓ Availability of Automatic Weather Stations (AWS) and 30 rainfall gauges across the country; ✓ Availability of installed SADIS software for the downscaling of climate projections; ✓ development of an EWS system in a pilot site in the Gishwati area. ✓ Meteo | I report on downscaled climate projections for the four catchments prepared. | The trainings on prediction of future climatic conditions using regional and GCM models should be organized. There is a need to select the best models to be using in predicting future climatic conditions over Rwanda. | progress Project progress report |
| | | Rwanda has access to Numerical Weather Prediction (NWP). | | | |

Activity: 1.2 Downscaled catchment-level climate projections for Rwanda developed

Rwanda, through METEO Rwanda, is increasing its technical and institutional capacity to address climate change at both national and local levels. The country has initiated the development of a climate information system through the AAP- and LDCF-funded initiatives entitled "Supporting Integrated and Comprehensive Approaches to Climate Change Adaptation in

 $^{^{\}rm 107}$ It is recommended that the TWG has at least 50% female representation.

Africa – Building a Comprehensive National Approach in Rwanda" and "Reducing Vulnerability to Climate Change by Establishing Early Warning and Disaster Preparedness Systems and Support for Integrated Watershed Management in Flood-prone Areas", respectively. These projects contributed to the: i) installation of 22 Automatic Weather Stations (AWS) and 30 rainfall gauges across the country; ii) implementation of a data analysis system, including the provision of material and training related to the analysis of weather data to METEO Rwanda staff; iii) installation of SADIS software for the downscaling of climate projections; and iii) development of an EWS system in a pilot site in the Gishwati area. Therefore, the same should be duplicated at NAP pilot sites. Moreover, there is a need to validate the most appropriate appropriate regional models to be use in predicting future climate conditions over Rwanda in general aand at specific regions particularly.

| Indicator | | Baseline | Target | Comments | Means of verification and tracking progress |
|---------------------|--|---|---|--|--|
| Original Amended | 1.3 Climate risk assessments for four catchments in Rwanda developed Climate risk assessment conducted for four catchment areas under project intervention. | 0 0 report for climate risk assessment for four catchment areas. | I Report for climate risk assessment for four catchment | Soil properties, slopes and rocks analysis should be conducted prio to the climate risk assessments. The data from vulnerability index assessment conducted in 2018 will used during climate risk assessments. | Climate risk assessment document/report. |

| 1.3 C | Climate risk | assessments | for f | our ca | tchments | in | Rwanda | devel | oped |
|-------|--------------|-------------|-------|--------|----------|----|--------|-------|------|
|-------|--------------|-------------|-------|--------|----------|----|--------|-------|------|

Long-term adaptation planning requires detailed information on climate change risks. These risks include first-order biophysical impacts, based on fine-scale climate projections, and second-order socio-economic impacts, based on risk assessments. During the proposed project, climate risk assessments will be developed for four catchments representing Rwanda's varied biophysical conditions (see Output 1.1 for more information on catchment selection). The experience will be used to develop guidance notes and recommendations that can be used for risk assessments in catchments across the rest of the country.

| 1.4 C | CA | strategies | developed | for the | e four | catchments | based | on climate | e risk | assessment | s |
|-------|----|------------|-----------|---------|--------|------------|-------|------------|--------|------------|---|
|-------|----|------------|-----------|---------|--------|------------|-------|------------|--------|------------|---|

| Indicator | | Baseline | Target | Comments | Means of verification and tracking progress |
|-----------|--|----------|---|---|--|
| Original | I.4 CCA strategies developed for the four catchments | 0 | I Report for climate change adaptation strategies for four catchment areas | Climate risk assessment should be conducted to be able to | CCA strategies document/report |

| | based on climate risk assessments | | under project intervention. | develop CCA strategies at four catchments | |
|---------|--|---|--------------------------------|--|--|
| Amended | Climate change adaptation strategies developed for four catchment areas under project intervention. | 0 Report for climate change adaptation strategies for four catchment areas under project intervention. | | area under project interventions. | |

1.5 CCA measures from catchment-level adaptation strategies extrapolated to the national level to develop adaptation plans for priority economic sectors (Agriculture, Infrastructure, Urbanisation and Landuse Management as indicated in National Strategy for transformation

| Indicator | | Baseline | Target | Comments | Means of verification and tracking progress |
|-----------|--|---|---|--|--|
| Original | 1.5 CCA measures from catchment-level adaptation strategies extrapolated to the national level to develop adaptation plans for priority economic sectors (Agriculture, Infrastructure, Urbanisation and Landuse Management as indicated in National Strategy for transformation | 0 | - Extrapolate CCA options from four catchment- level adaptation strategies | | Physical examination and progress reports |
| Amended | National climate change adaptation strategies developed for priority sectors (Agriculture, Infrastructure, and Land use Management as indicated in National Strategy for transformation). | 0 report for national climate change adaptation strategies for priority sectors (Agriculture, Infrastructure, and Land use Management as indicated in National Strategy for transformation). | 3 reports for national climate change adaptation strategies for priority sectors (Agriculture, Infrastructure, and Landuse Management as indicated in National Strategy for transformation). | There is a need to conduct first of all a climate risk assessment, develop CCA strategies at four catchment areas to be scaled up at national level. The development of national adaptation plans to come after. | National climate change adaptation strategies documents/reports |

The estimation of costs required for medium- to long-term adaptation planning at the national-level requires information on the cost-effectiveness and technical feasibility of CCA options at four catchment areas. This information will be scaled up at national level and be used in preparation of national adaptation plans for priority economic sectors (Agriculture, Infrastructure, Urbanisation and Landuse Management as indicated in National Strategy for transformation).

1.6 Refinement of National Determined Contributions (NDC) adaptation priorities related to the sectoral adaptation plans and Long term research program (LTRP)

| Indicator | | Baseline | Target | Comments | Means of verification and tracking |
|-----------|--|--|--|--|--|
| Original | Refinement of National Determined Contributions (NDC) adaptation priorities related to the sectoral adaptation plans and Long term research program (LTRP). | 0 | Convene a two-day workshop for national members of the TWG, LTRP members and other relevant stakeholders to identify how NDC priorities related to adaptation measures implemented through the LTRP and sectoral adaptation plans. | | Physical examination and progress reports |
| Amended | Adaptation actions from NDC across different sectors refined | 0 report on refined adaptation actions from NDC across different sectors (e.g. water, agriculture, land and forestry, human settlements, health, etc) at five pilots sites. | I report on refined adaptation actions from NDC across different sectors (e.g. water, agriculture, land and forestry, human settlements, health, etc) at five pilots sites. | The published NDC in 2020 will be referenced to identify priorities related to adaptation measures/actions implemented through the LTRP and sectoral adaptation plans | Report on refined adaptation actions. |

Based on the adaptation measures included in the sectoral adaptation plans developed under Output 1.5 and LTRP of Output 2.3, relevant NDC adaptation priorities will be identified for the refinement of descriptions, targets and implementation arrangements. This will be conducted in consultation with national members of the TWG, representatives from the LTRP and relevant government ministries. Guidelines for the refined NDC adaptation priorities will be developed based on the CCA measures implemented and researched under the LTRP, as well as those of the sectoral adaptation plans. Costs based on those calculated for the sectoral adaptation plans will be used to provide cost estimates for the implementation CCA measures associated with the relevant NDC priorities. The guidelines will also provide the information required for the implementation of appropriate CCA measures throughout Rwanda with the objective of meeting refined NDC targets. 1.7 Develop training manuals and conduct awareness-raising events for public, private sectors, Civil Society Organisations CSOs and local communities on the NAP process

| Indicator | | Baseline | Target | Comment s | Means of verification and tracking progress |
|-----------|--|---|--|--|--|
| Original | 1.7 Develop training manuals and conduct awareness-raising events for public, private sectors, Civil Society Organisations CSOs and local communities on the NAP process. | Department of Environmental Education and Mainstreaming (DEEM), training campaigns have been conducted . | identifying relevant fora through which awareness-raising on relevant risk assessments and catchment-level CCA strategies | | Physical examination and progress reports |
| Amended | Trainings conducted in raising the awareness for public and private sectors, CSOs and local communities on the NAP process Staff trained on NAP process | 0 trainings to raise the awareness for public and private sectors, CSOs and local communities on the NAP process. 0 trained staff on NAP process | 5 trainings to raise the awareness for public and private sectors, CSOs and local communities on the NAP process. | The training manuals should be prepared and select stakeholders from public, private sectors, Civil Society Organisations CSOs and local communities to be trained | Training reports |

Under Component I, the technical and institutional capacity to produce and use climate information necessary to advance the NAP process in Rwanda will be strengthened. This will entail: i) establishing a technical working group (TWG); ii) developing downscaled catchment-level climate projections for four catchments; iii) undertaking climate risk assessments for four catchments in Rwanda; iv) designing CCA strategies for four catchments based on climate risk assessments; v) extrapolating CCA measures from catchment-level adaptation strategies to the national level to facilitate the development of adaptation plans for priority economic sectors¹⁰⁸; vi) refining NDC adaptation priorities related to sectoral adaptation plans; and vii) producing training manuals and organising awareness-raising events on the NAP process.

Outcome 2: Climate-resilient technologies and practices adopted and scaled up

<u>Proposed Outcome 2 indicator:</u> Number of pilot sites established under the LTRP to conduct research on the financial and economic effectiveness of Ecosystem Based Adaptation (EbA); number of people benefitting from adaptation technologies and practices implemented at pilot sites; area of land (ha) managed sustainably for long-term adaptation at the pilot sites; and number of adaptation measures/technologies scaled up for sustainable long-term use.

2.1 A NAP funding strategy developed

| Indicator | Baseline | Target | Comments | Means verification | of |
|-----------|----------|--------|----------|-----------------------|----|
|-----------|----------|--------|----------|-----------------------|----|

¹⁰⁸ These sectors will be identified by the NAP TWG based on risk assessments and catchment level-adaptation plans and measures.

| | | | | | and tracking |
|----------|---|---|---|--|---|
| | | | | | progress |
| Original | 2.1 A NAP funding strategy developed | REMA in coordination with UNDP developed Public Expenditure Review for Environment and Climate Change (PERECC) for Rwanda (2008- 2012 | in i) central, provincial and district government (and programmes implemented by the government); ii) public autonomous and semi-autonomous agencies; iii) private firms, NGOs and CBOs; and iv) communities and end-users | | Physical examination and progress reports |
| Amended | A NAP funding strategy developed. | A NAP funding strategy developed | 0 NAP funding strategy produced | I NAP funding strategy report developed and disseminated. | NAP funding strategy documents/reports |

2.2 Recommendations for relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed

| Indicator | | Baseline | Target | Comments | Means of verification and |
|-----------|---|--|---|---|--|
| | | | | | tracking |
| Original | 2.2 Recommendations for relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed | | FWG meeting convened to develop a set of recommendations for each of the three selected ministries to mainstream the operationalisation of the sectoral adaptation plans | | Physical examination and progress reports |
| Amended | Recommendations for three relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed. | 0 reports of recommendatio ns developed and shared with relevant ministries to mainstream the operationalisati on of the sectoral adaptation plans and budget for them. | 3 reports of recommendations developed and shared with relevant ministries to mainstream the operationalisation of the sectoral adaptation plans and budget for them. | The recommendati ons will be formulated after developing CCA strategy and national adaptation plans. | Project progress reports |

2.3 Long-term research programme established to address gaps in knowledge needed to inform adaptation planning and funding in Rwanda

| Indicator | Baseline | Target | Comment | Means | of |
|-----------|----------|--------|---------|--------------|-----|
| | | _ | s | verification | and |
| | | | | tracking | |
| | | | | progress | |

| Original | 2.3 Long-term | | - FWG meeting | | Physical examination |
|----------|------------------|-----------------------|-----------------------|----------------------------|-----------------------|
| | research | | convened to | | and progress reports |
| | programme | | develop a set of | | |
| | established to | | recommendations | | |
| | address gaps in | | for each of the | | |
| | knowledge | | three selected | | |
| | needed to | | ministries to | | |
| | Inform | | mainstream the | | |
| | adaptation | | of the sectoral | | |
| | funding in | | adaptation plans: | | |
| | Rwanda | | - Establish a LTRP | | |
| | u | | between the UR | | |
| | | | and MoE to bridge | | |
| | | | the gaps in | | |
| | | | knowledge related | | |
| | | | to CCA options | | |
| Amende | MoU between | 1 MOUs signed | I signed MoUs | Researches | Signed MoUs |
| Ь | REMA and | between UR and | between REMA and | related to can | between REMA and |
| 2 | HEC/high | MOF | HEC/high learning | be improved | HEC/high learning |
| | learning | MOL. | institutions. | by improving | institutions. |
| | inations | | | the | |
| | institutions | | | botwoon | |
| | signed for | | | LIR/research | |
| | establishing | | | institutions | |
| | long-term | | | and | |
| | research | | | REMA/MOE, | |
| | programme | | | donors and | |
| | ostablishod | | | development | |
| | established | | | partners, UN | |
| | | | 5 research | agencies | Research |
| | Research | 0 research | reports/articles/pape | together with | reports/articles/pape |
| | produced in | reports/articles/pape | rs to be published in | Civil Society | rs |
| | collaboration | rs published in | collaboration | Organizations | |
| | between | collaboration | and high loarning | (national, rogional and | |
| | MOF/REMA | between MOF/RFMA | institutions/high | international | |
| | | and high learning | Education Council | NGOs) local | |
| | and nigh | institutions/high | | community | |
| | learning | Education Council | | and media. | |
| | institutions/hig | Education Council. | | | |
| | h Education | | | | |
| | Council. | | | | |
| | | | | | |
| | | | | | |

