

REPUBLIC OF RWANDA



**MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES (MINAGRI)
RWANDA AGRICULTURE AND ANIMAL RESOURCES DEVELOPMENT BOARD (RAB)**

Final report

**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)/ENVIRONMENTAL AND SOCIAL
MANAGEMENT PLAN (ESMP) OF THREE IRRIGATION SCHEMES IN NDEGO SECTOR, KAYONZA
DISTRICT, EASTERN PROVINCE IN RWANDA.**

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ENGINEERING-ENVIRONMENT-CLIMATE CHANGE & SOCIO-ECONOMIC STUDIES

DISCLOSURE OF CONSULTANT

Name of the Project: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)/ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) FOR THREE IRRIGATION SCHEMES IN NDEGO SECTOR, KAYONZA DISTRICT, EASTERN PROVINCE IN RWANDA	
Nature of assignment	Preparing Environmental and Social Impact Assessment (ESIA)/Environmental and Social Management Plan (ESMP) Report
Name of approved EIA expert	Bureau for Engineering and Environmental Studies/BESST LTD, RAPEP/EA/071
Team Leader	Mr. Théogène HABAKUBAHO/Lead EIA Expert / RAPEP/EA/024
Water Resources management	Nshimiyimana Fabien /Lead EIA Expert/RAPEP/EA/035
Soil Scientist	Ruzibiza Marcel
Ecologist	Kayijamahe Birasa Charles /Associate EIA expert/ RAPEP/EA/050
Mukarwego Mediatrice	Socio-economic Expert

I hereby undertake that all requirements included in terms of reference provided by the client and approved by Rwanda Development Board (RDB) are complied with. I also undertake that the facts given in the **Environment and Social Impact Assessment (ESIA)/Environmental and Social Management Plan(ESMP) for the three irrigation schemes in Ndego Sector Kayonza District of Eastern Province in Rwanda** are factually correct to the best of our knowledge.



Théogène HABAKUBAHO
Managing Director
Bureau for Engineering and Environmental Studies

EXECUTIVE SUMMARY

• Introduction

Rwanda is undergoing massive economic development and it is imperative to have facilities that can support the country's ambitions. In this framework, the Government of Rwanda received funds from International Fund for Agriculture Development (IFAD) to implement Kayonza Irrigation and Integrated Watershed Management Project(KIIWP), in Kayonza district, Eastern Province in Rwanda. The Ndego project is part of a larger scale investment by GoR to develop up to 7000ha of irrigated land over four sites in Kayonza district. This is in supporting the government of Rwanda to achieve its strategic goals of economic transformation whose focus is to unlocking rural growth in order to increase agricultural production, increase beneficiary farmers' income, reduce poverty, and improve living conditions.

The project is implemented by Ministry of Agriculture and Animal Resources (MINAGRI) through Rwanda Agriculture Board (RAB). Though the proposed projects is expected to have more benefits on socio-economic development, some of the proposed activities such abstraction of water in lakes, construction of irrigation canals, water storages, land husbandry works and use of fertilizers may have negative impacts on receiving environment and local communities. Therefore, the implementation of the proposed projects should be done in full compliance the law on Environment of 2018, Ministerial Order of 2019 Ministerial Order establishing the list of projects that must undergo environmental impact assessment, instructions, requirements and procedures to conduct environmental impact assessment and General Guidelines and Procedures for Environmental Impact Assessment (2006). Further, the project should comply with IFAD's Social Environmental and Climate Assessment Procedures (SECAP, 2017). To this effect, RAB contracted Bureau for Engineering and Environmental Studies (BESST LTD) to conduct an Environmental and Social Impact Assessment (ESIA) that includes an Environmental Management and Monitoring Plan (ESMMP). The present ESIA is for Ndego irrigation schemes with a targeted irrigated area of around 2,000ha net divided into three blocks, Ihema, Kibare and Nasho.

• Objectives of the ESIA study

The overall objective of the assignment is to develop an Environmental and Social Impact Assessment (ESIA) and an Environmental and Social Management Plan (ESMP) for the proposed Ndego irrigation schemes to ensure that the project is implemented in an environmentally and socially sustainable manner and in full compliance with national environmental regulations as well as best international Policies. Specific objectives of this ESIA are to: Contribute to the environmental and social design for the schemes, (ii) establish a baseline for biophysical, climatic conditions and socio-economic data, (iii) identify all potential adverse environmental and social impacts of the schemes and recommend measures for mitigation, and (iv) develop a comprehensive Environmental and Social Management and Monitoring Plan (ESMMP), which will include costs for mitigation;

• Approach and Methodology of the study

To achieve the study objectives consultant was guides by terms of Reference prepared by Rwanda Agriculture Board (RAB) and approved by Rwanda Development Board(RDB) EIA department, National general guidelines on Environmental impacts assessment, as well as international policies especially IFAD's Social Environmental and Climate Assessment Procedures (SECAP, 2017). The study adopted the following approach: (i) Preliminary assessment and review of preliminary design of the project, design studies, KIIWP Environmental and Social Management Framework(ESMF) and EIA reports of similar project, (ii) review of secondary data on baseline information (iii) review of policies and regulations, (iv) interviews with key stakeholders, and (v) field surveys at the project sites including socio-economic baseline, flora and fauna data collection. Spatial data ,site locations, land cover, proposed infrastructure were described fully with clear maps using Global Position System(GPS) and Geographic Information System (GIS) tools for a comprehensive understanding of the area and project activities and to make the task of planning and monitoring easier during the implementation of the mitigation measures for the identified impacts.

• Project location and description

Ndego irrigation schemes are part of Kayonza Irrigation and Integrated Watershed Management Project (KIIWP) funded jointly by International Fund for Agriculture (IFAD) and Government of Rwanda. KIIWP will be implemented in the most drought-prone Sectors of Kayonza District in Eastern Province, Rwanda. The

district is bordered to the north and north-west by Gatsibo District, Rwamagana District to the west, Ngoma District to the south-west and Kirehe District to the south. It shares its eastern border with Tanzania.

The Ndego Schemes covered under this Environmental and Social Impact Assessment (ESIA) are located in Ndego sector, Kayonza District, in the Eastern Province of Rwanda. The Targeted irrigated area is around 2,000ha net divided into three blocks, block Ihema, block Kibare and block Nasho, or designated as s Block 1,2 and 3. The irrigation infrastructures include balancing storages, CPT, pipelines, sprinkler and drainage canals. In addition to the irrigation facilities, land husbandry works will be implemented in this area. The command area catchment for each block will be treated and it totals up 2,491.75 ha accounting for 55.25 % of the total project site. The major portion of the command area catchment (86.2%) is situated in 0-6% slope class while 6-16% slope category cover only 13.8% of the total catchment. This shows that the project sites are almost flat and will therefore be treated with appropriate biological measures while the land on 6-16% of the slope will be treated with water retention ditches (or anti-erosive trenches) supported with appropriate biological technologies.

The command area (CA) is situated on the shores of the lakes and is under agricultural crops. Based on the soil and the slope maps for Ihema, Nasho and Kibare sub catchments, the slope of the area is dominantly characterised by gentle slopes ranging from 0 to 16%. The big part of CA (72.4%) is dominated by slopes varying between 0-6% while the rest ranges between 6 and 16% of slope. The construction of irrigation infrastructures and the implementation of land husbandry technologies are planned as the main activities of Ndego project. The irrigation facilities will only be installed in the command area while the command area catchment will remain rain fed. The land husbandry infrastructures will be executed both in CA and CAC. Land husbandry technologies were proposed based on the nature of the project watershed features of the command area catchment and the command area (ie slope category, soil depth). Access roads and post-harvest infrastructures are among other activities to be supported in Ndego area.

- **Legal and regulatory framework**

The preparation, implementation, and implementation of Ndego irrigation schemes will comply with both national regulations and IFAD environmental and Social Policies. At national level, environmental regulations start with the Constitution of the Republic of Rwanda, promulgated in 2003 and revised in December 2015, which articulates the rights and responsibilities of all citizens and the role of the state regarding the environment by providing that every citizen is entitled to a healthy and satisfying environment and that every person has the duty to protect, safeguard and promote the environment. The Constitution recognizes ownership of property and every person's right to private property. Consequently, private property, whether individually or collectively owned, is inviolable. However, the right to property may be overruled in the case of public interest, and in such cases procedures are determined by the law and subject to fair and prior compensation. Key national policies and strategies relevant to KIIWP are the National Environment Policy, Land Policy, Agriculture Policy, Fertilizer Policy, Water Resources Management Policy, Health Sector Policy, Green Growth and Climate Resilience Strategy, Biodiversity Strategy and the Strategy for Transformation. Pertinent national legislation and ministerial orders cover Environment, Land, Expropriation in the Public Interest, Structure of Lands, Modalities of Land Registration, Agrochemicals, Environmental Impact Assessment, and Protected Animal and Plant Species.

In terms of institutional arrangement for environmental management as applicable to KIIWP, the Ministry of Environment (MOE) is the ministry responsible for the environment. The Rwanda Environmental Management Authority (REMA) was established under Law No. 16/2006 of 2006 as amended in 2013, as the authority in charge of supervising, monitoring and ensuring that issues relating to environment are integrated in all national development programs. However, the mandate for implementing EIA of development activities is delegated to the One Stop Centre within the Rwanda Development Board (RDB). Ministry of Agriculture and Animal Resources (MINAGRI) has a primary mandate for the development, transformation and modernization of agricultural sector in Rwanda, while the Rwanda Agriculture and Animal Resources Development Board (RAB) has a mandate to coordinate all activities in relation with agriculture and animal resources development. The Rwanda Water and Forestry Authority (RWFA) is responsible for implementing policies, laws, strategies and Government decisions related to the management of forests and natural water resources. Finally, the Eastern Province and Kayonza District Administration are also involved in supporting

the RDB to review Project Briefs, EIA reports, organize and host public hearings, and in the implementation of environmental management and monitoring plans.

Further, Rwanda is party to a number of international treaties and conventions including: the Convention on Biological Diversity (CBD), Cartagena Protocol to the CBD, Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES), the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol to the UNFCCC, the Ramsar Convention, the Stockholm Convention on Persistent Organic Pollutants, the Rotterdam Convention on Commercial Transactions of Agricultural Pesticides and Other Poisonous Products, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes, the Montreal Convention on Substances that Deplete the Ozone Layer, and the Bonn Convention on Conservation of Migratory Species of Wild Animals

IFAD policies applicable to the proposed project include policies on Improving Access to Land and Tenure Security, Disclosure of Documents, Environment and Natural Resources, Gender Equality and Women's Empowerment, and Targeting, as well as a Climate Change Strategy and Social, Environment and Climate Assessment Procedures (SECAP). The preparation of this ESIA was also guided by the Environmental and Social Management Framework (ESMF) prepared for KIIWP.