2.4 A suite of EbA interventions implemented at LTRP pilot sites

| Indicator | | Baseline | Target | Comments | Means of verification and tracking progress |
|-----------|--|---|---|----------|--|
| Original | 2.4 A suite of EbA interventions implemented at LTRP pilot sites | i) Shagasha Tea Factory/Estate in Rusizi District; ii) Kimicanga wetland in Kigali; iii) Muvumba river in Nyagatare District; iv) Savannas of the Nyagatare | FWG meeting convened to develop a set of recommendations for each of the three selected ministries to mainstream the operationalisation of the sectoral adaptation plans | | Physical examination and progress reports |

| Amended | Area covered by EbA interventions implemented in pilot sites based pilot sites | District; and v) Ibanda-Makela Natural Forest in Kirehe District 0 ha covered by EbA interventions in Five pilot sites (e.g. Ibanda- Makela Natural Forest, Muvumba river, Eastern Savannah in the Nyagatare | Muvumba River EbA intervention on I 100 ha. Eastern Savannah interventions on 200 ha Ibanda Makera forest interventions on 2500 ha. | Project activities implemented at pilot sites based on LTRP program. | Project progress reports. |
|---------|---|---|---|--|------------------------------|
| | | Nyagatare District; Nyangungu wetland and Shangasha Tea Estate. | on 2500 ha. Nyandungu EbA interventions on 50 ha. Shagasha EbA interventions on 1100 ha. | | |

2.5 Strengthened awareness of the private sector on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA

| Indicator | | Baseline | Target | Comments | Means of verification and tracking progress |
|-----------|---|--|---|--|--|
| Original | 2.5 Strengthened awareness of the private sector on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA. | i) downscaled climate projections and risk assessments conducted under Outputs 1.2 and 1.3; and ii) the proof of concept and business case for EbA resulting from Output 2.3's LTRP | climate change vulnerability of the three priority economic sectors for which adaptation plans were developed under Output 1.5. | | Physical examination and progress reports |
| Amended | Awareness campaigns/ meetings for private sector undertaken on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA. | 0 awareness campaign/meetings organized | 3 awareness compaign/meet ings to be organized for strengthening awareness of the private sector on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, | Regional models should be used to predict future climatic conditions at project sites Building capacity for public and private partners in risk assessments conducted and CAA strategy developed | Campaign/meeti ng reports. |

| | to stimulate the | |
|--|------------------|--|
| | implementation | |
| | of CCA. | |

Under Component 2, climate-resilient practices and technologies will be adopted and scaled up. This will include: i) updating the 2013 Public Expenditure Review for Environment and Climate Change (PERECC)¹⁰⁹ through the conduction of a Climate Public Expenditure and Institutional Review (CPEIR)¹¹⁰ to determine available climate finance and assess the effectiveness of climate expenditures to date, determining funding gaps related to sectoral adaptation plans and developing a NAP funding strategy for Rwanda; ii) providing recommendations to relevant ministries on the mainstreaming of CCA into their budgeting and planning processes; iii) establishing a long-term research programme (LTRP) sites – to address gaps in knowledge required to inform the design of adaptation plans, selection of appropriate measures and the funding of CCA in Rwanda; iv) implement landscape-level EbA pilot in four selected catchments; and v) building awareness of the private sector on future climate scenarios, national priorities and investment opportunities related to increasing the climate-resilience of businesses.

Outcome 3: Monitoring, reviewing and knowledge-sharing framework developed to learn from the NAP process in Rwanda

<u>Proposed Outcome 3 indicator:</u> Number of adaptation outcome-level indicators revised and developed to inform the monitoring of adaptation in Rwanda

| Indicator | Outcome indicator | Baseline | Targets | Comments | Means of verification and tracking progress |
|-----------|--|---|--|---|--|
| Original | 3.1 A framework for the monitoring of long-term CCA outcomes developed | Monitoring and Evaluation (M&E) systems have been developed for EDPRSI, GGCRS, EDPRS2 and more recently NST1 | Increase the institutional capacity to monitor the NAP process in Rwanda | | Physical examination and progress reports |
| Amended | Framework for the monitoring and evaluating long-term CCA outcomes developed | 0 framework established for monitoring evaluationg long- term CCA outcomes developed. ✓ The project management established (e.g. project manager and SPIU | I framework established for monitoring evaluating long- term CCA outcomes developed. | UN Environment standard monitoring, reporting and evaluation processes and procedures will be followed. Substantive and financial project reporting requirements will be | Project progress reports |

3.1 A framework for the monitoring of long-term CCA outcomes developed

2008–2012. UNEP and REAM. Final report.

¹⁰⁹ Kazura, C. 2013. Public expenditure review for environment and climate change for Rwanda,

¹¹⁰ Climate Public Expenditure and Institutional Review.

| coordinator) is | followed as | |
|------------------|--------------|--|
| available within | presented in | |
| REMA and | Funding | |
| oversight by | proposal | |
| REMA | | |
| management | Reporting | |
| authority. | requirements | |
| ✓ I Monitoring | presented in | |
| and Evaluation | Funding | |
| specialist for | project | |
| NAP process | be also | |
| was appointed. | followed | |
| ✓ I task manager | | |
| from UNEP | | |
| was appointed | | |
| for the | | |
| implementation | | |
| of NAP in | | |
| Rwanda. | | |

| 3.2 | Adaptation | actions/ | plans | mainstreamed | into | the | main | sectoral | and | development | monitoring |
|------|------------|----------|-------|--------------|------|-----|------|----------|-----|-------------|------------|
| fran | neworks | | | | | | | | | | |

| Indicat | | Baseline | Target | Comments | Means of |
|----------|--|---|--|---|--|
| or | | | _ | | verification and |
| | | | | | tracking progress |
| Original | 3.2 Adaptation indicators mainstreame d into the main sectoral and developmen t monitoring frameworks | | Development of a training manual on public financial management systems; Conduction of financial literacy training events for financial and environmental specialists | | Physical examination and progress reports |
| Amended | Adaptation indicators mainstreame d into the main sectoral and developmen t monitoring frameworks. | 0 adaptation indicators, financial management systems related to the NAP process. | 3 reports on mainstreamed adaptation indicators into the main sectoral and development monitoring frameworks | Collaboration between various governmental and non-govermental institutions will be needed to be able to mainstream adaptation indicators/actions/pla ns into national sectoral and development frameworks and strategies. | Project progress reports |

3.3 Provide progress reports and communication material to learn from the formulation, implementation, funding and monitoring of the NAP process

| Indicator | | Baseline | Target | Comments | Means of |
|-----------|---------------------|----------------------------|----------------|---------------------------|---------------|
| | | | • | | verificatio |
| | | | | | n and |
| | | | | | tracking |
| | | | | | progress |
| Original | 3.3 Adaptation | no system in | A well- | | Physical |
| _ | indicators | place for | structured | | examinati |
| | mainstreamed | strategically | knowledge | | on and |
| | into the main | documenting | managemen | | progress |
| | sectoral and | and | t system | | reports |
| | development | assimilating | under the | | |
| | monitoring | the | NAP | | |
| | frameworks | successes, | process will | | |
| | | failures and | benefit the | | |
| | | lessons | design and | | |
| | | learned from | implementa | | |
| | | these | tion of all | | |
| | | initiatives. | future | | |
| | | | adaptation | | |
| | | | initiatives in | | |
| | | | Rwanda | | |
| Amended | Progress reports | 0 progress | 3 Progress | UN Environment | Communicat |
| | produced on NAP | report on NAP | reports | standard monitoring, | ion materials |
| | process. | process. | produced. | processes and | |
| | Communication | 0 communication | | procedures will be | |
| | materials produced | material | I | followed. Substantive and | |
| | to disseminate | produced to | Communicatio | reporting requirements | |
| | successes, failures | disseminate | n material to | will be followed as | |
| | from NAP process | successes, failures and | disseminate | presented in Funding | |
| | in Rwanda. | lessons learnt | successes, | project proposal | |
| | | from NAP | tailures and | Reporting requirements | |
| | | process in | from NIAP | and templates presented | |
| | | Kwanda. | | in Funding project | |
| | | | Rwanda | followed | |
| | | | | All these will be aligned | |
| | | | | with the existing | |
| | | | | and Evaluation system | |
| | | | | within REMA. | |

Under Component 3 of the proposed project, the capacity for monitoring, reviewing and sharing knowledge under the NAP process will be increased. This will entail: i) developing a framework to monitor the effectiveness of NAP process; ii) strengthening the technical and institutional capacity in Rwanda to assess the effectiveness of adaptation outcomes in Rwanda; and iii) producing progress reports and communication material on the NAP process.

7. REVISED RESULTS FRAMEWORKS

| Objective | Indicator | Unit of | Baseline | Target | Mode of |
|----------------------------|--|-------------|--|---|---------------------|
| | | measure | | | Verification |
| Project objective | Objective indicator | Rate | Majority of investigated institutions scores | I. Increase of at least 7 points in the | Scores awarded |
| Increased capacity of | Degree to which the technical and | | between 3-5 points at each level of | capacity score at each level. | to the selected |
| governmental | institutional capacity of targeted | | performance in NAP process. | (Max 10, Min 0). | institutions and |
| authorities and local | governmental institutions, district- | | | | beneficiaries in |
| communities in Rwanda | level stakeholders and local | | | | terms of |
| to plan, fund, implement | communities is strengthened at | | | | institutional |
| and monitor climate | national and sub-national levels to | | | | capacity to |
| change adaptation | advance Rwanda's NAP process. | | | | integrate NAP |
| solutions in the medium | | | | | process. |
| to long-term. | | | | | |
| Outcome I | Outcome indicators | Percentage | Majority of investigated institutions scores | I. Increase of at least 7 points in the | Training report |
| Technical and | Increase in adaptation planning | | between 3-5 points at each level of | capacity score at each level. | |
| institutional capacity for | capacities among national staff | | performance in NAP process. | (Max 10, Min 0 | |
| the NAP process in | across targeted governmental | | | | |
| Rwanda strengthened | institutions, district- and catchment-level committees and | | | | |
| using up-to-date climate | senior high school teachers in the | | | | |
| information. | five project sites. | | | | |
| | | | | | |
| Output LL NAD to shaind | NAD to shall we also a man | Nhumber | . Our gling group optichlished | L NIAD to shall working move | Minutes |
| Output 1.1 NAP technical | TNAP technical working group | Number | • 0 working group established. | I INAP technical working group | Minutes of meetings |
| working group (TVVG) | (TVVG) established and | | | established and operational | meetings |
| established | operational | | | | D |
| Output 1.2 Downscaled | Downscaled climatic projections | Number and | \checkmark 0 downscaled climatic projections for the | I report on downscaled climate | Project progress |
| catchment-level climate | for the four catchments | qualitative | four catchments generated. | projections for the four catchments | report |
| developed | generated. | | ✓ Availability of Automatic | prepared. | |
| developed <u>.</u> | | | Weather Stations (AWS) and 30 | | |
| | | | rainfall gauges across the | | |
| | | | country; | | |
| | | | ✓ Availability of installed SADIS | | |
| | | | software for the downscaling of | | |
| | | | climate projections; | | |

| | | | ✓ Development of an EWS system | | |
|-------------------------------|-------------------------------------|----------|---|---|--------------------|
| | | | in a pilot site in the Gishwati area. | | |
| | | | ✓ Meteo Rwanda has access to | | |
| | | | Numerical Weather Prediction | | |
| | | | (NWP). | | |
| | Staff trained to downscale climatic | Number | $\checkmark 0$ trained staff to downscale climatie | 6 staff tained to downscale climatic | Training reports |
| | projections for the four | | projections for four catchments | projections for four catchments | |
| | catchments | | | | |
| | | | | | |
| Output 1.3 Climate risk | Climate risk assessment | Number | ✓ 0 report for climate risk assessment for | I Report for climate risk assessment | Climate risk |
| assossments for four | conducted for four cathment | i tumber | four cathment areas | for four catchement | assessment |
| | areas under project | | | | document/report |
| catchments | intervention | | | | |
| | | | | | |
| Output I.4: CCA | Climate change adaptation | Number | \checkmark 0 Report for climate change adaptation | ✓ I Report for climate change | CCA strategies |
| strategies developed for | strategies developed for four | | strategies for four catchment areas under | adaptation strategies for four | document/report |
| four catchments based on | catchment areas under project | | project intervention. | catchment areas under project | |
| climate risk assessments. | intervention | | | intervention. | |
| | | | | | |
| Output 1.5: CCA | National climate change | Number | \checkmark 0 report for national climate change | ✓ 3 reports for national climate change | National climate |
| measures from catchment- | adaptation strategies developed | | adaptation strategies for priority sectors | adaptation strategies for priority | change adaptation |
| level adaptation strategies | for priority sectors (Agriculture, | | (Agriculture, Infrastructure, and Land use | sectors (Agriculture, Infrastructure, | strategies |
| extrapolated to the national | Infrastructure, and Land use | | Management as indicated in National | and Land use Management as | documents/reports |
| level to develop adaptation | Management as indicated in | | Strategy for transformation). | indicated in National Strategy for | |
| plans for three priority | National Strategy for | | | transformation). | |
| economic sectors. | transformation). | | | | |
| | | | | | |
| Output 1.6: | Adaptation actions from NDC | Number | 0 report on refined adaptation actions from | I report on refined adaptation actions | Report on refined |
| Refinement of NDC | across different sectors refined | | NDC across different sectors (e.g. water, | from NDC across different sectors | adaptation actions |
| adaptation priorities related | | | agriculture, land and forestry, human | (e.g. water, agriculture, land and | |
| to the sectoral adaptation | | | settlements, health, etc) at five pilots sites. | forestry, human settlements, health, | |
| plans and LTRP | | | | etc) at five pilots sites. | |
| Output 1.7: | Trainings conducted in raising the | Number | 0 trainings to raise the awareness for public | 5 trainings to raise the awareness for | Training reports |
| | awareness for public and private | | and private sectors, CSOs and local | public and private sectors, CSOs and | |