- **Topography of the project area**

The relief of project is made of many hills and slopes whose altitude varies between 1400 and 1600 masl, generally decreasing towards the East. The Project area is characterized by a series of hills with soft slopes except in the East where one finds some slopes stiff and stony. The hills roughly run North to South through the middle of the district (the Eastern Plateau) and give way to valleys where floodplains and wetlands are found. To the east of this line of hills is a large gently undulating expanse – the Eastern Savannah which slopes towards the Akagera wetlands system. In general the area has low to moderate slopes. The slope of the area is dominantly characterised by gentle slopes ranging from 0 to 16%. The geology of Rwanda generally comprises metamorphic rocks and granitic rocks of the Precambrian period. Metamorphic rocks are mostly schists produced by low to medium pressure metamorphic actions of sandy to muddy sediments, while the granitic rocks are intrusive rocks originating from metamorphic actions. Metamorphic rocks of quartzite and schist and sedimentary rocks of mudstone and sandstone run in a north-south direction through the middle of Kayonza District. The lakes and marshes have sediment alluviums, and alluvial layers composed of clay, sand and gravel layers are distributed along rivers and valley floors. The soil study was carried out to investigate on the current status of physical-chemical characteristics of soils in the study area and carry out a suitability analyses of the soil units for irrigated agriculture.

- **Climate and weather conditions**

The climate of the project area is characterised by two rainy seasons from March to May and from October to December (bimodal pattern). The area is also characterised with two dry season, long dry season (June-September) and short dry season(January-February). The monthly rainfall varies from 11mm in March, 162 mm in April declining through 10.3 mm in July. The annual rainfall for the command areas is 998 mm with annual dependable rainfall of 772mm. On average 71% of the annual total rainfall falls during the wet seasons. Data on wind speed, relative humidity and solar radiation was available at Ndego station whereas data on maximum and minimum temperature were available from Kayonza station.

- **Availability of Water resources**

The Project area lies within the natural drainage of lower Akagera Catchment characterized by high and sharp ridges on the west side and low slope catchments draining to the Lakes of interest as shown in Figure 7 above. The catchment elevation varies from 1276 m.a.s.l. to 1319 m asl. The Akagera ecosystem complex dominates the ecosystem of the project area with smaller lakes and wetlands located on both sides. Connections do exist between the Lakes and Akagera River which is a critical factor for recharge of the lakes especially during the dry season when the water level in the river is the lowest. Observations were made during the bathymetry survey providing evidence of hydraulic connection between the Lakes and the Akagera river.

- **Ecological status of project area**

Ndego irrigation systems are located in Kayonza district which hosts important ecological zone including savannah Park, lakes and wetlands. The District contains a half of Akagera National Park which accommodates a vast number of wildlife such as buffalo, elephants, antelopes and many other ruminants. The area targeted by project, used to be part of the park before 1994 and is located in new Akagera wetland complexes made of many lakes and wetlands. These characteristics make the project area biodiversity hotspots containing more endemic mammals, birds, butterflies, fish and amphibians than anywhere else does in the country. However the area targeted by the project is already transformed to agriculture land and natural habitat has already disappeared and only water abstractions from lakes is likely to affected biodiversity during construction and operation phase. Only overwater abstraction in lakes and excessive use of chemical fertilizers may affected Fauna and Flora species in Akagera wetlands complex.

- **Socio-economic situation**

In reference to the 4th population and households census (2012), the total number of households (HH) in Ndego sector is 4,542 with corresponding population of 18,918 residents of which 9,241 are male residents (about 49%) and 9,677 are female (51%). Regarding the population structure, as shown in Figure 4 below, there are more females (52%) than males (48%) in the affected areas. The targeted area population is generally young with 69% of the population below the age of 30 years and 55% below 20 years. 56% of the households in all sites consider crop production and livestock with some cropping (28%) as their main economic activity. Community members in the targeted areas reported repeated food shortages in the target areas over the last 2 years resulting in some households migrating from Ndego Sector into neighbouring areas such as Mpamba sector around lake Nasho and Nasho sector in Kirehe district.

- **Prediction and assessment of potential impacts**

The project is expected to have both positive and negative impact. Positive environmental impacts expected from Ndego irrigation project include: increased productivity and income with possibility of having more agriculture seasons, temporary and permanent employment opportunity, transfer of skills from construction activity, adaptation to climate change through provision of water in drought seasons, and environmental protection crop diversification and increased value of production in hillside areas; increased value of agricultural production, reduced post-harvest losses and increased sales in output markets production and improved access to water for livestock and humans. Key anticipated adverse impacts include those associated with establishment and operation of irrigation system including:

- Reduction in downstream flow as a result of diversion of water, which could compromise water availability downstream to satisfy human and livestock demand, and affect aquatic habitats and biodiversity (ie. environmental flow);
- Soil erosion caused by scheme excavation works (including access/scheme roads, dams) and poorly managed upper catchment areas, leading to loss of cultivable land and/or siltation of canals;
- Soil degradation and salinization due to improper application of agrochemicals, overwatering and poor drainage;
- Reduction in water quality due to application of agrochemicals or oil spills, affecting water for domestic and livestock use downstream, as well as causing poisoning of aquatic fauna;
- Loss of biodiversity and ecological imbalances caused by: clearing land for agriculture, installing irrigation infrastructure (eg. intakes in wetlands or lakes), poaching as a result of the schemes' proximity to the Akagera National Park, and from pesticides poisoning of non-target species, particularly bees and other beneficial insects;
- Resistance to pesticides and pest resurgence due to poor application of pesticides;
- Temporary and permanent land take for construction sites and irrigation infrastructure leading to loss of land and assets;
- Denied or hindered access for livestock to water sources and/or pasture;
- Community health and safety risks from: construction activities; storage, handling, use and disposal of agrochemicals; failure of dam structures; increase prevalence of water-borne diseases such as malaria;
- Human/wildlife conflict as a result of wildlife raiding farms and destroying crops;

- Reduction in water availability due to climatic events, such as prolonged dry seasons and subsequent drought,

Other anticipated impacts are associated with land husbandry works and include:

- Failure of structures such as water balancing due to poor design and/or construction, or maintenance;
- Use of exotic species for slope protection and bio-engineering resulting in the spread of invasive species;
- Denied or hindered access to natural resources or grazing areas;
- Temporary acquisition of land for catchment rehabilitation leading to loss of land and assets;
- Loss of plants or trees of cultural and traditional significance.
- Loss of income during land husbandry works

- **Involuntary resettlement implications**

Feasibility study applied avoidance principles and irrigation schemes are proposed in a way that avoided any physical resettlement. This was made possible mainly due to structure of settlement in project area where the local community is living in grouped settlement known as "imidugudu". However, land acquisition is expected where pressure pipe from Kibare Lake to Ihema blocks, Water Pumping stations and water balancing reservoirs will be constructed. Further, farmers will experience loss of income during land husbandry works as they may miss one or more agriculture season. Plots that will be affected have been identified but will be confirmed during detailed design study. Though there is no physical involuntary resettlement expected but around 200 households will lose part of the land and another more than 1,200 households will lose income during land husbandry work. Further, grazing land will be transformed into agriculture land and some cattle sheds will be relocated. Therefore, an abbreviated Resettlement Action Plan and Livelihood Restoration Plan are resettlement instruments recommended.

- **Mitigation measures**

Mitigation measures were proposed for each of the adverse impacts anticipated, to an extent that they can be avoided, reduced, limited or eliminated hence manageable. Furthermore, an Environmental and Social Management Plan (ESMP) and an Environmental Monitoring Plan indicating the mitigation measures, procedure to be followed, monitoring indicators, the responsible institutions to implement these measures and likely cost of implementing each of these mitigation measures have all been included in this report.

- **Implementation and Monitoring arrangement**

The Environmental and Social Monitoring Plan is included in this ESIA and details monitoring activities and measures to be undertaken during construction and operation phases. It provides key parameters to be monitored, indicators and means of verification, frequency and timeframe, responsible institution and the estimated cost. In terms of implementation, RAB through KIIWP SPIU is the lead agency in the implementation of this ESMP and the overall project. The role of RAB/KIIWP is to implement mitigation measures, building the capacity of other actors in SPIU, and in environmental management. The capacity building activities should be through hands-on experience approach. The project should establish one capacity building scheme, which will act as the field school. RAB/KIIWP should designate Environmental Specialist (ES), to formally address environmental and social issues on a routine basis, who will have an oversight of environmental aspects of the construction contracts, including the enforcement of all monitoring provisions, the locations of construction and labour camps, etc. Before the commencement of construction, the designated E&S will receive training in the environmental and social issues associated with irrigation facilities.

The training program will cover measurement techniques in the field, tools for the prediction of pollutants, conservation of water bodies including wetlands, etc. Rwanda Environmental Management Authority, Rwanda Water Resources Board and Rwanda Development Board may be consulted for such training. The need for additional and specialized training will be examined and appropriate training will be undertaken as required. Training of personnel to be deployed on the proposed project during construction and operation, with regard to environmental and social safeguards requirements and compliance should be the integral part of the planning. In addition, all employees will be trained on health and safety, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc. Capacity to quantitatively monitor water sediments or turbidity (by suitable portable test equipment) and noise is always

advantageous, but monitoring will primarily involve ensuring that actions taken are in accordance with contract and specification clauses, and specified mitigation measures. Some awareness trainings will be provided to the contractor personnel to ensure that this occurs effectively.

Establishment of irrigation schemes may raise complaints among local communities mainly due to conflict water users, from resettlement, conflict between workers and local community. In this situation, Grievance procedures are required to ensure that PAPs are able to lodge complaints or concerns, without cost, and with the assurance of a timely and satisfactory resolution of the issue. The procedures also ensure that the entitlements are effectively transferred to the intended beneficiaries. Stakeholders will be informed of the intention to implement the grievance mechanism, and the procedure will be communicated at the time that the RAPs are finalized. Grievances may arise from members of communities who are dissatisfied with eligibility criteria use, community planning and actual implementation or compensation. Grievance Redress mechanism is proposed and will be established before actual implementation.