| Training manuals and awareness-raising events for public and private sectors, | sectors, CSOs and local communities on the NAP process | | communities on the NAP process. | local communities on the NAP process. | |
|---|---|--------|--|---|--|
| CSOs and local communities on the NAP process. | Staff trained on NAP process | Number | 0 trained staff on NAP process | 150 trained people. | Training reports |
| Outcome 2 Climate-resilient technologies and practices adopted and scaled up. | Outcome indicator Pilot sites established under the LTRP to conduct research on the financial and economic effectiveness of EbA; | Number | ✓ 5 EbA pilot sites in four catchments established. | Five EbA pilot sites in four catchments established. | Project progress reports |
| | Project beneficiaries helped to adopt adaptation technologies and practices to climate change at the five EbA pilot sites. | Number | 0 people who have been benefiting from adaptation technologies and practices implemented by NAP | At least 20,000 people (50% of which are women) from five cells (4,000 per cell) benefiting from adaptation technologies and practices implemented at the | Project progress reports |
| | Land managed sustainably for long-term adaptation at the pilot sites. | Ha | 0 hectares managed sustainably for long- term adaptation at the pilot sites. | 6000 hectares of land managed sustainably for long-term adaptation at the LTRP's pilot sites by the end of the project's implementation period. | Project progress reports |
| Output 2.1 A NAP funding strategy developed. | A NAP funding strategy developed | Number | 0 NAP funding strategy produced | I NAP funding strategy report developed and disseminated. | NAP funding strategy documents/reports |
| Output 2.2 Recommendations for relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed | Recommendations for three relevant ministries on the mainstreaming of CCA into their budgeting and planning processes developed. | Number | 0 reports of recommendations developed and shared with relevant ministries to mainstream the operationalisation of the sectoral adaptation plans and budget for them. | 3 reports of recommendations developed and shared with relevant ministries to mainstream the operationalisation of the sectoral adaptation plans and budget for them. | Project progress reports |
| Galpat 2.5 Long-term | | Tumber | The signed between on and HOL. | i signed i 1003 between iten A and | Signed 1003 |

| research programme established to address gaps in knowledge needed to inform adaptation planning and funding in Rwanda | HEC/high learning institutions signed for establishing long-term research programme established Research produced in collaboration between MOE/REMA and high learning institutions/high Education Council | Number | 0 research reports/articles/papers published in collaboration between MOE/REMA and high learning institutions/high Education Council. | HEC/high learning institutions. 5 research reports/articles/papers to be published in collaboration between MOE/REMA and high learning institutions/high Education Council. | between REMA and HEC/high learning institutions. Research reports/articles/pa pers |
|---|--|------------|--|---|--|
| Output 2.4: EbA interventions implemented in five pilot sites based on CCA strategy and implementation protocol developed | Area covered by EbA interventions implemented in pilot sites based pilot sites | Ha | 0 ha covered by EbA interventions in Five pilot sites (e.g. Ibanda-Makela Natural Forest, Muvumba river, Eastern Savannah in the Nyagatare District; Nyangungu wetland and Shangasha Tea Estate. | Muvumba River EbA intervention on 1100 ha. Eastern Savannah interventions on 200 ha Ibanda Makera forest interventions on 2500 ha. Nyandungu EbA interventions on 50 ha. Shagasha EbA interventions on 1100 ha. | Project progress reports. |
| Output 2.5: Strengthened awareness of the private sector on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA. | Awareness campaigns/meetings for private sector undertaken on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA. | Number | 0 awareness campaign/meetings organized | 3 awareness campaign/meetings to be organized for strengthening awareness of the private sector on national adaptation priorities, future climate scenarios, risk assessments and investment opportunities, to stimulate the implementation of CCA. | campaign/meeting reports Project progress |
| Capacity for monitoring, reviewing and knowledge-sharing to | NAP process integrated in RBME | Quantative | though it is available in Ministry of Environment | | reports. |

| learn from the NAP | | | | | |
|-----------------------------|-------------------------------------|-------------|---|---------------------------------------|--------------------|
| process in Rwanda | | | | | |
| increased. | | | | | |
| Output 3.1: | Framework for the monitoring | Number and | 0 framework established for monitoring | I framework established for | Project progress |
| A framework for the | and evaluating long-term CCA | Qualitative | evaluating long-term CCA outcomes | monitoring evaluating long-term CCA | reports |
| monitoring of long-term | outcomes developed | | developed. | outcomes developed. | |
| CCA outcomes developed. | | | \checkmark The project management established (e.g. | | |
| | | | project manager and SPIU coordinator) is | | |
| | | | available within REMA and oversight by | | |
| | | | REMA management authority. | | |
| | | | \checkmark I Monitoring and Evaluation specialist for | | |
| | | | NAP process was appointed. | | |
| | | | I task manager from UNEP was appointed for | | |
| | | | the implementation of NAP in Rwanda. | | |
| | Staff in charge of monitoring and | Number | 0 staff in charge of monitoring and evaluation | 20 staff in charge of monitoring and | Training reports |
| | evaluation trained across different | | trained across different priority sectors | evaluation to be trained across | |
| | priority sectors | | | different priority sectors | |
| | | | | | |
| Output 3.2: | Adaptation indicators | Number | ✓ 0 adaptation indicators, financial | 3 reports on mainstreamed adaptation | Project progress |
| Adaptation indicators | mainstreamed into the main | | management systems related to the NAP | indicators into the main sectoral and | reports |
| mainstreamed into the main | sectoral and development | | process. | development monitoring frameworks | |
| sectoral and development | monitoring frameworks | | | | |
| monitoring frameworks. | | | | | |
| Output 3.3: | Progress reports produced on | Number | 0 progress report on NAP process. | 3 Progress reports produced. | Progress and final |
| Progress reports and | NAP process. | | | | project reports |
| communication material to | | | | | |
| learn from the formulation, | communication materials | Number | 0 communication material produced to | I Communication material to | Communication |
| implementation, funding and | produced to disseminate | | disseminate successes, failures and lessons | disseminate successes, failures and | materials |
| monitoring of the NAP | successes, failures and lessons | | learne from INAP process in Kwanda | lessons learned from NAP process in | |
| process | learnt from NAP process in | | | Rwanda | |
| | Rwanda | | | | |

8. PROJECT MONITORING AND EVALUATION ARRANGEMENTS

8.1. Monitoring and Evaluation Requirements

REMA as the Executing Entity of NAP, is responsible for ensuring that the project is implemented in accordance with the Funding Proposal and Fund Administration Agreement (FAA). As such, REMA will maintain and comply with an adequate system to monitor the performance of NAP and assure regular reporting from project management in the Subsidiary Agreement. Furthemore, the project will follow UN Environment standard monitoring, reporting and evaluation processes and procedures. Substantive and financial project reporting requirements are summarised in Appendix 8. Reporting requirements and templates are an integral part of the UN Environment legal instrument to be signed by the executing agency and UN Environment.

The Monitoring and Evaluation (M&E) plan of the project is consistent with the GEF M&E policy. The Project Results Framework presented SMART (specific, measurable, achievable, relevant and time-bound) indicators for each expected outcome as well as mid-term and end-of-project targets. The outcome-level indicators will be the main tools for assessing project implementation progress and whether project results are being achieved. The project will prepare Annual Progress Reports (APRs) including a narrative report on implementation progress based on the logical framework submitted in the Funding Proposal and considerations on the ongoing performance of the project against the Fund's investment framework criteria, including updates on the indicators as per the guidance provided by the Fund's results management framework.

The Project Steering Committee will receive periodic reports on progress and will make recommendations to UN Environment on the need to revise any aspects of the Results Framework or the M&E plan. The Task Manager (TM) is responsible for project oversight to ensure that the project complies with UN Environment and GEF policies and procedures. Project supervision will take an adaptive management approach. The emphasis of the Task Manager's supervision will be on monitoring outcomes, without neglecting financial management and monitoring of the project's implementation. Project risks and assumptions will be regularly monitored both by project partners and UN Environment. Risk assessment and rating is an integral part of the Project Implementation Review (PIR). The quality of project M&E will also be reviewed and rated as part of the PIR. The main financial parameters will be monitored quarterly to ensure effective use of financial resources.

The APR shall be submitted to by project partners and UN Environment on an annual basis for the period ending the relevant annual period. The budget and workplan, interim and final evaluation reports will be prepared and submitted to the relevant agencies as outlined in the Funding Proposal and FAA. An assessment of the performance of the project against the Fund's investment framework criteria, including financial/economic performances as part of the efficiency and effectiveness criterion, as well as the sustainability and scalability of results and impacts and lessons learned, during the relevant period. Moreover, these evaluation reports will be prepared by an independent evaluator selected by REMA and acceptable to the Fund. Copies of these reports will be forwarded by REMA to the funder (GCF) for information.

It is worth noting that the Monitoring, Evaluation and Reporting framework on adaptation options for Rwanda have been aligned with the options and the relevant analytics agreed to by various stakeholder consultations and responding to national strategic plans like Vision 2020, NSTI, GGCRS, 2030 and African Agenda 2063, SDGs and other sectorial strategic plans which are mainstreamed to Prime Minister and MINECOFIN offices. Assessment of adaptation options as well as their reporting framework demands periodic and timely data collection, analysis and overall management to ensure efficient reporting.

Furthermore, Monitoring, Evaluation and Reporting framework was made in line with a commitment towards the implementation of the Paris agreement with mitigation and adaptations actions. In the same framework, Rwanda has joined the NDC partnership and launched a plan during the Africa Green Growth Forum held in Kigali in November 2018. Rwanda has adopted the new Environmental law (Law No 48/2018 of 13/08/2018 on environment, in Official Gazette of 21/09/2018) that takes into account climate change more than the previous Environmental organic law. In addition, recently in June, 2019 a new National Environment and Climate Change Policy was enacted with the goal of achieving a climate resilient nation with a clean and heathy environment (MoE, 2019).

8.2. Monitoring and Evaluation Oversight and Responsibilities

The project will utilise and adapt REMA's established and operating framework and M&E procedures that have been used for other GCF funds awarded to REMA. Progress will be tracked against the milestones and the project's logframe which includes a complete set of indicators for monitoring project progress against key targets, both in terms of results and impact. Implementing partners (SPIU) will be responsible for reporting against the agreed indicators. Future disbursements will be considered in the light of the assessment of

performance against the milestones. The M&E systems will also contribute to learning and review of approaches in light of experience throughout the project lifetime to optimise performance and impact. Regular monitoring will take place through quarterly physical and financial progress reports against workplan and budget. These reports will provide an update on progress on the delivery of work stream and activities outputs contributing to the achievement of the project outcome.

The progress reports will be used to update work plans and budgets for the next quarter. The reports will also include lesson learning, a risk update and management and an ongoing assessment of sustainability and acceptance of project interventions by the stakeholders particularly the beneficiaries. At the end of each year an Annual Progress Review (APR) or lesson learning exercise to assess provisional impact will be undertaken at the project level. This is an internal exercise to be carried out by project implementers with support from the M&E Specialists as needed and may be outsourced for some activities (e.g. an annual gender assessment, for which the Gender Monitoring Office may be approached).

The APR is likely to include a stakeholder workshop, site/community visit (Ibanda-Makera forest, Muvumba River, Eastern Savannah in Nyagatare, Nyandungu wetland, and Shagasha Tea Estate sites) and case studies and will report on progress made against the indicators and targets in the project logframe, delivery of project outputs, and lessons learned. The SPIU working under REMA will prepare an annual work plan which will include proposed activities, detailed plans, and budgets for the operation of each component. Draft work plans will be submitted to the steering committee for review and approval. Project evaluations will assess the effectiveness, efficiency and sustainability of interventions and partner institutions.

Performance and impact will be assessed through: field data collection which will be compiled in the management information systems of implementing partners; the baseline report and follow-up surveys to collect impact data. The findings will be used to enhance implementation during the final half of the project's term. The reports will summarise the results achieved (outcomes, outputs), lessons learned, and make recommendations on any actions needed to ensure sustainability, replicability and scaling up. All monitoring and evaluation activities will align with Monitoring and Accountability Framework. The results from the M&E system will inform the replication and scaling up of project interventions. Data and quantitative information collected will be transformed into knowledge and learning products linked to organising, reflecting and using information gained. Furthermore, these data will be saved in appropriate format which is easier to be retrieved when needs arise. The knowledge management system will generate lessons, best practices, success stories, and other feedback coming from stakeholders and project partners. The results from the M&E system will inform the replication and scaling up of project interventions. Data and quantitative information collected will be transformed into knowledge and learning products linked to organising, reflecting and using information gained. The quantitative data will be combined with qualitative assessment and beneficiary feedback from the knowledge management activities carried out under each component to generate lessons, best practices, success stories, and other feedback coming from stakeholders and project partners.

8.3. Social and Environmental Safeguards

The design included an Environmental and social impact assessment (ESIA) which assessed the project as a whole and each intervention. The recommended mitigation measures were included in the workplan and budget. Issues raised in the ESIA will be tracked throughout the life of the project in line with the conditions set out by GCF in accrediting REMA. The general and more comprehensive compliance with Environmental Social Safeguards (ESS) will rely on equivalence assessments of national ESS standards that are planned as a quality assurance measure for Rwanda's ESS standards.

The project is expected to have largely positive impacts on the environment as much of the GCF investment is targeted towards ecosystem based adaptation. The main potential positive impacts arise from the protection of existing ecosystem at five pilot sites. The Eastern region that include three pilot sites (Ibanda-Makela forest, Muvumba River and Eastern Savannah in Nyagatare district sites) are most of time affected by long dry spells and drought episodes. Therefore, the irrigation should be considered as the essential adaptation measure to reduce tea farmer's vulnerability to climate variability and avoid production losses and livelihood deterioration.

Moreover, controlling water flows in the marshland will mitigate flooding caused by over bank flows of the river while the construction works for the marshland drainage may entail may take out the fertile soils and change the existing drainage pattern. Hence, such interventions, if not well designed, have the potential to destabilise the receiving downstream users and temporary destabilise the ecosystem dependent on the current river flow. Thus, Social and Environmental Safeguards should be taken into account during implementation period of project activities.

9. GENERAL CONCLUSION AND RECOMMENDATIONS

9.1. General conclusion

The baseline study was designed to facilitate the implementation of NAP activities in five pilot sites which include Ibanda-Makera forest, Muvumba River in Nyagatare district, Eastern Savannah in Nyagatare district, Nyandungu wetland and Shagasha Tea Estate sites. The target population for the survey is all households living in private dwellings during the interviewing period in areas surrounding the project sites. The Key Informant Interviews were held with selected secondary school teachers, head teachers, local leaders at sector and district level of the project sites along with various stakeholders from central government which are direct or indirectely linked to the climate change activities.