- **Conclusion**

Given the nature, location of the proposed project, proposed works and the potential impacts associated with the implementation of project, the consultant is the view that the nature and extent adverse impacts identified are medium to high significance if mitigation measures are not implemented to avoid mitigated and compensate. As a matter of fact, the development of irrigation infrastructure in Ndego schemes is bound to be executed in a sustainable manner and in compliance with national environmental regulations, IFAD's Social Environmental and Climate Assessment Procedures (SECAP, 2017) and the Environment and Social Management Framework (ESMF) prepared for KWIIP. This should be done by implementation of proposed mitigation measures and regular monitoring done as per (ESMMP) provided in the report and well as resettlement instruments. The estimated total cost for ESIA/ESMP implementation and monitoring is 308,000 USD. This budget include the cost for implementation and Monitoring of ESMP as well as well as estimated budget for resettlement which will be confirmed after detailed design and detailed resettlement action Plan. The budget for land husbandry and soil improvement technologies and inputs such as lime and fertilizers as well as watershed protections measures will be included in land husbandry package. Based on the current design there is no residential house to be affected but cattle sheds, grazing lands and agriculture lands will be lost permanent at pumping station, water balancing reservoir and pressure pipes. Further, loss of income is expected during construction especially for land levelling/land husbandry. A preliminary Abbreviated Resettlement Action Plan is presented as appendix 1 and Resettlement cost is estimated at 183,000 USD.

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ABBREVIATIONS AND ACRONYMS

AHS	: Agriculture Households Survey
AfDB	: African Development Bank
BESST	: Bureau for Engineering and Environmental Studies
CA	: Command area
CAC	: Command Area Catchment
CEC	: Capacity of Exchange
CPT	: Center Pivot
CSA	: Climate Smart Agriculture
DAP	: Diammonium Phosphate
DDS	: District Development strategy
EA	: Environmental Assessment
EIA	: Environmental and Social Impact Assessment
EICV	: Integrated Household Survey
EMMP	: Environmental Management and Monitoring Plan
EMP	: Environmental Management Plan
EO	: Environmental Officer
ESIA	: Environmental and Social Impact Assessment
ESMP	: Environmental and Social Management Plan
EU	: European Union
FAO	: Food and Agriculture Organization
FONERWA	: Fond National pour Environment au Rwanda (Green Fund)
GIS	: Geographic Information System
GoR	: Government of Rwanda
GPS	: Global Positioning System
HIV	: Human Immunodeficiency Virus
IFAD	: International Fund for Agriculture Development
IPM	: Integrated Pest Management
IUCN	: International Union for the Conservation of Nature
IWRMP	: Integrated Water Resources Master Plan
IWUA	: Irrigation Water Users Association
KIIP	: Kayonza Integrated Irrigation and Watershed Development Project
KOICA	: Korean International Cooperation Agency
LWH	: Water Harvesting and Hillside Irrigation
MINAGRI	: Ministry of Agriculture and Animal Resources
MoE	: Ministry of Environment
NBS	: National Biodiversity Strategy
NST1	: First National strategy for Transformation
OFID	: OPEC pec Fund for International Development
PIM	: Project Implementation Manual
RDB	: Rwanda Development Board
RAB	: Rwanda Agriculture Board
RADA	: Rwanda Agriculture Development Agency
RAPEP	: Rwanda Association for Professional Environmental Practitioners
RARDA	: Rwanda Animal Resources Development Agency
REMA	: Rwanda Environment Management Authority
RLMUA	: Rwanda Land Management and Use Authority
SECAP	: Social Environment and Climate Assessment
SPAT	: Strategic Plan for Agriculture Transformation
SPIU	: Single Project Implementation Unit
ToRs	: Terms of Reference
WHO	: World Health Organization
WUA	: Water Users Association

CHAPTER ONE: INTRODUCTION

1.1. Project background

Ndego irrigation schemes is part of Kayonza Irrigation and Integrated Watershed Management Project (KIIWP) jointly funded by the Government of Rwanda and International Fund for Agriculture Development (IFAD) and implemented by Ministry of Agriculture and Animal Resources (MINAGRI) through Rwanda Agriculture Board (RAB). The overall KIIWP's Development Goal is to "Contribute to poverty reduction in the drought prone Eastern Province of Rwanda". KIIWP will improve the resilience of smallholder farmers to droughts and effects of climate change through increased levels of production and productivity of selected food and cash crops, livestock and improved market access and business development.

The project area comprises the eight drought-prone sectors of the District of Kayonza in the Eastern Province of Rwanda. These sectors, namely Gahini, Kabare, Kabarando, Murama, Murundi, Mwiri, Ndego and Rwinkwavu which are relatively hot, with limited rainfalls but have good potential for irrigation. KIIWP 1 will comprise two components: (i) Strengthening resilience to droughts that will invest in catchment rehabilitation, livestock and domestic water infrastructure development, and the establishment of efficient infrastructure management institutions, and Institutional development and project coordination. The anticipated components and activities in KIIWP 2 comprise: (i) Strengthening resilience to droughts component that will promote climate smart agriculture for irrigated and rain-fed lands through Farmer Field Schools, (ii) Support to farm business development component and, (iii) Institutional development and project coordination.

The main expected outcomes of the project include: (i) improved access to land, forests, water and water bodies for production purposes; (ii) increased acreage of farmland under water-related infrastructure; (iii) increased acreage of farmland under climate resilient management and practices; (iv) increased capacity of smallholder farmers and local government to sustainably manage natural resources and climate related risks; (v) enhanced use by farmers, including youth, of technologies, equipment and infrastructure adapted to smallholder agriculture and (vi) increased farmers' economic benefits from market participation and increased sales.

The proposed Ndego irrigation schemes covers about 2,000 ha and is part of a larger scale investment by GoR to develop up to 7000ha of irrigated land over four sites in Kayonza district. This is in supporting the government of Rwanda to achieve its strategic goals of economic transformation whose focus is to unlocking rural growth in order to increase agricultural production, increase beneficiary farmers' income, reduce poverty, and improve living conditions.

1.2. Source of Funds

KIIWP I is financed by: (i) IFAD up to US\$17.79 million (85 per cent), through a highly concessional loan; (ii) Government of Rwanda for a total of US\$2.83 million (13.5 per cent) in the form of tax exemptions and consultancies for the Ndego irrigation scheme; (iii) DFID for a total of US\$0.3 million (1.5 per cent) in the form of consultancies for Ndego irrigation scheme. The estimated costs for KIIWP 2 are approximately US\$59 million (RWF 53 billion), including US\$3.7 million in contingencies, broadly broken down by project component as follows: (i) Strengthening resilience to droughts: US\$44 million; (ii) Support to farm business development: US\$8 million; (iii) Institutional development and project coordination: US\$4 million.

KIIWP 2 is expected to be financed by: (i) IFAD up to US\$26 million, through a highly concessional loan; (ii) Private sector for US\$322 thousand; (iii) ICCO for US\$ 246 thousand, (iv) Government of Rwanda for a total of US\$9 million in the form of tax exemptions; (v) Co-financiers for a total of US\$22 million; and (vi) Beneficiaries for US\$2 million. 26. Co-financing arrangements. It is anticipated that the total IFAD loan for KIIWP (KIIWP 1 + KIIWP 2) would amount to about US\$43.4 million, to be sourced from IFAD 11 financing cycle. Several development partners esp. the Korean International Cooperation Agency (KOICA), but also the African Development Bank (AfDB), the OPEC Fund for International Development (OFID), the Spanish Government and the European Union (EU) have expressed interest in co-financing KIIWP 2 once the results of the feasibility studies and Environmental and Social Impact Assessments will be disclosed.

1.3. Presentation project implementing entity

Ndego irrigation schemes will be implemented by Rwanda Agriculture Board (RAB). RAB is a government body established by law n°38/2010 of 25/11/2010. The law specifies that RAB has the general mission of championing the agriculture sector development into a knowledge based; technology driven and market oriented industry, using modern methods in crop, animal, fisheries, forestry and soil and water management in food, fibre and fuel wood production and processing.

RAB was formed from three agriculture agencies, namely the Rwanda Animal Resources Development Authority (RARDA), the Rwanda Agricultural Development Authority (RADA) and the Rwanda Agriculture Research Institute (French acronym: ISAR). The GoR expects this reform to remove the historical legacy that created artificial gaps between research and extension, strengthen the linkage with policy, and establish efficiency in service delivery through institutional integration in the agricultural sector for improved livelihoods of the Rwandan people. This expectation premises on: physical proximity under one administrative structure, using a common standard operating procedure, which removes institutional boundaries by improving communication, mutual understanding and consensus building between extension, research and policy.

The vision of RAB is to improve food security and livelihoods of all Rwandans by transforming agriculture from subsistence into modern farming through generating research and extension innovations that generate sustainable crop, animal husbandry and natural resource management. RAB has the mission of developing agriculture and animal husbandry through their reform, and using modern methods in crop and animal production, research, agricultural extension, education and training of farmers in new technologies.

Key responsibilities of RAB include the implement the national policy of agriculture and animal husbandry, contribution in determining policy in agriculture, animal husbandry, agricultural and animal husbandry research and technology and to provide farmers and consumers of agricultural products with information, techniques and services meant for improving their profession and supplying the internal market with increased and quality production thereby raising their agricultural and animal husbandry incomes. RAB has 5 departments namely Crop Production & Food Security, Animal Resources Extension, Land Husbandry, Irrigation & Mechanization, Research and Corporate Services. It has also four regional offices known as agricultural zones: Eastern Zone, Southern Zone, Western Zone and Northern Zone. The implementation of this project will be done on daily basis with an established Single project implementation unit, which houses technical, financial and safeguards experts.

1.4. IFAD Single Project Implementation Unit(SPIU)

The Lead Project Agency for KIIWP will be the RAB which will have the overall responsibility for the coordination and execution of the Project. However, on day to day basis, KIIWP will be implemented by IFAD funded project Single implementation unit (IFAD-SPIU). KIIWP will be integrated within the SPIU of IFAD projects (PASP and RDDP) that are under RAB. The SPIU Coordinator will also oversee and coordinate KIIWP activities that will be implemented at both the central and district level.

In addition to the existing IFAD SPIU staff performing cross-cutting functions of finance/accounting, M&E, procurement and administration, the following KIIWP staff are proposed: (i) a KIIWP Programme Manager; (ii) an accountant dedicated to KIIWP implementation and transactions; (iii) an M&E officer in charge also of gender and youth; (iv) an Irrigation engineer; (v) a WUO Specialist, (vi) a Land Husbandry/Soil and Water Conservation (SWC) Engineer, and vii) a Cooperative Development Officer. The IFAD SPIU Environmental and Climate Change Specialist will be responsible for monitoring the environmental, social and climate performance of the subprojects. At the District level, KIIWP staff will consist of an accountant, a WUO Specialist, a Land Husbandry (SWC) Engineer, a Cooperative Development Officer, a horticulture specialist, an irrigation technician, an Environmental and Climate Change Officer (ECCO), and a Social Safeguards Officer (SSO).

1.5. Presentation of the Consultant

BESST LTD (Bureau for Engineering and Environmental Studies) is a Rwanda company Registered with Rwanda Development Board (RDB) and is certified EA firm of Expert under Rwanda Association of Environmental Professional Practitioners (RAPEP/EA/071). It has its headquarter in Kigali Rwanda, Gasabo district, KG 182 St, Martin Plaza, second Floor. The company is specialized in Environmental Studies, Social Studies, Feasibility and Engineering design studies, Social assessment, Involuntary Resettlement, climate change risk assessment, socio-economic assessment, baseline surveys, waste management, water and sanitation, advisory services in sectors ranging from Agriculture, energy development, Infrastructure and housing development, transport and water supply.

1.6. Objectives of the ESIA study

The overall objective of the assignment is to assist RAB to develop an Environmental and Social Impact Assessment (ESIA) and an Environmental and Social Management Plan (ESMP) related to the development of Ndego irrigation schemes. This is to ensure that the project is implemented in an environmentally and socially sustainable manner and in full compliance with national regulations as well as international policies especially IFAD's Social Environmental and Climate Assessment Procedures (SECAP, 2017).

Specifically, the consultant will:

- assess the potential environmental and social impacts associated with Ndego irrigation schemes, whether positive or negative,
- propose mitigation measures which will effectively address the adverse impacts and enhance positive impacts;
- provide guidance and means for monitoring the implementation of environmental and social management measures;

1.7. Scope of the study

Scoping study was undertaken by the consultant's team with an intention of collecting enough and relevant information so as to ensure that the ESIA report is prepared in compliance with National Environmental Regulations and international safeguards policies including IFAD's Social Environmental and Climate Assessment Procedures. The study covered the impacts of the projects from planning phase, construction and operational phases and considered the site selected and its surroundings.

Therefore the Scope of work is to:

- Identify which legislation, policies (both local and international) are likely to influence impacts caused by this project.
- Develop an overview of the baseline environment of the project intervention area. I.e. study area description, physical, biological and social- economic-environment etc.
- Develop an Overview of likely impacts (positive or negative) that could be caused by construction or upgrading of dams and rehabilitation of irrigation canal.
- Propose mitigation measures against of the predicted adverse impacts identified.
- Propose an Environmental and Social Management Plan (ESMP) on how these mitigation measures can be implemented.
- Propose an Environmental and Social Monitoring Plan with measurable indicators and parameters for these mitigation measures to ensure sustainability of the project.
- Suggest recommendations and possible measures to fix gaps if any
- Assess resettlement impacts and prepare initial Resettlement Action Plan

1.8. Approach and methodology ESIA study

The proposed methodology for the environmental and social impact assessment for Ndego irrigation schemes is drawn from the general guidelines for conducting EIA in Rwanda, terms of reference provided by the client and approved by Rwanda Development Board, our technical proposal and the best practices drawn from international environmental and social policies especially IFAD's Social Environmental and Climate Assessment Procedures. It involves a number of stages from scoping or preliminary assessment to understand and establish boundaries of the study, desk review of available literature, field visit to collect baseline data, analysis of all available data (secondary and primary data), prediction of positive and negative impacts,

analysis of alternatives for such a project, proposal of mitigation measures leading to the preparation of an Environmental and Social Management Plan and Monitoring plan, all incorporated in a comprehensive ESIA/ESMP Report.

1.8.1. Documents review

An intense documents review was done at the beginning of the study and provided substantial information on project features, existing institutional legislation, policies, plans and programs, which are likely to influence different parts of development of Ndego irrigation schemes, its sustainability and ensure enhancement of the environmental resources. Key legal and policy instruments to be considered include the following:

- Rwanda Vision 2050 aspirations;
- National Strategy for Transformation (2018-2024);
- National Agricultural policy(2018)
- National environmental and Climate change(2018);
- IFAD's environmental and social safeguards: Social, Environmental and Climate Assessment Procedures (SECAP)
- Expropriation Law in the public interest (2015);
- Strategic Plan for Agriculture Transformation (PSTA4);
- Integrated Water Resources Management Policy(IWRMP), 2018;
- Water Resources Master Plan 2015;
- National Land use Master Plan;
- Irrigation Master Plan;
- Integrated water Resources master Plan(2015);
- National Biodiversity Strategy (NBS), 2015;
- Water law (2018);
- MINAGRI policy/strategy document;
- REMA general guidelines and procedures for Environmental Impact Assessment;
- Project design Report for KIIMP,
- Project Implementation Manual(PIM)
- Environmental and Social Management Framework (ESMF) for KIIMP;
- Other relevant policy and regulatory documents;
- Kayonza district development Strategy.
- Project feasibility study etc

1.8.2. Public Consultation with Stakeholders

Information collected from the preliminary desk review was completed by information obtained through interviews with key stakeholders. Stakeholders consulted include RAB team involved in project design and environmental and social management. Other stakeholders consulted include category of Government officials, local government officials at district and sector level and local farmers and cooperative leaders with activities in project area such as USAID Project_Hinga weze, Bramin, and Musambi Project. Outcome of consultations are presented in consultation section.

1.8.3. Environmental and biological baseline survey

Geomorphological features, topographic data and slop layers was produced using Geoformation system. This will be done by interpretation of recent aerial photo and satellite images and by topographic map, which has contours. This information was cross-checked and supplemented by field observation whereby the surveyor and other team member visited the site and collected GPS coordinates of key features of the project area including current land use patterns.

In terms of biological environment baseline data, the consultant established reconnaissance route (recce) in each site block and each route was designed in a way that covers most representative areas within each site. The length of the reconnaissance routes varied according to the size of the site. Each reconnaissance route and data was recorded using a GPS for mapping purpose. For recording data on birds, two methods were used. The first method consisted of point counts where observation points was established at an interval of 200

meters along the reconnaissance route. At each point observers waited for 3 minutes to allow birds to settle down and then record all sightings and calls of birds for a period of 10 minutes. The observers then moved on to the next point and repeated this same process. The second approach consisted at opportunistic sampling where all bird species seen or heard at different times of the day was recorded.

For surveying flora, the same reconnaissance routes established during fauna survey was be used. All plant species recorded in « Flore du Rwanda » in 4 volumes (Troupin 1978, 1983, 1985, 1988) was used as the main source for plant species identification. The circumscription of plant families followed APG (2009). Conservation status of various species, IUCN Red List of Threatened Species, version 2016-1 (IUCN, 2016). Any endangered or listed species on IUCN red list was highlighted for client attention.

1.8.4. Socio-Economic baseline data

During the feasibility study a socioeconomic survey was conducted and the report provide information on population characteristics, socioeconomic activities and community livelihood. This information will be used to documents the current status and predicts potential changes brought by proposed projects. Other source of data include EICV5, agricultural Household Survey (AHS), and Seasonal Agricultural Survey. This information was complemented with information collected through interview with key informants including district land officer, district agronomist, district veterinary, sector agronomist/veterinary and sector land and infrastructure officer.

1.9. Report structure

The structure of the report is as follows:

Chapter 1: Introduction;

Chapter 2: Project description and its components;

Chapter 3: Policy, legal and institutional framework;

Chapter 4: Environmental, socio-economic and cultural Baseline data;

Chapter 5: Findings of the Stakeholders' consultation and public participation;

Chapter 6: Project Needs and project alternatives;

Chapter 7: Impacts identification, evaluation and proposed mitigation measures;

Chapter 8: Environmental and Social Management Plan and Environmental Monitoring Plan;

Chapter 9: Conclusions and recommendations of the project

Annexes and appendices

CHAPTER TWO: PROJECT DESCRIPTION AND LOCATION

2.1. Project location

Ndego Hillside Irrigation Project site is composed of three irrigation schemes mainly located in Ndego Sector of Kayonza District, Eastern Province in Rwanda. Ndego Sector is one of 12 Sectors forming Kayonza District. This has borders with Rwamagana district on the West, Gatsibo district on the North, Ngoma and Kirehe districts on the South and Tanzania on the East.

The project site is accessed from Kigali-Kabarondo – Rwinkwavu – Nyankora - Ndego road at about 120 Km from Kigali City. The total distance from Kabarondo to the site is about 37km. It targets an irrigation area of around 2,018 ha net with potential water sources from two lakes (Nasho and Kibare) around Ndego Sector and this represents 11.3% of the total Sector area. The area is composed of 3 blocks, two (Kibare and Ihema blocks) tapping water from Lake Kibare and the 3rd from Lake Nasho. The irrigation areas are designated as Kibare, Ihema and Nasho Blocks, interchangeably named as Block 1 to 3, respectively. Most of the irrigation area are situated in Nasho block (898.9ha).

2.2. Project description

2.2.1. Overview on KIIWP Project

Kayonza Irrigation and Integrated Watershed Management Project (KIIWP) is an IFAD funded project that will be implemented in the most drought-prone Sectors of Kayonza District in Eastern Province, Rwanda. The district is bordered to the north and north-west by Gatsibo District, Rwamagana District to the west, Ngoma District to the south-west and Kirehe District to the south. It shares its eastern border with Tanzania.

The Project area includes eight drought-prone sectors of the District of Kayonza, namely Gahini, Kabare, Kabarondo, Murama, Murundi, Mwiri, Ndego and Rwinkwavu sectors. These sectors are relatively hot and semi-arid with rainfall averaging 900 mm per year. However, the abundant surface water resources, mostly lakes, suggest that there is a good potential for irrigation estimated at some 30,000ha for Kayonza District. About 80% of the total active population in the District is engaged in agriculture as their main economic activity and source of income. In the eight drought-prone sectors targeted by the Project, 58% of all households raise some type of livestock, 24% have cows. The next map shows the project location.