The studies on climate change trends and scenario across the study areas revealed that a rise in mean annual temperatures and a decrease in the number of mean rainfall days in some regions, while an increase in heavy rainfall and other extreme weather events. Different project areas were assessed to be highly vulnerable to these continuous changes. These include energy, agriculture, water resources, infrastructure, biodiversity as well as health sector. In addition to the current situation, the vulnerability of Rwanda's sectors is projected to increase with the projected impacts of climate change.

Therefore, NAP came at the right time as it will help the household to restore and enhance ecosystem services in project sites, increase the capacity of communities to renew and sustainably manage forest resources and support smallholders to develop appropriate climate resilient technologies and support community based adaptation planning and build the capacity of both local community and central government to deal with adverse impacts of climate change.

This baseline study has shown that the areas under study are no exception, where the occurrence of extreme weather events (e.g., droughts, strong winds, thunder storms with lightning and floods), the increase in temperatures and in fluctuations of seasonal rainfall patterns, duration and intensity reported by interviewed households have inevitably immediate impacts on cropping patterns, timing of growing crops, agronomic practices and seed needs. These events do not only affect food production but also food and water safety and availability, livelihood assets and human health and properties.

It was declared that in the past 12 months, heavy rainfall has occasioned fluvial erosion and destroyed crops as reported by the majority of respondents. The majority of respondents pointed out heavy rainfall to have occasioned fluvial erosion and destruction of crops and the similar percentage of respondents mentioned drought episodes and long dry spells to have led to poor crop productivity and a shortage of food. Additionally they mentioned floods to

have destroyed their crops and caused poor agricultural productivity. Moreover, the households are not very active in adopting climate resilient technologies, as only small percentages of households have been able to adopt the use of crop varieties, develop technologies for rain water harvesting, waste water management at household level and protecting their housing infrastructure against lightening.

Besides the floods, strong winds have also been very harmful to the project areas. In order to deal with the impacts of the above and to create resilience to climatic changes, GoR has pursued ambitious policies and strategies including the Environment and Climate Change Policy which aims to address climate change by providing strategic direction on environment and climate change, and consequently spur socio-economic development in Rwanda. Another important strategic approach is the NAP which aims to build the capacity of both local community and central government in dealing with adverse effects of climate change. From the findings of the study, the key recommendations were formulated and presented in the following paragraphs.

9.2. General Recommendations

The following are key challenges and recommendations that should be taken into account by relevant stakeholders in implementation of NAP project in project intervention area.

- The current vulnerability to the effects of climate change of rural beneficiary populations in project areas is high, and it is necessary to go further to ensure that more communities will have socio-economic capacity to deal with adverse effects of climate change. In this respect, REMA as well as the Ministry of Environment and other stakeholders should continue to strengthen their role in capacity building of local community and implement climate resilience actions and develop useful tools for strengthening the country's capacity to adapt to climate change. Action: REMA and MOE
- The population does not take into account weather information and forecasts (especially the likelihood of natural disasters), which renders the population in a perpetual emergency situation without moving to a process of planning and preparing for disasters. The possibility of disseminating weather/climate information to the farmers should be timely and accurate in order to carry out crops monitoring, early warning and disaster management, and the selection of appropriate crops to grow in specific agro-climatic zones and seasons. Futheremore, farmers should also received training on how to effectively use this information best in their planning. Action: REMA and METEO
- NAP project should continue activities to promote conservation agriculture in project areas and larger scale adoption by the government in order to improve land management and prevention of land degradation through good agricultural practices. This can be done through the following suggested actions: reforestation activities;

terracing activities and reduction of steep slopes, Design Sustainable Land Management Plan; Create awareness raising of population through regular trainings, etc. **Action:** REMA, NAP mostly in Muvumba river site

- From the study, it is evident that there is need to promote the adaptation to climate change which is bound to include a wide range of anticipatory measures and strategies based on findings of the study and expected goals to the project.. These are as follows:
- Carry out progressive and radical terracing: (terracing refers to landscaping of sloping topography into a series of successively receding flat surfaces or platforms that resemble steps) in Muvumba River basin;
- Agro-forestry has among its advantages the benefit of increasing non-farm incomes in eastern savannah of Nyagatare site, around Ibanda Makera forest and Shagasha Tea Estate;
- > Promote afforestation in Nyandungu wetland site;
- Continue to promote the use of energy saving stoves to reduce the amount of wood used as charcoal and hence save the forests from excessive use and destruction for all sites;
- Support the promotion of horticulture crops growing because they serve the role as forests and contribute at the same time to the food security for all sites;
- Promote soil fertility conservation practices which is the use of manure, mulching, planting of leguminous crops, which help improve soil fertility by increasing the microorganism composition in the soil mostly in savannah of Nyagatare site;
- Support seed and grain storage which involves collecting seeds and grains from farmers at post-harvesting season and releasing them within the timely agreed periods for all the sites;
- Promote ecological pest management which is the use of natural enemy dynamics or environmental positioning (e.g., crop shading) to eliminate or reduce the presence of pests for all the sites;
- Promote the use of improved seeds which is vital to improve crop productivity for all sites;
- Train farmers to use crop varieties and diversification consisting of integration of different varieties of crops and hybrids of a particular crop for all the sites;
- > Train and support land use consolidation programmes by encouraging farmers with adjacent lands to grow the same crop for all sites;
- Promote rain water harvesting consisting on collecting and storing rainwater from rooftops, land surfaces or rock catchment areas for different use mostly in Nyandungu, Muvumba river and Shagasha sites;

- Develop irrigation systems to provide controlled water in farmlands in Muvumba river site;
- Promote wastewater reuse to form a reliable source for crop irrigation and a positive way to dispose of sewage water for all sites;
- Promote the use of barrier crops that are used as a cultural control strategy for reducing the spread of pests and diseases to the most vulnerable crops for all sites;
- Integrate dissemination of meteorological information in daily household activities to develop early warning systems, crop monitoring and disaster management and work on raising awareness among farmers to enable them to take alerts into account especially in the likelihood of an event for all sites;
- Train farmers through offering short courses, seminars and group discussions on the impacts of climate changes and variability on natural and artificial environment and on various ways of mitigation and adaptation for all sites;

Thus, the use domestic biogas plants and renewable energy are also recommended. The biogas plant have a direct positive effect on rural peoples' energy supply, environment, health and agricultural production. Biogas is part of a closed ecological cycle, which makes it a sustainable and renewable source of energy. By replacing traditional energy sources (notably, firewood) and by digesting cow dung in a closed environment, it results in a significant reduction in the emission of methane, which is a greenhouse gas. This has a positive gender sensitive factor as it reduces the burden on women through collecting firewood. It is also relatively better for the health of family members especially that of women and children who are predominantly present for meal preparation. **Action**: all sites.

REFERENCES

- Bizuru E, Nyandwi E, Nshutiyayesu S & Kabuyenge JP., (2011). Inventory and mapping of threatened remnant terrestrial ecosystems outside protected areas through Rwanda. National University of Rwanda.
- Gatali C. 2013. Herbivory and biodiversity conservation of the savannah habitats in Akagera National Park, Rwanda. Doctoral thesis, Department of Biological and Environmental Sciences, University of Gothenburg
- 3. Government of Rwanda, (2017). Official Gazette N° 07/of 13/02/2017.
- 4. Republic of Rwanda, (2018). Third National Communication under the United Nations Framework Convention on climate change, Kigali, Rwanda.
- 5. Republic of Rwanda, (2020). Revising Nationally Determined Contribution (NDC) mitigation and adaptation priorities for Rwanda. Kigali, Rwanda.
- 6. Ilunga, L., Muhire, I., Mbaragijima, C. (2004). Pluviometric seasons and rainfall origin in Rwanda, Geo-Eco-Trop, **28**, 1-2: 61-68
- Karamage F, Zhang C, Ndayisaba F, Shao H, Kayiranga A, Fang X, Nahayo L, Muhire Nyesheja E & Tian G. 2016. Extent of cropland and related soil erosion risk in Rwanda. Sustainability. 8: 609.
- 7. Kigali City Master Plan 2020-2050.
- 8. Google Earth, US Dept of State Geographer, (2020). Image 2021 CNES/Airbus
- Mary, A.L. and Majule, A.E., (2009). Impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas of Tanzania: the case of Manyoni district in Singida region, Tanzania. African Journal of Environmental Science and Technology, 3(8):206-218.
- 10. MIDIMAR. 2015. The national risk atlas of Rwanda.
- 11. Ministry of Agriculture and Animal Resources. 2009. Land husbandry, water harvesting and hillside irrigation (LWH) project.

- 12. Ministry of Agriculture and Animal Resources. 2016. Rwanda Feeder Roads Development Project: Final Report. Nyagatare District.
- 13. Ministry of Environment, (2018). Muvumba Catchment Management Plan (2018–2024).
- 14. Ministry of Environment, 2017. Environmental and social impact assessment for muvumba multipurpose dam project, Rwanda.
- 15._Ministry of Environment, (2017). Rwanda Water and Forestry Authority Muvumba Multipurpose Dam Development Project.
- 16. Ministry of Environment, 2019. Forest cover mapping report, Kigali, Rwanda
- Ministry of Lands and Forestry, (2015). Forest Investment Program for Rwanda, Kigali, Rwanda.
- Muhire, I., Ahmed, F., and Abd Elbasit, M.M. (2015). Spatio-temporal variations of rainfall erosivity in Rwanda. Vol. 6(4), pp. 72-83, 2015.
- 19._Muhire, I., Ahmed, F., (2015). Spatio-temporal trend analysis of precipitation data over Rwanda, South African Geographical Journal, 97(1): 50-68.
- 20. National Institute of Statistics of Rwanda, (2019). The annual report, Kigali, Rwanda
- Ntaribi T & Paul DI. 2019. The economic feasibility of Jatropha cultivation for biodiesel production in Rwanda: A case study of Kirehe district. *Energy for Sustainable Development*. 50: 27–37.
- 22. Nzeyimana I & Philliper K. N.d. Drought conditions and management strategies in Rwanda.
- 23. Rwanda Environment Management Authority. 2015. Rwanda: State of environment and outlook report 2015.
- 24. Sindayigaya, S., Nyongesa, L.K., Adu, A.M.W., 2014. Statistical Model for Poverty Estimation with Assessmentof One-Cow-One Family program in Rwanda, International Journal of Statistics and Systems, Volume 9, Number 2, P 119-145.
- 26. The Rufford Small Grants Foundation, (2009). Eastern Gallery Forest Conservation Project: Biodiversity survey.

- 27. World Bank Group. 2020. Climate Change Knowledge Portal: Rwanda climate data projections. Available at: <u>https://climateknowledgeportal.worldbank.org/country/rwanda/climate-data-projections#</u>
- 28. Wronski T, Bariyanga JD, Sun P, Plath, M. & Apio A. 2017. Pastoralism versus agriculturalism—how do altered land-use forms affect the spread of invasive plants in the degraded Mutara rangelands of north-eastern Rwanda? *Plants*. 6: 19.
- https://web.archive.org/web/20160305061619/http://www.ibidukikije.com/2012/03/rwandakirehe-districts-characterized-high-temperatures/.
- https://www.thewoodfoundation.org.uk/making-markets-work-for-thepoor/rwanda/imbarutso/. Accessed on December, 2020

https://www.reg.rw/what-we-do/access/2020

https://www.gfdrr.org/en/rwanda

10. APPENDIX

10.1. Appendix 1:Individual Questionnaire /Ifishi y'ibibazo

Introduction of interviewer to the respondent(s) / Kwimenyekanisha kutanga amakuru Greetings / Gusuhuzanya

UKWIMENYEKANISHA:

Turabasuhuza, nitwa,...., tuje gushaka amakuru ajyanye n'ibidukikije, imibereho n'ubukungo mu ngo tubisabwe na REMA ifatanyije na SESMEC Ltd. Amakuru mutanga azafasha mu gushyira hamwe amakuru y'ibanze ku mushinga ujyanye no kubaka ubushobozi bw'u Rwanda mubijyane no gutegura igenamigambi rifasha guhangana n'ingaruka z'ihindagurika ry'ibihe. Ibisubizo muduha byose tuzabigira ibanga. Ibizava muri iri kusanyamakuru bizakoreshwa mugutegura raport y'ibanze y'umushinga. Kuvugisha ukuri bizadufasha cyane muri iri kusanyamakuru.