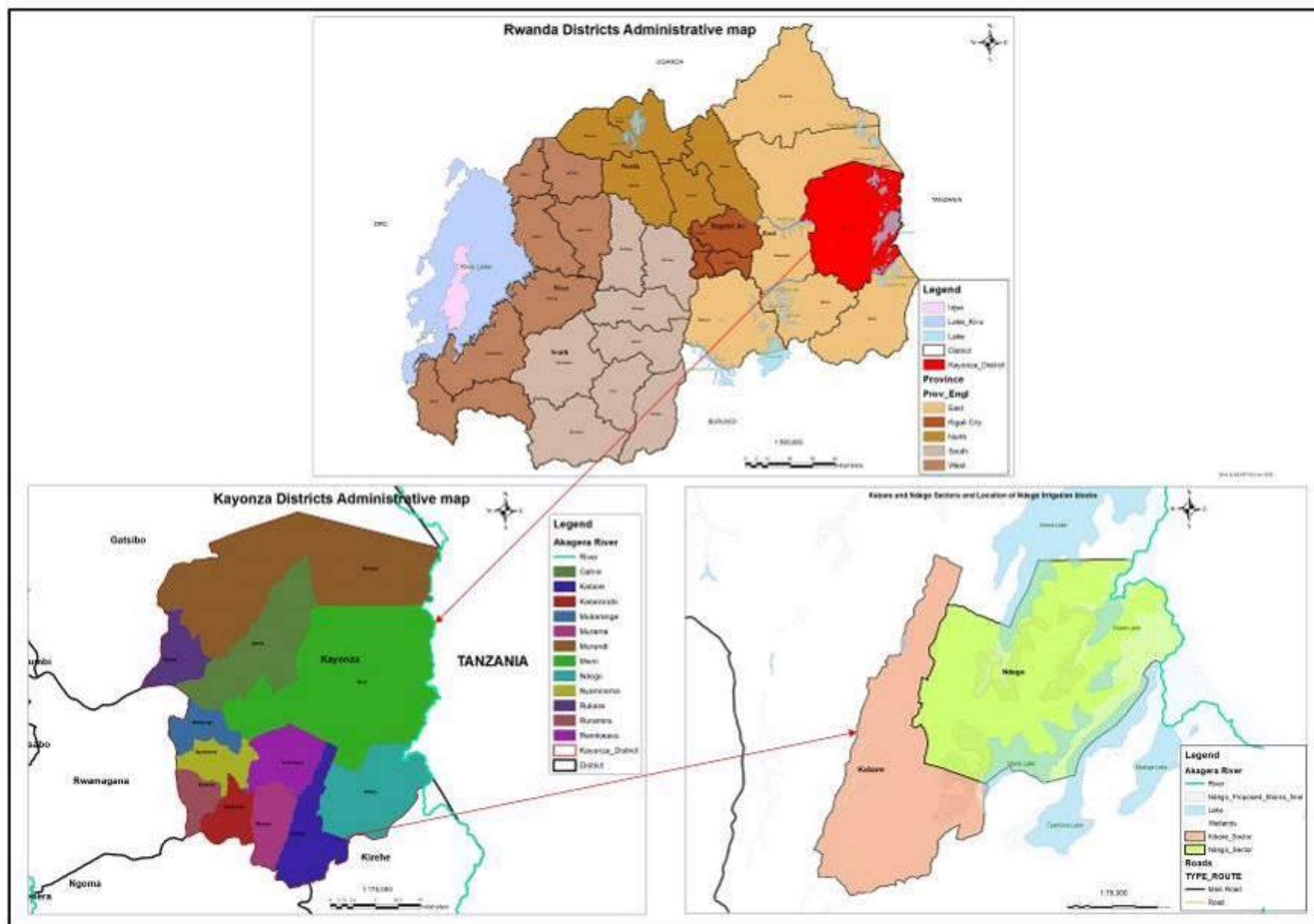


Figure 1: Administrative location of project area
Source: BESST LTD with Available administrative Maps, 2020

KIIWP directly targets 28,000 households in the eight Project sectors broken down as follows:

- 21,925 households that are members of the 54 farmer cooperatives growing rice, maize and beans or horticulture in these sectors, and will be supported through Farming as a Business (FAAB) skills, cooperative strengthening, and backward/forward linkages. Depending on their locations, a large part of these households will also benefit from other specific activities.
- 6,415 households that are not members of these cooperatives, but may be supported by other specific activities

Out of the total direct target households, 21,585 will receive specific support as follows:

- ✓ 7,350 households benefiting from terracing and agro-forestry (estimated on basis of average 0,3 ha land area per household);
- ✓ 2,225 households farming in marshlands and hillsides that will be developed by KIIWP (estimated on basis of average 0.3 ha land area per household);
- ✓ 5,560 households in marshland schemes where no infrastructure development will take place, but organizational strengthening activities are geared towards sustainable water management by Water Users Organizations (WUOs);
- ✓ 4,350 households to be included in small/holder schemes in Ndego pumping schemes;
- ✓ 400 households benefiting from water harvesting infrastructure;
- ✓ 1,700 households that have cows and benefit from water for animals.

Indirectly, all households farming in the watersheds (another 22,000 households) will be targeted under Catchment Rehabilitation and Protection Component and will thus benefit from improved water retention and improved soil fertility. Business development opportunities and market linkages will also benefit other farming families.

KIIWP project will comprise of two core technical components and a third component supporting institutional development and Project coordination. These components and their sub-components are presented below.

Component 1: Strengthening Resilience to Drought

- Sub-component 1.1: Catchment Rehabilitation and Protection
- Sub-component 1.2: Irrigation Development
- Sub-component 1.3: Infrastructure Management Institutions

Component 2: Support to Farm Business Development

- Sub-Component 2.1: Enhancing Climate Smart Agriculture (CSA) Practices and Technologies.
- Sub-component 2.2: Developing Farming as a Business (FaaB) Skills
- Sub-Component 2.3: Supporting Backward and Forward Market Linkages

Component 3: Institutional Development and Project Coordination

- Sub-component 3.1: Policy and Institutional Development
- Sub-component 3.2: Project Coordination

The current study concerns Ndego Sector, one of the 8 KIIWP sites to be developed in Kayonza District. The entire targeted watershed is portioned into 2 sub-watersheds as follows: the command area (CA) and the command area catchment (CAC). The command area catchment covers 2,491.75ha and the command area is 2018.2 ha split into three blocks touching Kibare, Ihema and Nasho lakes respectively. The total command area is currently used for agriculture, as shown on land use map below.

2.2.2. Ndego Project layout

Three options were identified in feasibility study and the following maps presents key components of Ndego irrigation system including water sources (lakes) pumping stations, balancing storage, centre pivots and roads network). Key project components are shown on the next map.

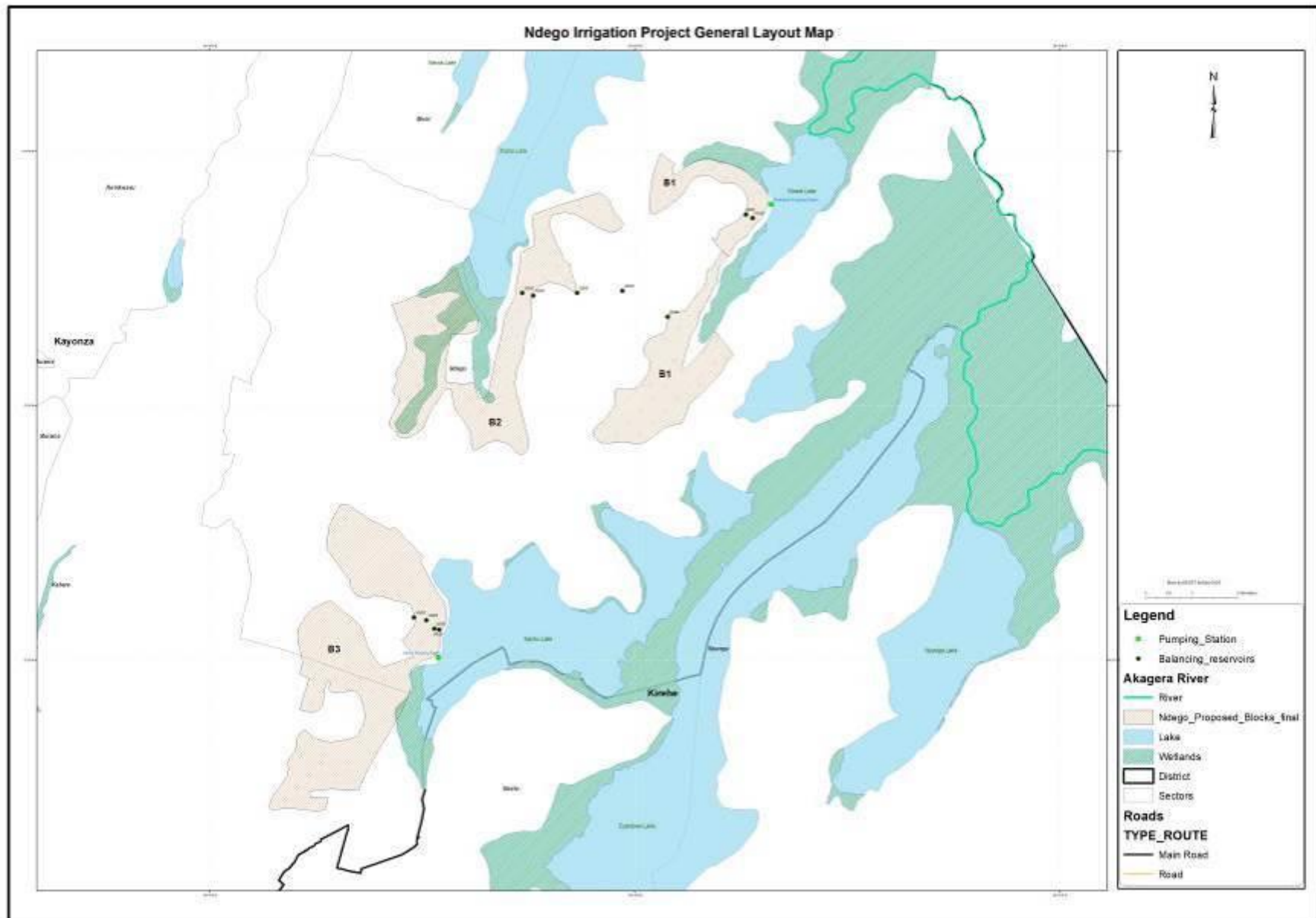


Figure 2: Project layout
Source: ESIA, 2020

The irrigation infrastructures include balancing storages, CPT, pipelines, sprinkler and drainage canals. In addition to the irrigation facilities, land husbandry works will be implemented in this area. The command area catchment for each block will be treated and it totals up 2,491.75 ha accounting for 55.25 % of the total project site. The major portion of the command area catchment (86.2%) is situated in 0-6% slope class while 6-16% slope category cover only 13.8% of the total catchment. This shows that the project sites are almost flat and will therefore be treated with appropriate biological measures while the land on 6-16% of the slope will be treated with water retention ditches (or anti-erosive trenches) supported with appropriate biological technologies.