I. Identification of respondent Umwirondo w'ubajijwe

Province / Intara: District / Akarere: Sector / Umurenge: Cell / Akagari: Village / Umudugudu: Name of enumerator / Izina ry'Ubaza: Name of respondent / Izina ry'Ubajijwe: Respondent's phone number /Telephone y'Ubajijwe: Date of the survey / Itariki y'Ikiganiro: Starting Time / Isaha yo gutangira: Ending time / Isaha yo gusoza: GPS:

Ubudehe category 2020 of respondents / Icyiciro cy'ubudehe muri 2020 cy'ubajijwe:

2. Household members' details: Ibarura ry'abagize urugo (bamaze nibura amezi 12 muri uru rugo)

| N° | Name of f | amily | Q2_1. | Q2_2. | Q2_3. | What is | Q2_ | 4. | Q2_ | 5. Can | Q2_6. | | Q2_ | 7. | What |
|-------|--------------------|--|-----------|---------------|----------|-----------|-------|--------------------------------|------------------------------|-----------------|---------------|---------------------|-------|-------|-------|
| | members | /Izina | Sex | Age | the | highes | Relat | ionw | read | and | Marital | i | s t | he | main |
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| | | [2]: Pı | rimary : | school | /Amasł | nuriaban: | za; | | [1]: | Head of | househ | old/l | Nyir | 'uru | go |
| | | [3]: J | unior | high s | chool/ | lcyiciro | o rus | ange, | [2]: \$ | Spouse / | Umugo | re/U | mug | gabo | ; |
| (2)A | ge/ Igihe | Artisa | inal, CE | RAR, F | amilial, | CERAI, | CFJ; | - | [3]: \$ | Son/daug | hter /U | Jmwa | ana; | | |
| yavu | kiye (Umwaka | [4]: H | ligher s | chool/A | mashu | liyisumb | uye; | | [4]:Father/mother /Se/Nyina; | | | | | | |
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| (5) | an read and | (6) Ma | aritai st | atus /ir | angami | merere: | | | (/) C | Jecupati | | iziak | ora: | | |
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| [1]Ye | es/Yego | [3]: D | ivorceo | l /Yatar | iyen'uv | vobashal | kanye | | muto | с; | | | | | |
| [2]N | o/Oya | [4]: Separated /Ntabana n'uwo bashakanye | | | | | ye | [3]: Student/Umunyeshuri; | | | | | | | |
| [3]C | an read only / | /[5]: Polygamy/Afiteabagorebenshi | | | | | | [4]: Farmer/Umuhinzi/Umworozi; | | | | i; | | | |
| Gusc | oma gusa | [6]: V | Vidow(e | er)/Yara | apfakay | 'e | | | [5]: / | Artisan / | Umuny | abuk | orik | ori; | |
| | | | | | | | | | [6]: | | | | | | |
| | | | | | | | | | Com | <u>nmerce/t</u> | ranspoi | rt/Ur | nuc | uruz | i/At |

3. Sources of household income/livelihood/ Aho urugo ruvana ibirutunga

3.1 What is the main source of household income in last year?/ Ni ahahe hantu h'ingenzi mukura ibitunga umuryango muri 12 months?

| Source | Yes/yego | No/oya |
|--|----------|--------|
| Food crops farming / Ubuhinzi bw'ibiribwa ngandurarugo | | |
| Cash crops farming / ubuhinzi bw'ibihigwa ngengabukungu | | |
| Business / Ubucuruzi | | |
| Selling of logs, wood, timber, and/or charcoal / Gucuruza, kugurisha ibiti, imbaho, ingiga, amakara | | |
| Artisan (e.g. Carpenter/Mason | | |
| /Barber/Cobbler/Tailor/Potter/Butcher, etc) / Umwuga n'ubukorikori | | |
| Part time employment / Nyakabyizi | | |
| Permanent job (wage/salary employment)/ Akazi gahoraho | | |
| Renting property / Inyungu ku mitungo cyangwa/hamwe n'ubukode | | |
| Retirement allowances / Pansiyo | | |
| Gifts /remittances/Kohererezwa ibintu/biva ku nshuti cyangwa abo mu muryango (amafaranga cyangwa ibindi bintu by'agaciro) | | |
| Mining and queries /Ubucukuzi | | |
| Animal Husbandry and Production/ Ubworozi n'ibikomoka ku matungo | | |
| Any other (specify) /lkindi (sobanura) | | |

3.2 Househld income per month/Umusaruro w'ukwezi

| | Yes/yego | No/oya |
|---------------------------|----------|--------|
| < 30,000 | | |
| 30,000-100,000 | | |
| 100,000-200,000 | | |
| Above 200,000 | | |
| Don't know / ntabwo mbizi | | |

3.3 Number of reared domestic animals/ Umubare w'amatungo mworoye

| Animals / amatungo | Number / umubare |
|--|------------------|
| Cow/ Inka | |
| Pig/ Ingurube | |
| Goat / Ihene | |
| Sheep / Intama | |
| Hen/Chicken / Inkoko | |
| Duck/other bird / Ibishuhe n'ibindi biguruka | |
| Rabbits / Inkwavu | |
| Other (specify) / Ikindi kivuge | |
| | <u> </u> |

3.4 What do you do when your livestock gets ill? / Iyo amatungo yanyu arwaye mubigenza mute?

| | Yes/yego | No/oya |
|---|----------|--------|
| Nothing / ntacyo dukora | | |
| Traditional medicine /dushaka abavuzi ba gihanga | | |
| Call the veternary / duhamagara veterineri | | |
| Take the animal to the veternary /tujyana itungo kwa veterinari | | |
| Any other (specify) /ikindi kivuge | | |

4. Land property / Umutungo w'ubutaka

| 4.1. Do you own a land? | Yes /yego |
|--|-----------|
| If yes, mention the number/ Niba ari yego vuga umubare | |

4.2 Location of land / Aho ubutaka duhinga buherereye

| | Codes (1,2,3,4 all possible) |
|--|--|
| | 1,2,3 bishobora gusubirizwa rimwe |
| 4.3 Your farmlands are located at/ (ubutaka bwanyu buherereye aha): | I = Hillside /imusozi 2 = Marshland /mu gishanga 3 = Steep slope /ku manga 4 = Floody areas /ahantu hakunda kunda kurengerwa n'amazi |

4.3 The size of the land? /Uko ubutaka bungana

| Yes/yego | No/oya |
|----------|--------|
| | |

| Less than 0.5 ha /Hasi ya 0.5 ha | |
|--|--|
| Between 0.5-1 ha / Hagati ya 0.5 na 1 ha | |
| Between 1-2 ha /Hagati ya 1ha na 2 ha | |
| More than 2 ha / Hejuru ya 2 ha | |

4.4 The use of land / ikoreshwa ry'ubutaka

| | Yes/yego | No/oya |
|--|----------|--------|
| Food crop farming /Ubuhinzi bw'ibihigwa ngandurarugo | | |
| Cash crop farming / Ubuhinzi bw'ibihigwa ngengabukungu | | |
| Livestock /Ubworozi | | |
| Forestry /Amashyamba | | |
| Napier grass/lbyatsi bufata ubutaka | | |
| Buildings /Inyubako | | |
| Others /Ibindi Specify (bivuge) | | |

4.5 Farming / guhinga ubutaka

| | Yes/yego | No/oya |
|--|----------|--------|
| Are you farming your own land/ Uhinga ubutaka bwawe? | | |
| Do you have any farm which was integrated in land use consolidation/ Waba ufite ubutaka washyize muri gahunda yo guhuza ubutaka? | | |
| Did you rent/borrow any farm land / Haba hari ubutaka ukodesha? | | |
| | | |

5. House / homestead Characteristics / Imiterere y'inzu utuyemo

5.1. What about the ownership status of the main house?/ Umutungo w'inzu

| | Yes/yego | No/oya |
|---|----------|--------|
| 5.1.a) Do own any other house/ Mwaba mufite inzu? | | |
| Give the number of rooms in the house / Vuga umubare w'ibyumba i | fite | |
| 5.1.b) If yes how many other houses do you own? (give the number) / Niba ari yego mwavuga | | |
| umubare w'izindi nzu mutunze? | | |
| 5.2. Materials used on the walls / ibikoresho byubakijije urukuta | | |
| | Yes/yego | No/oya |
| Baked clay bricks / Amatafari ahiye | | |

| Adobe bricks / Amatafari y'ubundi bwoko | |
|---|--|
| Cement blocks / boroke sima | |
| Wood / Imbaho | |
| Trees / Ibiti | |

5.3. Materials used for foundation / Ubwoko bw'umusingi

| | Yes/yego | No/oya |
|--|----------|--------|
| None/ nta musingi | | |
| Baked clay bricks/Adobe bricks / amatafari | | |
| Stones/ amabuye | | |
| Other (specify) / ikindi (kivuge) | | |

5.4. Materials used of roof / ubwoko bw'isakaro (igisenge)

| | Yes/yego | No/oya |
|-----------------------------------|----------|--------|
| Iron sheet roof / amabati | | |
| Tile / amategura | | |
| Other (specify) / ikindi (kivuge) | | |

5.5 Possession of house equipments / ibikoresho byo mu nzu

| | Yes/yego | No/oya |
|--|----------|--------|
| Benches only/Ntacyo kwicaraho cg utubaho | | |
| Chairs/Intebe | | |
| Sofa /Foteyi | | |
| Beds/lbitanda | | |
| Mattress/Igodora | | |
| Cupboard/akabati | | |
| Table/ameza | | |

5.6 Quality of toilet /Ubwoko bw'ubwiherero?

| | Yes/yego | No/oya |
|---|----------|--------|
| None / Ntayo | | |
| Non covered latrine / Budasakaye | | |
| Covered latrine but not cimented /busakaye ariko butarimo isima | | |
| Covered latrine and cimented /busakaye kandi burimo isima | | |
| Modern flashing latrine /Umusaranew'amazi mu nzu | | |

5.7. Causes of damages experienced on the house if any in 12 past mounths/ Icyaba cyarangije inzu zawe niba yarigeze kwangirika mu mezi 12 ashize

| | Yes/yego | No/oya |
|---------------------|----------|--------|
| Flooding / Umwuzure | | |

| Heavy rain / Imvura nyinshi | |
|-----------------------------------|--|
| Landslides / Inkangu | |
| Heavy winds / Umuyaga mwinshi | |
| Other (specify) / Ikindi (kivuge) | |

5.8. Location of the house / Aho inzu iherereye

| | Yes/yego | No/oya |
|---|----------|--------|
| Flat areas without any floods or landslides / Ahantu haterereye | | |
| hatagera umwuzure cyangwa inkangu | | |
| In less than 50 meters from the river or marshland/ hasi ya metero | | |
| 50 uvuye ku mugezi cyangwa kugishanga | | |
| In high risk zone (hilly and sloppy areas) / mu manegeka (hahanamye | | |
| cyane) | | |

6. Household Financial Assets and savings

| | Yes/yego | No/oya |
|--|----------|--------|
| 6.1.a) Does any member of the household have a bank account/ | | |
| Mwaba mufite umuntu mu rugo ubitsa muri bank? | | |
| 6.1.b) If yes how many (Give the number) / niba ari yego ni bangahe? | | |

6.2. If yes, the account is operational in the following banking institutions / Niba ari yego konti iri aha hakurikira:

| | Yes/yego | No/oya |
|---------------------------------------|----------|--------|
| Umwalimu SACCO | | |
| Umurenge SACCO | | |
| BPR / Banki y'abaturage | | |
| Bank of Kigali / Banki ya Kigali | | |
| Duterimbere | | |
| Any other (specify) / lyindi (yivuge) | | |

| | Yes/yego | No/oya |
|---|----------|--------|
| 6.3. Did you ever accessed to a laon/credit/ Waba warafashe umwenda | | |
| muri banki | | |
| If yes, mention the source of laon/credit/ Niba ari yego vuga aho | | |
| wawufatiye | | |

6.4.a) Does any member of the household belong to tontine whether is a female or male / Hari umuntu mu mu rugo rwanyu wababa ari mu kimina ? (Sobanura niba ari igitsina Gabo cyangwa Gore)

6.4.b) If yes, name it/ Niba ari yego kivuge

- 6.5.a) Does any member of the household belong to cooperative precise whether is a female or male/ Hari umuntu mu rugo rwanyu waba ari muri koperative? (Sobanura niba ari igitsina Gabo cyangwa Gore)
- 6.5.b) If yes, name it / Niba ari yego zivuge
- 6.6. Give the number of family member belonging to the following cooperatives/ tanga umubare w'abagize umuryango bari muri koperative zikurikira

| The type of cooperatives | Number of males/umubare w'igitsina Gabo | Number of famales/umubar e w'igitsina gore |
|---------------------------------------|---|--|
| Tree nurseries/growers/Abinaza | | |
| Bee keeping/ ubworozi bw'inzuki | | |
| Agricultural cooperatives/ubuhinzi | | |
| Tontine/ ibimina | | |
| Any other (specify) / lyindi (yivuge) | | |
| | | |

7. Health/Ubuzima

7.1 Number of the household possess one of the following health insurance scheme in last 12 months/ Umubare w'abantu mu rugo bafite ubwishingizi bukurikira mu mezi 12 ashize

| | Number/umubare |
|---------------------------------|----------------|
| Mutuelle de santé | |
| RSSB | |
| MMI | |
| CORAR | |
| MEDIPLAN | |
| Other (specify) / ubundi buvuge | |

7.2. In the last 12 months has anyone in your household suffered from the following illness/ Mu myaka ibiri ishize haba hari umuntu wo mu rugo waba wararwaye ndwara izukikira.

| | Yes/yego | No/oya |
|---------------------------------|----------|--------|
| Malaria / <i>Malaria</i> | | |
| Hot/cold stress/ ibicurane | | |
| Pneumonia / umusonga | | |
| Diarrhea / impiswi | | |
| Other specify / ikindi (kivuge) | | |

7.3. If yes, where was he/she treated? /Niba ari Yego, bamuvuje hehe?

| | Yes/yego | No/oya |
|--|----------|--------|
| At the health centre (kwa muganga) | | |
| At a traditional healer (ku muvuzi wa gakondo) | | |
| He/she was not treated (Yararwaye arikiza) | | |
| Other specify / ikindi (kivuge) | | |

7.4. How long does it take to reach to the health center/ Bibatwara igihe kingana gute ngo mugere ku ivuriro?

| | Yes/yego | No/oya |
|---|----------|--------|
| Less than an hour/ Hasi y'isaha | | |
| Between one and two hours <i>/hagati y'isaha imwe n'abiri</i> | | |
| Between 2 and 3 hours /hagati y'amasaha 2 na 3 | | |
| Between three and four hours / hagati y'amasaha 3 na | | |
| 4 | | |
| Above four hours / hejuru y'amasaha 2 | |
|---------------------------------------|--|

8. Food Security/ Kwihaza mu biribwa

8.1. What is your capacity in terms of number of meals per day/Mufite ubushobozi bwo kurya kangahe kumunsi?

| | Yes/yego | No/oya |
|---|----------|--------|
| No hope of regular daily meal/ nta kizere cyo kubona icyo | | |
| kurya buri munsi | | |
| Once a day/ Rimwe ku munsi | | |
| Twice a day/Kabiri ku munsi | | |
| Three times and more/Gatatu cyangwa karenga | | |

8.2. What is the most important meal of a day? / Ni ryari mufata ifunguro rihagije ku munsi?

| | Yes/yego | No/oya |
|------------------------------------|----------|--------|
| Morning/Mu gitondo | | |
| Lunch /Mu ma saa sita | | |
| Supper /Ku mugoroba | | |
| Never / Nta na limwe riba rihagije | | |

8.3. What food your household normally often eat / Ni ibiki mukunda kurya?

| | Yes/yego | No/oy |
|-----------------------------------|----------|-------|
| | | а |
| Maize/ Ibigori | | |
| Sorghum / amasaka | | |
| Beans / ibishyimbo | | |
| Rice / Umuceri | | |
| Cassava /Imyumbati | | |
| Sweet Potato / Ibijumba | | |
| Irish Potatoes / Ibirayi | | |
| Vegetables/imboga | | |
| Fruits/Imbuto | | |
| Others (specify) //bindi (bivuge) | | |

| | Yes/yeg | No/oya |
|---|---------|--------|
| | 0 | |
| 8.4.a) In the last 12 months, did you receive any assistance in | | |
| terms food or money from the government or other institution/ | | |
| Mu mezi 12 ashize wowe cyangwa abo mubana mwigeze mwakira | | |
| ubufasha bw'ibiribwa cyangwa amafaranga itanzwe na leta cyangwa | | |
| ikindi kigo? | | |
| 8.4.b) If yes, mention such assistance/ Niba ari yego buvuge | | |

| | Yes/yego | No/oy |
|--|----------|-------|
| | | а |
| 8.5. In the last 12 months did your household experience any food | | |
| shortage / Mu mwaka ushize wowe cyangwa abandi mu uru rugo, | | |
| mwigeze mugira ikibazo cy'amafunguro adahagije n'inzara igihe kigera | | |

| ku byumweru cyangwa amezi bitewe n'umusaruro muke mu mirima | |
|---|--|
| yanyu? | |
| | |

| | Number | of | days/ |
|---|-----------|--------|-------|
| | Umubare v | v'imin | isi |
| 8.6 Number of days you have passed without having sufficient food | | | |
| from your harvest/Mu rugo mwaba mwaramaze iminsi ingahe mufite | | | |
| amafunguro adahagije aturuka ku musaruro wanyu? | | | |

8.8. Main causes of food shortage in last 12 months / impamvu nyamukuru y'ibura ry'ibiribwa mu rugo mu mezi 12 ashize.

| | Yes/yego | No/oya |
|---|----------|--------|
| Poor crop production due to rain shortage (any dry spells) / | | |
| Umusaruro muke utewe n'imvura nke, | | |
| Heavy rains / Imvura nyinshi ikabije, | | |
| Late onset of rains / imvura yaguye itinze | | |
| Early offset of rains / imvura yagiye kare | | |
| Lack of irrigation facilities/ Kubura uburyo bwo kuhira | | |
| Crops diseases and pests/ Indwara z'ibihingwa zitewe n'udusimba | | |
| Health problems of the members of the family/ Kurwara kwabo mu | | |
| muryango kuburyo badashobora kujya gukora imirimo y'ubuhinzi. | | |
| Other (specify) /lbindi (bivuge) | | |

9. Access to basic facilities and infrastructure / kubona ibikoresho by'ingenzi n'ibikorwa remezo

9.1. What is the main source of water for domestic use /Amazi mukoresha mu rugo muyavana he?

| | Yes/yego | No/oya |
|---|----------|--------|
| Inside the house or within the compound/Mu rugo | | |
| Public source of water/lvomero rusange | | |
| Rain water/Amazi y'imvura | | |
| Dam/river/spring/lbizenga/lmigezi/Amazi y'isoko | | |
| Other/Ibindi | | |

| | Number of jerrycans of 20 liters /Umubare w'amajerikani ya litiro 20 |
|---|---|
| 9.2. On average what quantity of water do you use | |
| per day for domestic usage/ Mugereranije, musanga | |
| mukoresha amazi angana ate ku munsi mu rugo | |

| | Yes/yego | No/oya |
|---|----------|--------|
| 9.3.a) Do have any tank or any other tools used for rain water collection / Mwaba mufite itanki cyangwa ikindi gikoresho gifata amazi y'imvura? | | |
| 9.3.b) If yes, how big it? / Niba ari yego kingana gute? | | |

| | Yes/yego | No/oya |
|---|----------|--------|
| 9.3.c) Do have any infrastructure to clean water / Mwaba mufite | | |
| igikoresho cyo gutunganya amazi yo kunywa? | | |
| 9.3.d) If yes, name it? / Niba ari yego kivuge? | | |

9.4. Who is most often made responsible for getting domestic water? Ni nde akenshi ushinzwe kujya kuvoma yo gukoresha mu rugo?

| | Yes/yego | No/oya |
|------------------|----------|--------|
| Husband/ Umugabo | | |
| Wife/Umugore | | |
| Children /Abana | | |
| Workers/ Abakozi | | |

9.5. How long does it take to get domestic water? /Kujya kuvoma amazi akoreshwa mu rugo bitwara igihe kingana iki?

| | Yes/yego | No/oya |
|---|----------|--------|
| Less than ten minutes/ Munsi y' iminota icumi | | |
| Less than 30 minutes/ Munsi y' igice cy'isaha | | |
| Less than an hour/ Munsi y' isaha | | |
| More than an hour/ Birenze isaha | | |
| I don't know/ Simbizi | | |

9.6. What is the main source of energy used for cooking /Mukoresha iki muguteka ibiryo mu rugo rwanyu?

| | Yes/yego | No/oya |
|--|----------|--------|
| Straws /Ibyatsi | | |
| Fire wood/Inkwi | | |
| Chacoal/Amakara | | |
| Biogaz/Biyogaze | | |
| Electricity power or gas/Amashanyarazi cg gazi | | |
| Other (specify) /Ikindi (kivuge). | | |

9.7. If you use fire wood for cooking, how many bunches of firewood and sacks of charcoal do you use per week? /Mukoresha imiba y'inkwi ingahe mu cyumweru cyangwa imifuka y'amakara ingahe mu cyumweru mu guteka?

| | Number/Umubare |
|--|----------------|
| a. How many bunches of firewood do you use per week? / Mukoresha | |
| imiba y'inkwi ingahe mu cyumweru? | |
| b. How many sacks of charcoal do you use per week? / Mukoresha | |
| imifuka y'amakara ingahe mu cyumweru? | |

9.8. What is the main mode used for cooking? Muteka ku yahe mashyiga mu rugo rwanyu ?

| | Yes/yeg | No/oy |
|---|---------|-------|
| | 0 | а |
| Traditional stoves/ Amashyiga asanzwe ya gakondo | | |
| Use of improved stoves/ Amashyiga ya kijyambere (nka rondereza, | | |
| Imbabura) | | |

| Electrical/Gas stoves/ Amashiga akoresha amashanyarazi cg gazi | |
|--|--|
| Other (specify) /lkindi (kivuge). | |

9.9. What is the main source of energy used for lightening in houses / Ni ubuhe bwoko bw'ingufu mukoresha mu kubonesha mu nzu?

| | Yes/yego | No/oy |
|---|----------|-------|
| | | а |
| Electricity (grid) Wood (Amashanyarazi) | | |
| Kerosene (Itara rya peteroli) | | |
| Wood (inkwi) | | |
| Biogas (biyogazi | | |
| Solar energy (imirasire y'izuba) | | |
| Battery (itoroshi) | | |
| Candle (buji) | | |
| Other (specify) /lkindi (kivuge). | | |

9.10. How long does it take to get the following services (One way in minutes, using usual mode of transportation)/Bitwara igihe kingana iki kugira ngo mugere aha hakurikira (Kugenda cyangwa kugaruka ukoresheje uburyo busanzwe)?

| Basic infrastructure (Ibikorwa remezo byibanze) | Code below (use codes from table below/ koresha amakode Yatanzwe hepfo) |
|--|---|
| Bus stop or taxi (Aho bategera bisi cyanga tagisi) | [] |
| Primary school (Amashuri abanza) | [] |
| Health centre (Ivuriro) | [] |
| Main market for food products (Isoko rikomeye bagurishirizamo imyaka) | [] |
| Main market for animal products (Isoko rikomeye bagurishirizamo amatungo cyangwa ibiyakomokaho) | [] |
| The closest all-weather road/ | [] |

Table of Codes (Amakode agomba gukoreshwa haruguru muri 9.10)

| [I] : Less than 30 minutes (Hafi igice cy'isaha) |
|---|
| [2] : Between 30 minutes and I hour (Hagati y'igice cy'isaha kugeza ku isaha) |
| [3] :Between I hour and 2 hours (Hagati y'isaha I n'amasaha 2) |
| [4] : More than an 2 hours /(Birenze amasaha 2) |
| [5] : I do not know (Simbizi) |

9.11. Possession of transport and communication means/ umutungo w'ibikoresho byo kwifashisha mu ngendo n'itumanaho

9.12. Do you own any of the following means of transport? /Waba utunze ikinyabiziga muri ibi bikurikira

| | Yes/yeg | No/oy |
|----------------------|---------|-------|
| | 0 | а |
| None/ Nta na kimwe | | |
| Bike/Igare | | |
| Motorcycle/lpikipiki | | |
| Car/Imodoka | | |

9.13. Do you own any communication means in the following /Hari uburyo bw'itumanaho mufite mu bukurikira?

| | | | Yes/yeg | No/oy |
|----------------------------|-----------|--------|---------|-------|
| | | | 0 | а |
| Radio/ Radiyo | | | | |
| Television/Televiziyo | | | | |
| Mobile phone/Telefone igen | danwa | | | |
| Computer/Mudasobwa | | | | |
| Internet /Murandasi | | | | |
| Other | (Specify) | lkindi | | |
| (Kivuge) | | | | |
| None/ Nta na kimwe | | | | |

10. Access to weather/climate information/ kubona amakuru agendanye n'ihindagurika ry'ibihe

10.1 What is climate change? (ask question and listen to answer – circle one of the following using your discretion)/ Ihindagurika ry'ibihe n'iki?

0) Not sure/ Ntacyo mbiziho

1) A variation in weather elements over time/Ihindagurika rigaragarira mu ihindagurika ry'igihe kirekire mu migwire y'imvura, ubushyuhe, ubuhehere mu kirere, n'ibindi

2) A variation in weather over time caused by changes in land use around the world lhindagurika rigaragarira mu ihindagurika ry'igihe kirekire mu migwire y'imvura, ubushyuhe, ubuhehere mu kirere, n'ibindi bitewe n'imikoreshereze y'unutaka ku isi.

10.2. What is causing climate change? (ask question and listen to answer – circle one of the following using your discretion) Ihindagurika ry'ibihe ryaba riterwa n'iki?

0) Not sure /Ntacyo mbiziho

I) Natural causes/Impamvu karemano

2) Human activities /ibikorwa bya muntu

3) Humans and natural causes/Impamvu karemano n'ibikorwa bya muntu

10.3. Have you felt the effects of climate change? (ask question and listen to answer – circle one of the following using your discretion) Mwaba mwarigeze mugerwaho n'ingaruka z'ihindagurika
0) No/not sure/Oya

1) Yes, I have noticed climate change (e.g. increased temperatures, more floods, etc.) Yego nabonye ko ibihe byahindutse (urugero: ubushyuhe bwarazamutse, imyuzure iriyongera, n'ibindi

2) Yes, I have noticed climate change and it is affecting my livelihoods (e.g. reduced productivity of crops, increased frequency of water-borne diseases) Yego ihindagurika ry'ibihe ryagize ingaruka ku mibereho yacu (urugero: kugabanuka ry'umusaruro, indwara zikomoka ku ikoreshwa ry'amazi yanduye zariyongereye n'ibindi)

3) Yes, I have noticed climate change and it is affecting many sectors/Yego nabonye ko ibihe byahindutse kandi byageze ku bice byinshi by'imirimo y'abantu

10.4. Please give an example of how you have been affected by climate change/*Tanga urugero* ry'uburyo waba baragezweho n'ingaruka z'ihindagurika ry'ibihe:

.....

10.5. Has climate change affected your daily activities?/lhindagurika ry'ibihe ryaba ryagize ingaruka ku kazi kawe ka buri munsi? (including employment/small business) No / yes Oya/yego

10.6. If so, have you changed your livelihood practices to cope with climate change? Waba warahinduye imibereho yawe kugira ngo ubashe guhangana n'ihindagurika ry'ibihe? No / yes *Oya/Yego* (if yes *please describe how?Niba ari yego bisobanure hasi*):

.....

10.7. How often do you talk about climate change?/Ni inshuro zingahe waba uvuga ku ihindagurika ry'ibihe?

0) Never /Nta na rimwe

I) Sometimes (once a week) /Rimwe na rimwe (nka rimwe mu cyumwer)

2) Often (more than once a week) / Kenshi (inshuro zirenze rimwe mu cyumweru)

10.8. With whom do you talk about climate change with? /Ni bande mwaba muvugana n'ibijyanye n'ihindagurika ry'ibihe?

0) family and friends /Abo mu muryango n'inshuti zanjye

I) Co-workers /Abo dukorana

2) User groups and community leaders /abo duhurira mu matsinda n'abayobozi b'inzego z'ibanze

10.9. How often do you receive information and/or training on adapting to climate change? Ni kangahe mwaba mubona amakuru n'amahugurwa mubijyanye no guhangana n'ingaruka z'ihindagurika ry'ibihe?