The command area (CA) is situated on the shores of the lakes and is under agricultural crops. Based on the soil and the slope maps for Ihema, Nasho and Kibare sub catchments, the slope of the area is dominantly characterised by gentle slopes ranging from 0 to 16%. The big part of CA (72.4%) is dominated by slopes varying between 0-6% while the rest ranges between 6 and 16% of slope.

2.3. Description of Project activities

The construction of irrigation infrastructures and the implementation of land husbandry technologies are planned as the main activities of Ndego project. The irrigation facilities will only be installed in the command area while the command area catchment will remain rain fed. The land husbandry infrastructures will be executed both in CA and CAC. Land husbandry technologies were proposed based on the nature of the project watershed features of the command area catchment and the command area (ie slope category, soil depth). Access roads and post-harvest infrastructures are among other activities to be supported in Ndego area.

2.3.1. Irrigation Targets and options

Ndego project targets 2,000 ha net (or 2,500 ha gross irrigation area) for irrigation development with potential water sources from the two lakes (Kibare and Nasho) around Ndego Sector in Kayonza District. The targeted irrigation area is made of 3 blocks, two abstracting water from Kibare lake and the last from Lake Nasho. The blocks are designated as Kibare, Ihema and Nasho Blocks, interchangeably named as Block 1 to 3, respectively. Most of the irrigation area is located in Nasho block. The Table 1 below depicts irrigation blocks, their size as well as the source of water of irrigation.

Table 1: Target Blocks and Water Source

SNo	Site name (Block)	Gross Irrigation area (Ha)	Net target area (Ha)	Water source
1	Kibare	600	482.8	Lake Kibare
2	Ihema	830	636.5	Lake Kibare
3	Nasho	1,070	898.9	Lake Nasho
	Total	2,500	2,018.2	

Source: SMEC (2020). Final Feasibility Study at Ndego in Kayonza District

The two lakes are connected to Akagera river which provides significant amount of recharge and it was assumed that 0.1% of Akagera river flow recharges Lake Ihema, Lake Kibare and Lake Nasho. Ndego irrigation area is dominantly sandy. The soil infiltration rate of Ndego sites is greater than 3.0cm/hr which is high (SMEC, 2020). The surface irrigation system is not the preferred choice with such soil characteristics; hence another method or system should be considered. Three options were assessed and accordingly, about 2,024ha, 2, 017 ha and 2,018 ha are proposed for options 1, 2 and 3B. The preliminary findings are shown in the table below.

Table 2: Findings of assessed options

SNo	Main features	Unit	Quantity		
			Option 1	Option 2	Option 3
1	Gross Area	Ha	2,500	2,500	2,500
2	Net Irrigation area		2,024	2,017	2,018
3	No of sub-blocks	No	15	12	10
4	No of CPT		-	29	40
5	Main canals lengths	m	57,408	36,792	
6	Secondary canals		44,663	30,400	
7	Tertiary canals		45,056	13,194	
8	Tertiary pipes		84,996	65,740	
9	Drainage canals		140,594	80,992	80,992
10	Main pipeline to CPT			26,953	73,576

SNo	Main features	Unit	Quantity		
			Option 1	Option 2	Option 3
11	Main pipeline to Sprinkler			5,325	
12	Distribution/infield pipeline to sprinkler				154,081
13	Access road		76,256	75,290	79,511

Source: SMEC 2020, feasibility study

SMEC (2020) states that the analysis of all options at feasibility stage reveal that Option 3 is superior since the proposed irrigation systems are more suitable for the sandy soil types, more cost efficient, more diverse, more water efficient and may be constructed in a shorter time duration. The farmers will be able to start farming and generating revenues earlier and recommend either Option 3 (Option 3B) to be developed during detailed design phase.

2.3.2. Development of Irrigation layouts

At the feasibility study stage, preliminary assessment and comparison were conducted on the main system for all the blocks and engineering estimates were prepared based on the preliminary layout. The soil and land characteristics, pressure requirements, beneficiaries' interest and loss of soil fertility as a result of land preparation were considered as main factors. Taking into consideration these factors, four options considered and studied for the preparation of preliminary irrigation layouts include:

- ✓ Option 1 - Open channel conveyance for surface irrigation
- ✓ Option 2/2B- Piped conveyance for pressurized and open channel conveyance for surface irrigation
- ✓ Option 3/3B- Fully pressurized irrigation (Center Pivot Technology and Sprinkler)
- ✓ Option 4- Piped gravity conveyance, mixed distribution and surface irrigation application

The Option 3/3B (fully pressurized irrigation) was found to be economically viable. As mentioned above, the pressure required for surface varies up to 60.0m in most of the areas and 67.5m for B3/BS4 (net). To convert this system to fully pressurized irrigation, additional pumping head of 25 to 30m is required so that sprinkling to the required diameter can be possible. This requires 90m pumping head (net), or 100m including head losses of 10%, and this is above the head threshold. Therefore, this option was previously dropped since it is above the threshold head of 65m.

2.3.3. Main irrigation blocks

Ndego site is split into 3 blocks (Kibare, Ihema and Nasho). For the good operation and management of the irrigation system in Ndego sites, the blocks within the project were subdivided into sub-blocks. These will help in entertaining different irrigation methods, regulating pressure heads and minimizes investment and operation costs. Block numbers and their designations are following the main canals/pipelines. Main irrigation sub-blocks for Kibare, Ihema and Nasho are five, two and three respectively. The naming and area coverage of blocks and sub blocks are shown in Table below.

Table 3: Irrigation areas and designations for pressurized irrigation (Option-3)

Block No	Sub Block designations	Designations		Remarks
		Off taking main pipeline	Branch pipes	
B1	B1/BS1 PP B 1-1	B 1-1 MP	BP 1 – BP21	Sprinkler
	B 1-2	B1-2 MP	BP 1 – BP5	
		B1-2 CPT MP	BP 1 – BP10	CPT
	B 1-3	B 1-3 MP	BP 1 – BP2	Sprinkler
	B 1-4	B 1-4 MP	BP 1 – BP14	
	B 1-5	B 1-5 MP	BP 1	
		B 1-5A MP	B1- CPT BP	CPT
		B 1-5 CPT MP		
B2	B2/BS1 PP			
	B2/BS2 PP			
	B 2 – 1	B2-1 MP	BP1 – BP 31	Sprinkler
		B2-1 CPT MP		CPT
		B2-1 CPT BP MP		
	B 2 – 2	B2-2 MP	BP 1 – BP9	Sprinkler
		B2-2 CPT MP		
B3	B3/BS1 PP			
	B3-1	B3-1 MP	BP1 – BP31	Sprinkler
		B3-1 CPT MP		CPT
	B3-2	B3-2 MP	BP1 – BP3	Sprinkler

Block No	Sub Block designations	Designations		Remarks
		Off taking main pipeline	Branch pipes	
		B3-2 CPT MP		CPT
		B3-2 CPT MP BP		
	B3-3	B3-3 MP	BP 1 – BP 12	Sprinkler

MP -MAIN PIPELINE, CPT- CENTRE PIVOT SYSTEM, BP-BRANCH PIPELINE, BS-BALANCING STORAGE, BP -BRANCH PIPE

Source: SMEC (2020), Feasibility Study Report

The table below presents the main features of Option 3/ 3B.

Table 4: Main features of the irrigation method per block

No	Main Features	Blocks			Total
		B1 (Kibare)	B2 (Ihema)	B3 (Nasho)	
1	Gross Command Area (Ha)	600.0	830.0	1,070.0	2,500
2	Net Irrigation Area (Ha)	482.8	636.5	898.9	2,018.2
3	Number of Sub-blocks (No)	5	2	3	10
4	Sub-blocks served	B1-1 to B1-5	B2-1 to B2-2	B3-1 to B3-3	
5	Number of CPT (No)	10	14	16	40
6	Drainage Channels (m)	15,118	35,663	30,211	80,992
7	Main pipeline to CPT & Sprinkler (m)	24,776	21,842	26,958	73,576
8	Distribution and infield pipeline to Sprinkler (m)	38,460	53,206	62,415	154,081
9	Access road (m)	26,209	28,041	25,261	79,511

Source: Feasibility study 2020,

The potential net irrigation area per sub-blocks, regardless of the land suitability in terms of soil fertility and depth is presented in the following Table.

Table 5: Allocation of net irrigation by blocks for proposed irrigation method

Block	Sub-block designations	Gross Area (Ha)	Net area (Ha)		Total (ha)
			Sprinkler	CPT	
B1	B1-1		78.1		78.1
	B1-2		27.5	13	40.5
	B1-3		47.7		47.7
	B1-4		18.3		18.3
	B1-5		88.2	210	298.2
	Total	600	259.8	223	482.8
B2	B2-1		249.1	228	477.1
	B2-2		99.4	60	159.4
	Total	830	384.5	288	636.5
B3	B3-1		176.1	141	317.1
	B3-2		27.3		27.3
	B3-3		169.5	385	554.5
	Total	1,070	372.9	526	898.9
Project Area Total (Ha)		2,500	981.2	1,037	2,018.2

2.3.4. Irrigation System Components and methods

The proposed Ndego Project consists of the following main components:

- ✓ Intake Works/Pumping stations;
- ✓ Pipeline and related structures;
- ✓ Irrigation canals, drain channels and related structures;
- ✓ Sprinkler system;
- ✓ Centre pivot;
- ✓ Different hydraulic structures;
- ✓ Water storage facilities (Balancing storage reservoirs)
- ✓ Land husbandry technologies;
- ✓ Road networks.