0) Never / Nta narimwe

I) Once a year /Rimwe mu mwaka

2) More than once a year /Inshuro zirenze imwe mu mwaka

3) Once a week /Rimwe mu cyumweru

3) More than once a week/Inshuro zirenze imwe mu cyumweru

4) Every day/ Buri munsi

10.10. How do you get access to weather/climate information / Amakuru agendanye n'iteganyagihe abageraho ate?

| Sources of information/ Aho mukura amakuru | Yes/yeg | No/oy |
|--|---------|-------|
| | 0 | а |
| Radio / Radiyo | | |
| Mobile phone/Telefone | | |
| Television/Televizion | | |

| Journals / Ibinyamakuru | |
|--|--|
| Meetings / Inama | |
| Other sources (mention) / ahandi (havuge | |

10.11. How frequent are you receiving weather/climate information/ Ni ryari mubona amakuru ajyanye n'iteganyagihe?

| Frequency/ inshuro | Yes/yego | No/oya |
|------------------------|----------|--------|
| Never/ Ntabwo | | |
| Per day/Buri munsi | | |
| Per week/Buri cyumweru | | |
| Per month /Buri kwezi | | |

| | Yes/yego | No/oya |
|---|-----------------|--------|
| 10.12.a) Have you received any technical advice or training related to the use of weather information / Mwaba mwarigeze muhabwa ubujyanama bubafasha kubyaza umusaruro amakuru y'iteganyagihe? | | |
| 10.12.b) If yes, mention it / Niba ari y | rego bisobanure | |

10.13 Have you adopted one or more of the following climate resilient technologies? /Mwaba mukoresha bimwe muri ibi bikorwa bigaragaza ubushobozi bwo guhangana n'ingaruka ziterwa n'imihindagurikire y'ibihe?

| | Yes/yeg | No/oy |
|---|---------|-------|
| | 0 | а |
| Protection of housing infrastructure against lightening / Kurinda inyubako | | |
| | | - |
| Rain water harvesting and utilization /Gufata amazi y'imvura no kuyakoresha | | |
| Household waste water management /Gucunga neza amazi y'imyanda ava | | |
| mu rugo | | |
| Use of alternative sources of cooking other than biomass energy/ | | |
| Gukoresha ibidakomoka ku biti mu gucana | | |
| Development of irrigation scheme / Kugira imashini zuhira imirima | | |
| Adoption of crop varieties / Gusimburanya ibihingwa | | |
| Other climate resilient technology/ Ibindi | | |

| | Yes/yego | No/oya |
|--|----------|--------|
| 10.14 Do you have a Kitchen garden (Mwaba mufite akarima | | |
| k'igikoni) | | |

| | Yes/yego | No/oya |
|--|----------|--------|
| 10.15. Do you have any forest / waba ufite intamba | | |
| 10.16. If yes, how big it is / Niba ari yego ingana ite? | | |

| Yes/yego | No/oya |
|----------|--------|
| | |

| 10.17 (a) Do you have progressive terrances in your farmland / waba waraciye imiringoti mu mirima yawe? | |
|---|--|
| 10.17 (b) If yes, how big the covered area / Niba ari yego yaba | |
| ari ku butaka bungana gute? | |

| | Yes/yego | No/oya |
|--|----------|--------|
| 10.17 (c) Do you have radical terrances in your farmland / | | |
| waba baraciye amaterasi y'indinganire mu mirima yawe | | |
| 12.17.(d) If yes, how big the area covered by radical terrances/ | | |
| Niba ari yego wayiciye ku butaka bungana gute? | | |

10.18. Mention any other methods used to protect your land against flooding, fluvial erosion and landslides

10.19. In the 12 months, is there any household member(s) who received a training in any of these following areas / Kuva umwaka ushize hari umuntu wo mu rugo rwanyu waba warabonye amahugurwa?

| Areas | Yes/yeg | No/oya |
|---|---------|--------|
| | 0 | |
| Small-scale irrigation / Gufata amazi makeya yo kuhira imyaka | | |
| Tree nursery / Kwinaza ingemwe z'ibiti | | |
| Rainwater collecting/harvesting / Gufata amazi y'imvura | | |
| Improved grain drying, storage / kumusha imyaka | | |
| Improved seed preservation / guhunika imyaka | | |
| Mulching of soils / gusasira ubutaka | | |
| Inter-cropping methods / gusimburanya imyaka | | |
| Tree planting / gutera ibiti | | |
| Pest and weed control / gurwanya ibyonnyi n'udusimba turya imyaka | | |
| Use of organic manure / gukoresha ifumbire y'imborera | | |
| Domestic animal treatments (kwita ku matungo yo mu rugo) | | |
| Terracing and slope maintenance / Guca amaterasi no gutunganya | | |
| ubutaka buhanamye | | |
| Crop rotation /kunyuranya umusaruro | | |
| Mixing trees with crops /Gutera ibiti bivangwa n'imyaka | | |
| Accounting and improved business management for farming/ | | |
| | | |

10.20. List which skills are being used on any of the plots / Ni ubuhe bumenyi mwaba mukoresha bwakomotse kuri ayo mahugurwa mwabonye?

| Areas | Yes/yeg | No/oya |
|---|---------|--------|
| | 0 | |
| Small-scale irrigation / Gufata amazi makeya yo kuhira imyaka | | |
| Rainwater collecting/harvesting / Gufata amazi y'imvura | | |
| Tree nursery / Kwinaza ingemwe z'ibiti | | |
| Improved grain drying, storage / kumisha imyaka | | |
| Improved seed preservation / guhunika imyaka | | |
| Mulching of soils / gusasira ubutaka | | |
| Inter-cropping methods / gusimburanya imyaka | | |
| Tree planting / gutera ibiti | | |

| Pest and weed control / gurwanya ibyonnyi n'udusimba turya | |
|--|--|
| imyaka | |
| Use of organic manure / gukoresha ifumbire y'imborera | |
| Terracing and slope maintenance / Guca amaterasi no | |
| gutunganya ubutaka buhanamye | |
| Crop rotation /kunyuranya umusaruro | |
| Mixing trees with crops /Gutera ibiti bivangwa n'imyaka | |
| Accounting and improved business management for farming/ | |
| lcungamutungo no gucunga ibikorwa by'ubuhinzi | |
| Any other (specify)/ lyindi (yivuge) | |

10.21. How often do you meet/are you visited by following extension services/agents? Ni kangahe muhura/musurwa n'abashinzwe iyamamaza buhinzi?

| Agents | Frequency | /Inshuro |
|--|-----------|----------|
| | abasura | |
| Project service provider staff/Umukozi w'umushinga ufasha mu | | |
| gutanga serivisi | | |
| District agronomist/Umukozi w'akarere ushinzwe ubuhinzi | | |
| District veterinary officer/Umukozi w'akarere ushinzwe ubuvuzi | | |
| bw'amatungo | | |
| District Cooperative officer/Umukozi w'akarere ushinzwe | | |
| amakoperative | | |
| Sector agronomist/Umukozi w'umurenge ushinzwe ubuhinzi | | |
| Sector veterinary officer/Umukozi w'umurenge ushinzwe | | |
| ubuvuzi bw'amatungo | | |
| Sector Cooperative officer/Umukozi w'umurenge ushinzwe | | |
| amakoperative | | |
| Other visit (specify)/ Ubundi buryo (sobanura) | | |

Codes

| Never /ntabwo baza |
|--|
| Once a week/Buri cyumweru |
| Once a month /Buri kwezi |
| Every 2 months or more /Buri mezi 2 kujyana hejuru |
| I don't know/Ntabwo mbizi |

| | Yes/yego | No/oya |
|---|----------|--------|
| 12.22. Do you or any member of your household receive any | | |
| agricultural inputs in last I2 months/ Hari umuntu mu | | |
| muryango wanyu waba warahawe inyongeramusaruro mu | | |
| mezi 12 ashize | | |
| If yes name it/Niba ari yego yivuge | | |

11. Evidences of climate change and variability Exposure to climate change during the last 12 months / Ihinduka ry'ibihe mu mwaka ushize

11.1. How has the temperature been changing in last 12 months? /Ubushyuhe bwahindutse gute mu mezi 12 ashize?

| | Yes/yego | No/oya |
|-------------------------------------|----------|--------|
| Much hotter/Ubushyuhe bwahindutse | | |
| gute? | | |
| Warmer/ Bwariyongereye gake | | |
| No change/same / Ntacyahindutse | | |
| Cooler/Harushujeho gukonja | | |
| Much colder /Hasigaye hakonje cyane | | |

11.2. How has the rainfall been changing in last 12 months? /Imvura yahindutse gute?

| | Yes/yego | No/oya |
|--|----------|--------|
| Much more/Yariyongereye cyane | | |
| Small amount more/Yariyongereye | | |
| gahoro | | |
| No change/same /ntacyahindutse | | |
| Small amount less/Yaragabanutse gahoro | | |
| Much less/Yaragabanutse cyane | | |

11.3. How has the rainfall onset been changing in last 12 months? / Hari impinduka zabaye mu gihe imvura itangirira kugwa mu mezi 12 ashize?

| | Yes/yego | No/oya |
|--------------------------------|----------|--------|
| Early onset /Iratangira kare | | |
| Late onset/ Irakererwa kugwa | | |
| No change/same /Ntacyahindutse | | |

11.4. How has the rainy period been changing in last 12 months? Ni gute igihe imvura yagwagamo cyahindutse mu mezi 12 ashize?

| | Yes/yego | No/oya |
|---------------------------------|----------|--------|
| Became shorter / Cyabaye kigufi | | |
| Became longer /Cyabaye kirekire | | |
| No change/same / Ntacyahindutse | | |

11.5. How the changes observed in rainfall amount have affected your household's livelihood in last 12 months? /Ni gute impinduka mu migwire y'imvura zagize ingaruka ku mibereho y'urugo rwanyu mu mezi 12 ashize?

| Yes/yego | No/oya |
|----------|----------|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | Yes/yego |

11.6. Droughts or dry spells in last 12 months / amapfa n'igihe kirekire imvura yarabuze mu mezi 12 ashize

| | Yes/yego | No/oya |
|---|--------------|-------------|
| 11.6.1.a) .Have you experienced or observed dry | | |
| spells during the last 12 months in your village? / | | |
| Mwaba mwarigeze mugira amapfa muri uyu | | |
| mudugudu wanyu mu mwaka ushize | | |
| 11.6.1.b) If yes, mention the number the droug | ht episodes | have been |
| registered in the village | | |
| Niba ari yego wavuga inshuro yaba yarabaye muri | iyi myaka ib | iri ishize. |

11.6.2 The following are some of consequences resulted from drought episodes in last 12 months /lzi zikurikira ni zimwe mu ngaruka zakurikiye amapfa yabaye mu mezi 12 ashize.

| | Yes/yego | No/oya |
|--|----------|--------|
| Poor agricultural productivity / Umusaruro muke | | |
| Food shortage / kubura ku ibiribwa | | |
| Diseases and pests / udukoko n'udusimba byangiza imyaka | | |
| Water shortage for domestic and agricultural use / ibura | | |
| ry'amazi yo gukoresha mu rugo no mu mirimo y'ubuhinzi | | |
| Any other (specify)/ ikindi (kivuge) | | |

11.7. Flooding episodes in last 12 months / imyuzure mu mezi 12 ashize

| | Yes/yego | No/oya |
|---|---------------|----------------|
| 11.7a) Have you experienced or observed flooding episodes | | |
| during the last 12 months in your village? Mu mwaka ushize hari | | |
| ikibazo cy'imyuzure mwagize mu mudugudu wanyu? | | |
| II.7.b) If yes, mention the number the flooding episodes have bee | en registered | in the village |
| in past two years | | |
| Niba ari yego wavuga inshuro yaba yarabaye muri iyi myaka ibiri i | shize. | |

11.8 The following are some of consequences resulted from flooding episodes in last 12 months /lzi zikurikira ni zimwe mu ngaruka mbi zatewe n'umwuzure mu mezi 12 ashize:

| | Yes/yego | No/oya |
|---|----------|--------|
| Poor agricultural productivity / umusaruro muke w'ubuhinzi | | |
| Destroying crops / Kwangiza imyaka | | |
| The increase of the level of rivers water / kwiyongera kw'amazi | | |
| y'imigezi | | |
| Rivers water pollution / guhumanya imigezi | | |
| Increase of diseases / kwiyongera kw' indwara | | |
| Destruction of family properties / kwangiza imitungo y'urugo | | |
| Destruction of bridges / gusenya ibiraro | | |
| Destruction of roads / gusenya imihanda | | |
| People's death / guhitana ubuzima bw'abantu | | |
| Any other (specify) / ikindi (kivuge) | | |

11.9. Occurrences of strong winds in last 12 months /Imiyaga ikabije mu mezi 12 ashize

| | Yes/yego | No/oya |
|--|---------------|-------------|
| | | |
| 11.9.1.a) Have you experienced any occurrence of strong winds | | |
| during the last 12 months in your village?/ hari ikibazo cy'imiyaga | | |
| ikabije cyabayeho mu mwaka ushize muri uyu mudugudu wanyu? | | |
| 11.9.1.b) If yes, mention the frequency (number) of occurrence of st | rong winds | have been |
| registered in the village / Niba ari yego wavuga inshuro yaba yaraba | ye muri iyi r | nyaka ibiri |
| ishize. | | |

11.9.2 The following are some of consequences resulted from occurred strong winds in last 12 months /Izi zikurikira ni zimwe mu ngaruka mbi zatewe n'imiyaga ikabije mu mezi 12 ashize:

| | Yes/yego | No/oya |
|---|----------|--------|
| Destruction of crops / kwangiza imyaka | | |
| Destruction of family properties / gusenya imitungo y'umuryango | | |
| Destruction of trees /kwangiza ibiti | | |
| People's death / guhitana ubuzima bw'abantu | | |
| Any other (specify) /ikindi (kivuge) | | |

11.10. Severe thunder storms with lightning in last 12 months /Inkuba n'imirabyo mu mezi 12 ashize

| | Yes/yego | No/oya |
|--|-------------|-----------|
| 11.10.1.a) .Have you experienced any severe thunder storms with | | |
| lightning during the last 12 months in your village?/ Mwigeze mugira | | |
| ibibazo by'inkuba nyinshi n'imirabyo mu mudugudu wanyu mu | | |
| mwaka ushize | | |
| 11.10.b) If yes, mention the frequency (number) of occurrence of s | evere thund | er storms |
| with lightning in the past 2 years in your village? / Niba ari yego | wavuga ins | huro yaba |
| yarabaye muri iyi myaka ibiri ishize | | |

11.11. The following are some of consequences resulted from severe thunder storms with lightning in last 12 months /lzi zikurikira ni zimwe mu ngaruka mbi zatewe n'inkuba nyinshi n'imirabyo mu mezi 12 ashize:

| | Yes/yego | No/oya |
|--|----------|--------|
| Destruction of crops / Kwangiza imyaka | | |
| Destruction of family properties / kwangiza imitungo | | |
| y'urugo | | |
| Destruction of trees / kwangiza ibiti | | |
| People's death / guhitana ubuzima bw'abantu | | |
| Any other (specify) /ikindi (kivuge) | | |

| | Yes/yego | No/oya |
|---|----------|--------|
| 11.12. Are you aware of adverse effects of climate change/ ingaruka mbi z'ihindagurika ry'ibihe? / Mwaba muzi ingaruka mbi z'ihindagurika ry'ibihe? | | |
| If yes mention them /Niba ari yego zivuge | | |