1) Balancing storages

Five balancing storages (BS) are proposed at the same locations: two in Kibare, two in Ihema and one in Nasho Block. The next table presents the storage capacity of balancing storage and net irrigation area per block.

Table 6: Balancing storages and net irrigation command area per block

Balancing storage	Off taking pipeline	Net irrigation are (Ha)	Storage Capacity (m3)
Kibare Irrigation Block: Block 1			
B1/BS1	B1-3 MP	47.7	713
	B1-4 MP	18.3	
B1/BS2	B1-5A MP	12.3	3,100
	B1-5 MP	75.9	
Ihema Irrigation Block: Block 2			
B2/BS1	B2-1 CPT BP MP	73.0	691
B2/BS2	B2-1 MP	249.1	3,272
	B2-2 MP	99.4	
Ihema Irrigation Block: Block 3			
B3/B S1	B3-1 MP	176.6	
	B3-2 MP	27.3	4,698
	B3-3 MP	128.0	
	B3-2 CPT BP MP	169.0	

Source: SMEC (2020).Feasibility study report

2) Allocation of Dragline sprinkler and CPT irrigation

The following main criteria are followed to prepare option 3/3B layout. These are:

- ✓ The maximum pumping head considered ranges between 65 and 70m. Medium head sprinklers and CPT irrigation requires operating head of 25 to 30m (minimum) so that to enable sprinkling to the designed diameters. Therefore, areas with higher elevations (i.e greater than 1325.0 El) which requires to exceed the specified pumping head of 65 to 70m, are proposed to be irrigated by boosting from the balancing storages;
- ✓ Minimum available CPT size is 6.5Ha with a diameter of 288.0m (Manufacturers Manual). For Ndego Project, this size is excluded from the layout as this will cause to remove a lot of surveyed and suitable land from the proposed irrigation layout. The minimum CPT size considered in the layout preparation is 13Ha, with a diameter of 410m. Therefore, any potential command area with a width of less than 410m won't be developed with CPT alternative. Instead, sprinkler systems are proposed in these areas, provided that the head requirement mentioned above is satisfied;
- ✓ After analysing the experience in Rwanda with implemented irrigation projects, the drip system alternative got dropped. This method is not welcomed by the farmers and operation experts, due to complicated tasks during farm preparation, farming and harvesting. In addition, this system incurs a lot of expenses as a result of replacement costs for the laterals and re modification of the spacing from the proposed ones.

3) Centre Pivot (CPT) pipelines

Three types of pipelines are aligned in the CPT layouts. Main pipelines (MP) convey flow by pumping from pumping station at the lakes or boosting from balancing storages, branch pipelines (BP) branched from the main pipelines and a distribution pipe connected to the CPT inlet. Depending on the layouts, the main lines are also directly connected to the CPTs inlet. The systematic and clear understanding of the layouts, the pipeline and the CPT system are designated as discussed below:

B1-CPT MP = Block 1 main pipeline to CPT's

B1-CPT MP BP = Block 1 main pipeline to CPT's by Booster Pumps

CPTs for each Block are designated by initial of the Block as KCPT, ICPT and NCPT for Kibare, Ihema and Nasho respectively.

4) Pipe networks/Lengths

The general preliminary pipeline layouts for each Block were prepared and the total pipe length for centre pivot irrigation for main pipeline, branch and distribution to the CPTs is 41.5 km and irrigation area of 1,037Ha. The Table below indicates the summary of pipelines lengths per block as well as corresponding irrigation areas.

Table 7: Summary of pipelines lengths and irrigation area per block

Block	No of main pipelines	No of branch lines	Pipe lengths (m)			Total irrigation area (ha)
			Main pipeline	Branch pipe	Distribution to CPT	
Kibare	2	1	4,340	1,808	4,821	223
Ihema	4		11,826	95	1,543	288
Nasho	3		12,783		4,381	526
Total			28,949	1,903	10,682	1,037

Source: SMEC (2020)

For inspection and maintenance purpose, the main and branch pipelines to the distribution pipes to CPT inlet are provided with 6.0m access road.

5) Sprinkler Irrigation

Two types of pipelines are aligned in the Sprinkler layouts. The main pipelines convey flow from pumping station and branch /secondary pipelines connected to the sprinkler laterals. Sprinkler systems are designated as discussed below:

B1-1MP = Block 1 main pipeline 1

B1-2MP = Block 1 main pipeline 2

• Selected Sprinkler sizes

The sprinkler sizes exercised in Ndego project are medium heads from 25 to 30m head.

Pipe networks/Lengths

Typical sprinkler arrangement is shown in Figure 6 below.

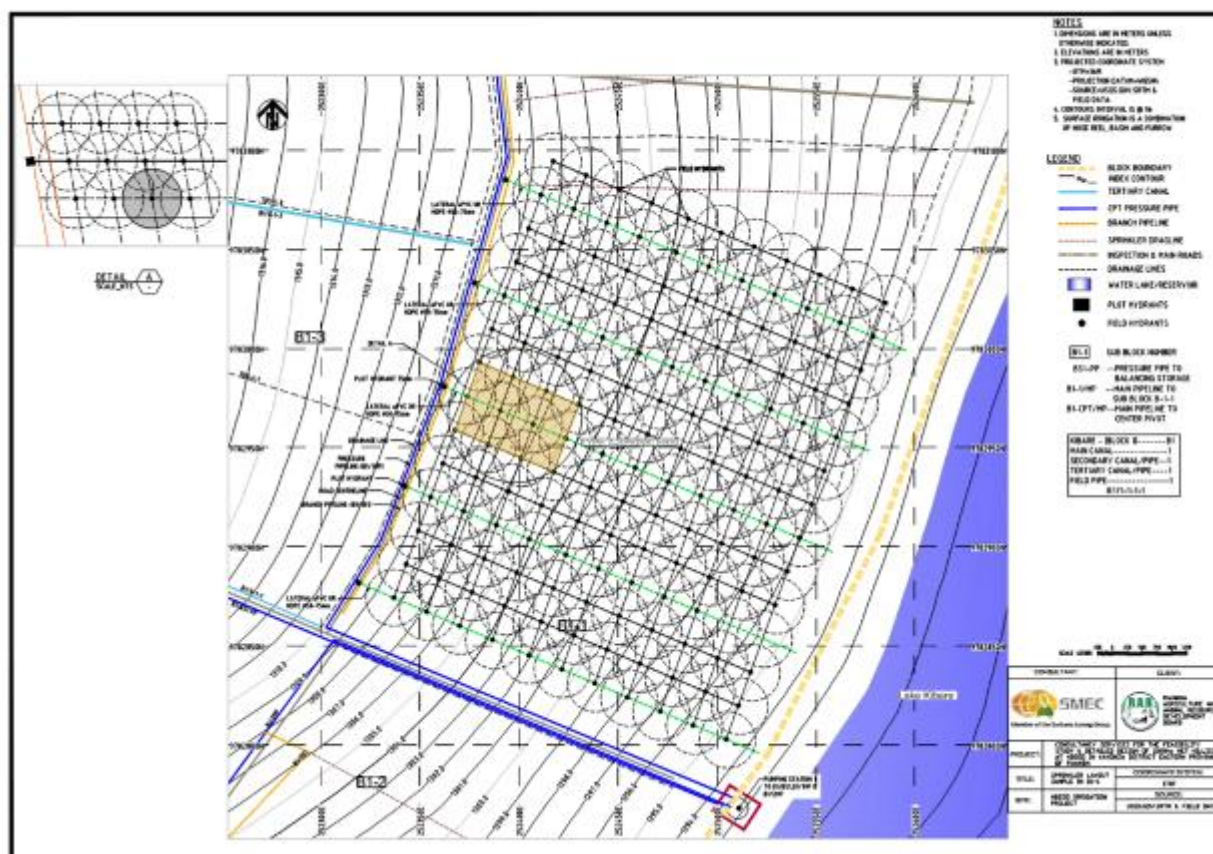


Figure 3:Typical sprinkler arrangement in block B1-1

Source: Feasibility study

The total main pipeline lengths are 42.8km and irrigation area of 981.2ha. The distribution and lateral lengths are presented in the following Table.

Table 8 :Pipe network characteristics

Blocks	Main pipeline (m)	Distribution (m)	Laterals (m)	Total by block
B1-1	4,412	7,929	13,416	
B1-2	2,520	2,837	1,386	
B1-3	3,673	4,056	7,558	
B1-4	50	1,079	1,921	

Blocks	Main pipeline (m)	Distribution (m)	Laterals (m)	Total by block
B1-5A	1,4,13	1,456	2,169	
B1-5	5,720	7,419	12,010	
	17,788	24,776	38,460	81,024
B2-1	8,847	16,811	37,918	
B2-2	3,348	5,031	15,288	
	12,195	21,842	53,206	87,243
B3-1	4,150	9,722	27,665	
B3-2	1,708	2,072	4,523	
B3-3	7,032	15,164	30,227	
	12,890	26,958	62,415	102,263
	42,873	73,576	154,081	270,530

Source: Feasibility study, 2020

2.3.5. Irrigation area coverage by type

A net irrigation area of 2,018ha is available in this option as shown in the Table below. The net irrigation area per block and for each irrigation system is presented in the following table.

Table 9: Irrigation area coverage by type

Block	Irrigation Area (Ha)				Total Net (Ha)
	Sprinkler		CPT		
	Direct pumping	Booster pump	Direct pumping	Booster pump	
Kibare	105.6	154.2	223		482.8
Ihema		348.5	215	73	636.5
Nasho		372.9	398	128	898.9
Total	105.6	875.6	836	201	2,018.2

Source: SMEC (2020)

2.4. Land Husbandry Infrastructures

2.4.1. Targeted areas

The command area catchment (CAC) and the command area (CA) are split into three blocks touching Kibare, Ihema and Nasho lakes respectively. The net CAC and CA cover 2,491.75 ha and 2,018.2 ha respectively. The proposed area for the treatment of both CAC and CA is illustrated in the following table.

Table 10: Land Husbandry area per block

No	Site	Blocks			Total
		B1 (Kibare)	B2 (Ihema)	B3 (Nasho)	
1	Net Command Area Catchment (ha)	439.25	1,077.75	974.75	2,491.75
2	Net Command Area (Ha)	482.8	636.5	898.9	2,018.20
	Total area	922.05	1,714.25	1,873.65	4,509.95

Source: Feasibility study SMEC (2020)

2.4.2. Land Husbandry technologies

Ndego project area falls in the dry-low-land agro climatic zone with a gently sloping landscape ranging between 0 to 16%. Land husbandry technologies were proposed based on the soil nature and slopes of the command area catchment and the command area.