12. Capacity to adapt to climate change impacts / Ubushobozi mu guhangana n'ihindagurika ry'ibihe

| | Decreased | No change | Increased |
|---|-----------------|-------------------|-----------------|
| | Bwaraganut | Ntibwahindut | Bwariyongere |
| | se | se | уе |
| 12.1. Did you see any change in woodland areas for the past two years?/ Haba harabayeho ihindagurika ry'ubutaka | | | |
| buhinzeho amashyamba muri iyi myaka ibiri ishize? | | | |
| 12.2. Do you or any member of your house | ehold belong to | o any Forest Man | agement Units? |
| (Waba uba mu itsinda ryita ku kubungabun rivuge). | ga amashyamba | a? If yes name it | (Niba ari yego, |

12.3. Do you have the following capacity to deal with climate change/variability impacts/ Mwaba mufite ubu bushobozi muguhangana n'ingaruka z'izindagurika ry'ibihe?

| | Yes/yego | No/oya |
|--|----------|--------|
| Enough knowledge on climate change and their impacts / Ubumenyi | | |
| buhagije muguhangana n'ingaruka z'izindagurika ry'ibihe | | |
| Financial capacity / ubushobozi bw'amafaranga | | |
| Availability of timely weather/climate information / amakuru ya buri | | |
| gihe y'iteganyagihe | | |
| Governmental/non-governmental support / inkunga ikomoka kuri leta | | |
| n'imiryango yigenga | | |
| Awareness to adapt to climate change and variability / kumenya | | |
| uburyo bwo kubana n'ihindagurika ry'ibihe | | |
| Availability irrigation schemes and water channels /Mwaba mufite | | |
| uburyo bwo kuhira imyaka n'imiyoboro y'amazi | | |
| Availability of basic infrastructure (e.g. roads and bridges, rain-water | | |
| channels, etc.) / ibikorwa remezo (urugero:, imihanda n'ibiraro, | | |
| imiyoboro y'amazi y'imvura n'ibindi) | | |
| Others (specify) /ikindi (kivuge) | | |

12.4. Mention the appropriate adaptation measures to be undertaken to deal with climate change effects in this sector / Ni ubuhe buryo bukwiye gukoreshwa mu rwego rwo guhangana n'imihindagurikire y'ibihe muri uyu murenge?

| | Yes/yego | No/oya |
|---|----------|--------|
| Planting trees / gutera ibiti | | |
| Radical terraces / gukora amaterasi y'indinganire | | |
| Progressive terraces / gucukura imiringoti | | |
| Rainwater harvesting / gufata amazi y'imvura | | |
| Growing selected seeds / Guhinga imbuto y'indobanure | | |
| Integration of weather/climate information in agricultural activities | | |
| Gukoresha amakuru y'iteganyagihe mu bikorwa by'ubuhinzi | | |
| n'ubworozi | | |
| Irrigation / gufata amazi yo kuhira | | |

| Plant diseases and pest control / Gutera ibiti bishanya ibyonnyi by'imyaka | |
|--|--|
| Multi-cropping / Kuvanga imyaka | |
| Any other (specify) / ibindi (bivuge) | |

| | Yes/yego | No/oya |
|---|----------|--------|
| 12.5. Are you aware of improved soil management practices | | |
| If yes mention them/Niba ari yego zivuge | | |

| | Yes/yego | No/oya |
|--|----------|--------|
| 12.6. Are you aware of erosion control practices?/Mwaba muzi | | |
| uburyo mwakoresha mu kurwanya isuri? | | |
| If yes mention them/Niba ari yego zivuge | | |

10.2. Appendix 2:FGDs guide with respondents from around five project sites

- 1. What are the main sources of income for your families?/Ni hehe h'ingenzi mukura ibitunga umuryango?.....
- 2. Have you ever experienced negative impacts due to drought or dry spells episodes in this sector for the last two years?/ Mwaba mwarigeze mugira ingaruka zikomoka ku mapfa cyangwa ibura ry'imvura muri uyu murenge mu myaka ibiri ishize ?....

If yes mention them / Niba ari yego wavuga igihe byabereye.

- 3. Have you ever experienced negative impacts due to flooding episodes or heavy rainy fall in this village for the last two years?/Mwaba mwarigeze mugira ingaruka zikomoka ku mwuzure muri uyu murenge mu myaka ibiri ishize......
 If yes, mention them / Niba ari yego wavuga igihe byabereye......
- 4. If you have faced negative impacts from any other extreme weather events mention it and describe how it was the situation/ Niba mwarigeze mugira ikindi kiza gikomoka ku ihindagurika ry'ibihe wakivuga, ukanasobanura uko byagenze.
- 5. (a) If you have experienced negative impacts due to the above mentioned weather extreme events, how did you cope with them / Niba mwarahuye na kimwe mu biza byavuzwe haruguru musobanure uburyo mwabyitwayemo.....
- 6. Mention any support you have receive if any the time you have been affected by weather extreme events/Mwatubwira inkunga mwaba mwarabonye mu gihe mwahuraga n'ibyo biza.
- 7. What can be done to reduce negative impacts of weather extreme events in this area?/Mubona hakorwa iki mu rwego rwo guhangana n'ibiza muri aka gace?.....

- 8. What strategies have been put in place to mitigate the negative impacts of weather extreme events mentioned above?/ Ni izihe ngamba mwashyizeho kugirango mukumire ingaruka mbi zibiza bitewe n'ihindagurika ry'ibihe?.....
- 9. What are you proposing to be done improve your capacities to deal with adverse impacts of climate change/ Mwumva hakorwa iki cyabafasha kongera ubushobozi bwanyu bwo guhangana n'ingaruka z'ihindagurika ry'ibihe?

10.3. Appendix 3:KIIs guide with local leaders of around five project sites

I. What are the main sources of income for households in this area? Ni hehe h'ingenzi mukura ibitunga umuryango?.....

(a) What are the negative impacts of climate change which affected much more the households of this area? / Ni izihe ngaruka zikabize kuruta izindi zikomoka ku ihindagurika ry'ibihe mwaba mwaragize muri aka gace?....

(b) Do the people's activities in this area contribute to the causes of negative weather change?/ Abaturage bo muri aka gace baba bafite ibikorwa byatera ihindukagurika ry' ibihe?.....

2. What did people do to cope with them / Ni iki abaturage bakoze mu rwego rwo guhangana n'izo ngaruka?

.....

3. Mention any support provided to households affected negatively by weather extreme events / Mwatubwira inkunga abaturage baba barabonye mu rwego rwo guhangana n'ingaruka z'ihindagurika ry'ibihe

- 3. Is there any relationship between climate change and food security in this Area? If yes, provide it / Mubona hari isano riri hagati y'imibereho mwiza y'abaturage muri iki gihe n'ihindagurika ry'ibihe? Niba ari yego mudusobanurire.....
- 4. What are the key projects/programs supporting households of this sector/area to improve their standard of living / Mwatubwira imishinga yaba iri muri uyu murenge/agace ifasha abaturage kuzamura imibereho myiza?....
- 5. What would you consider the best climate change adaptation measures that could be applied in this Sector/area? / Mwumva hakorwa iki mu rwego rwo guhangana n'ingaruka z'imihindagurikire ry'ibihe muri uyu murenge/ agace?.....
- 6. (a) Are there any community based initiatives that are used to cope with climate change?/ Haba hari uburyo abaturage bishyiriyeho bwo guhangana n'ihindagurika ry'ibihe?
 - (b) What the financial constraints do you encounter/Ni izihe mbogamizi zijyana n'ubushobozi bw'amafaranga muhura nazo
- 7. What measures do you propose that would build your capacity to deal with the impacts of climate change?/ Ni izihe ngamba mwumva zikwiye kujyaho mu rwego rwo kubongerera ubushobozi bwo guhangana n'ingaruka z'ihindagurika ry'ibihe.
- 8. What can be done to improve the institutional capacities to deal with adverse impacts of climate change?/Mwumva hakorwa iki mu rwego rwo kongerera ubushobozi inzego za leta n'izigenga muguhangana n'ingaruka z'ihindagurika ry'ibihe?

10.4. Appendix 4:KIIs guide with leaders at central and institutional level

- I. (a) Do have any training or staff capacity building programs in dealing with adverse impacts of climate change at institutional level? Mwaba mugira gahunda y'amahugurwa cyangwa yo kongera ubushobozi abakozi banyu mubijyanye no guhangana n'ingaruka z'ihindagurika ry'ibihe?
 - (b) Grading the availability of training related to environment and climate change ((i): never,
 - (ii) Rarely, (iii) some times, (iv) Frequent
- 2. What would you consider the best climate change adaptation measures that could be applied in Rwanda? / Mwumva hakorwa iki mu rwego rwo guhangana n'ingaruka z'imihindagurikire ry'ibihe muri uyu murenge/ agace?.....
- 3. (a) Do have any budget allocated to activities related to environment and climate change? Haba hari amafaranga mwaba mwarateganyirije ibikorwa bijyana n'ihindagurika ry'ibihe?
 - (b) If not, do you think that such budget for activities related to environment and climate change is needed by your institution? Niba ntayo waba ubona se ingengo y'imari ijyanye n'ibikorwa byerekeranye n'ibidukikije ndetse n'ihindagurika ry'ibihe yaba ikenewe?
- 4. What measures do you propose that would build your capacity to deal with the impacts of climate change?/ Ni izihe ngamba mwumva zikwiye kujyaho mu rwego rwo kubongerera ubushobozi bwo guhangana n'ingaruka z'ihindagurika ry'ibihe.
- 5. What can be done to improve the institutional capacities to deal with adverse impacts of climate change?/Mwumva hakorwa iki mu rwego rwo kongerera ubushobozi inzego za leta n'izigenga muguhangana n'ingaruka z'ihindagurika ry'ibihe?

THANK YOU/MURAKOZE

| SN | Institution/Organisatio | Names | Position | Telephone |
|-----|---|-------------------------------|---|--------------------------|
| ١. | Ministry of Environment (MoE) | Dusengimana Theophile | Environment and Climate Change Policy specialist | 0788799280 |
| 2. | Ministry of Finance and Economic Planning (MINECOFIN) | Harerimana Bernard | Planning Specialist | 0788845349 |
| 3. | Ministry of Local Government (MINALOC) | Maurice Nsabibaruta | Acting Director General for Planning, Monitoring and Evaluation | 0788478131 |
| 4. | Ministry of Infrastructure (MININFRA) | Emmanuel Nuwamanya | Planning Division Manager | 0788660227 |
| 5. | Ministry of Emergency Management (MINEMA) | Elisabeth Yambabariye | Drought and Flood Risk Management Engineer | 0788810262 |
| 6. | Ministry of Agriculture (MINAGRI) | Emmanuel Twagirayezu | Soils and Water Management Specialist | 0788640537 |
| 7. | Rwanda Land Management and Use Authority | Leonard Kayonga | Director of Land Use Management and Spatial Planning | 0788491881 |
| 8. | Rwanda Development Board (RDB) | Telesphore Ngoga | Analyst, Tourism and Conservation | 0788874321 |
| 9. | Rwanda Mines, Petroleum and Gaz Board | Byayesu Karakire Nathan | Mining Inspector | 0786422422 |
| 10. | Rwanda Forestry Authority (RFA) | Gahigi Didas | Forest Plantation and Monitoring Officer | 0788683948 0727000597 |
| 11. | Rwanda Green Fund (FONERWA) | Sylviia Kawera | Project Analysis Specialist | 0788637631 |
| 12. | Meteo Rwanda | Tuyisenge Aminadab | Senior Forecaster | 0788541981 |
| 13. | Rwanda Water Resources Board | Remy Norbert Duhuze | Water Monitoring And Quality Control Division Manager | 0788612725 |
| 14. | Ministry of Education | Rugamba Vianney | Financial expert, climate change | 0784481618 |
| 15 | GS Giheke, Rusizi district, Giheke sector, Giheke cell, Rwumvangoma village | Nshimiyimana Thomas | Head Teacher | 0788692873 |
| 16 | Rusizi district | Kankindi Léoncie | Vice Mayor Economic Affairs | 0788491401 |
| 17 | Giheke Sector in Rusizi district | Bavugamenshi Théoneste | Sector agronomist | 0788440882 |
| 18 | Ndera sector in Gasabo district | Kampundu Jeannette | Executive Secretary at Ndera Sector | 0788415501 |

10.5. Appendix 5: List of Key Informants

| 19 | College Doctrinal Vital at | Iradukunda | Head Teacher | 0785700146 |
|----|----------------------------|----------------|-----------------------------|------------|
| | Ndera sector, Kibenga cell | Joseline | | |
| | | | | |
| 20 | Gasabo district | Kayihura Félix | Director of Agriculture and | 0738303340 |
| | | N.L | Natural Resources | 0700050070 |
| 21 | Kicukiro district | Ngizwenayo | Forestry and natural | 0788250962 |
| | | Anaclet | resources officer at | |
| 22 | | M | Kicukiro District | 070000051 |
| 22 | Karama sector in | Munyanama | Sector Agronomist | 0788808351 |
| | Nyagatare district | Emmanuel | | |
| 23 | Tabagwe Sector in | Kanyange | Forestry and natural | 0735298595 |
| | Nyagatare district | Olive | resources officer | |
| 24 | Rwempasha sector | Nubuhoro | Forestry and natural | 0783366397 |
| | | Sarah | resources officer | |
| 25 | Nyagatare district | Murenzi | Officer in charge of | 0783589143 |
| | | Samuel | environment | |
| 26 | GS Nyagatare in | Kamali Jean | Director of studies | 0788605083 |
| | Nyagatare Sector | Damascène | | |
| 27 | Mpanga sector in Kirehe | Niyonzima | Sector agronomist | 0787809845 |
| | district | Jean Paul | | |
| 28 | Kirehe district | Kilinda Vital | Forestry and natural | 0788454466 |
| | | | resources officer | |
| 29 | EP Ibanga in Mpanga sector | Munyemgabe | Head Teacher | 0783338266 |
| | in Kirehe district | Alfred | | |
| | | | | |