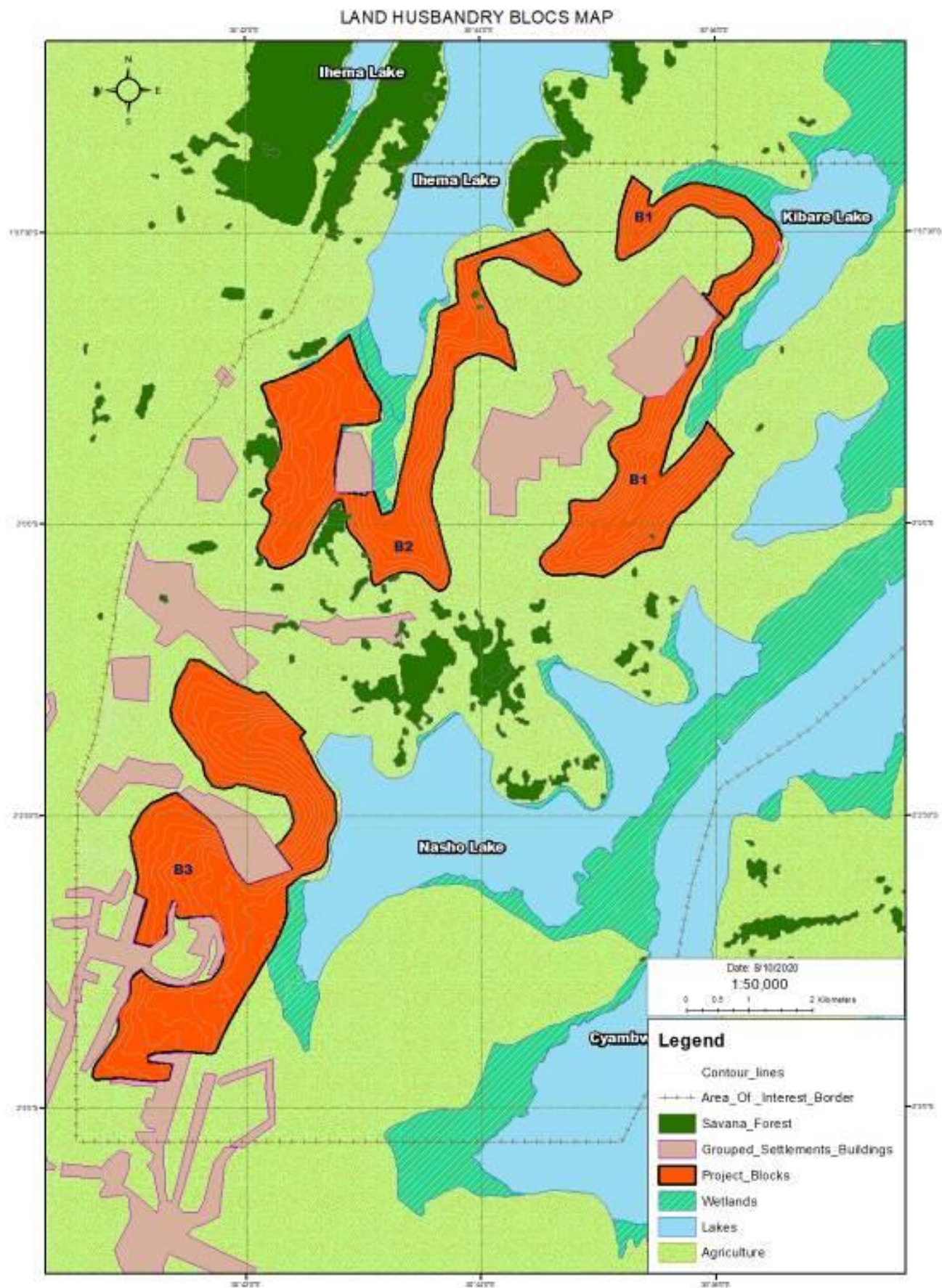


Figure 4: Land husbandry blocks
Sources: Adapted from Feasibility study, 2020

2.4.2.1. Command Area Catchment

Land husbandry technologies in the CAC were proposed to various slope categories (0-4%, 4-6% and 6-16%) as follows. The estimated area with 0-4%, 4-6% and 6-16% slope in the CAC will be about 714.2 ha, 1,431.43ha and 344.6 ha respectively.

(i) Contour ploughing and Grass strip/ trash line

The contour ploughing and row planting along the contour line was designed for 0-4% slope because it is enough to obstruct the water movement. Grass strip and trash line were recommended on slope class of 4-6% to lay alternatively along the contour line in 10-meter interval of either the grass strip or the trash line so that every five meters' interval either the grass strip or the trash line could hinder the water movement within the sub-slope category. The width of Trash line and grass strip is recommended to be 1 meter and the density of the grass strip and the trash line will be 1 km/ ha each. The grass strip is advised to be managed properly so that, frequent cutting of the grass strip, through time, could develop into bund like elevated embankment to effectively obstruct the sheet erosion that may occur in this flat to gentle slope.

(ii) Anti-erosion trenches

The proposed technology for 6-16% slope category is the establishment of the trenches technique, also known as "Fanya juu". It consists of excavating ditches along the contour lines, making bunds with the excavated earth upstream with the purpose of creating progressive terraces. The recommended dimensions of the anti-erosion trenches are as follows: depth 0.5m, width 0.4m and 4m length or depth 0.5m, width 0.5m and 4m length depending upon the quantity of coming run off to be accommodated. Ditches are separated by a distance of 0.5m with 20cm below the soil level, playing a role of a check dam. These are positioned in a staggered fashion to prevent accumulation of water and then enhance the infiltration. Trenches are constructed in such a way the soil is evenly piled on the upper side of the trench to avoid collapsing and facilitate the plantation of grasses, shrubs and trees which help to stabilize the soil and prevent erosion.

(iii) Biological measures

The agroforestry species (timber trees and/or fruits and shrubs) and grasses should be planted along the embankments of ditches to stabilize them, with two rows of grasses separated 50cmX50cm¹(RAB agenda agricole) in the case of nappier grasses. However, the plantation should be done in staggered fashion in the way to cover properly the piled up soil. Agroforestry trees and shrubs should be planted on the upper side on the embankment, the spacing between timber trees should be 12m or 6m between fruit and timber trees (12m between two consecutive trees of the same type and 6m between fruits and timber tree) and shrubs spaced to 2m from each other. *Cedrela serrata*, *Maesopsis eminii*, *Grevilea robusta*, *Acacia* spp, Mango tree (*Mangifera indica*), *Avocado americana* are some of the tree component adapted to savannah conditions of Ndego area while *Senna* spp, *Calliandra* spp, *Leucaena* spp, etc should be used as shrubs.

For the quick stabilization of the soil on upper side of the ditches, the planting of grass species is 25 cm between plants and 25 cm between rows of plants. Two rows of grasses should be planted in staggered fashion to cover properly the soil. The grass species proposed include *Brachiaria* spp, *Panicum* spp and *Kakamega* spp.

(iv) Mulching and manure application

The mulching technique should also be applied to limit evapotranspiration, ensure the possible runoff that could invade the command area is controlled and improve physico-chemical properties of the soil. The organic manure can also be used. The mulch materials are decomposable plants and or crop residues. Thickness of the mulch is approximately 10 cm throughout the area. The fresh green-plant mulch is not left on the surface to dry before it is incorporated to the soil.

(v) Drainage systems

Though erosion is not a serious problem in the project area due to low rainfall and gentle slopes, drainage systems will be required for the protection of the site. The cut off drains are necessary to avoid runoff incidence and arrest the soil movement. They are recommended to be constructed in every 800-meter surface distance and be graded to 3-5%. A number of cut off drains are constructed in such a way that all are

¹ On dry sites, like Ndego area, it is necessary to plant widely apart and to remove all competing ground vegetation to increases infiltration of rainwater and decreases water losses through transpiration by plants and evaporation from the soil (FAO). <http://www.fao.org/3/t0122e/t0122e00.htm>

connected to the natural or artificial water ways. The water ways are expected to be constructed or reshaped not to have more than 15% slope against the contour line and also it requires check dams to hinder the runoff as well as to trap silt. It is compulsory to plant grass in the cut-off drains and water ways and manage it properly all along their length.

2.4.2.2. Command Area (CA)

The technologies recommended in the CA include the following:

(i) Drainage systems

Surface drainage is very useful in removing excess water from land in a controlled manner and as quickly as possible, to an artificial drainage system or a natural watercourse. This should be done with no damage to the environment. The design and location of the manmade drainage system should take into consideration the existing natural drainage network in both the command area catchment and command area. The drainage network from the command area catchment should match well with the drainage infrastructures of the command area.

Cut off drains are firstly located below the source of water which would invade agricultural lands (Houses, rocks, forests...); secondly, remaining cut off drains and manmade waterways are located considering the slope category. Each cut off drain, leads the water to the natural or manmade waterway. Manmade waterways are located at the end (Outlet) of cut off drains if these ones cannot convey excessive water in reasonable distances. Start lying out from the drainage divide and orient the cut-off-drains to both directions. Water ways are constructed from outlet to the tail end while the construction of cut off drains starts from the outlet where the cut-off-drain joins the waterway.

Both waterways and cut off drains are constructed in the form of inverted trapezoid with both sides sloping at 2:1 (V: H) ratio respectively; the average floor width is 40 cm. The minimum recommended depth of water channels after terracing is 50cm. Waterways are constructed with side pass for pedestrians. The check dams will be built across the floor of waterways and cut-off drains. Grasses will also be planted to stabilize the constructed drainage systems.

(ii) Land levelling

Levelling will be done in the command area on nearly level to gently sloping land (slope 0-4 %). The levelling has importance of facilitating irrigation. The ground irregularities should be removed and try to make the slope uniform. The levelled land should be separated by the cut off drains spaced of 50m from one another. The cut off drains should be laid on 2% to 3% slope against the contour. Where the slope may not allow the above rule to be respected, it is better to try to orient the cut off drain perpendicularly to the ground slope in such way to avoid making an irrigable zone larger than 50m width cut off drain to cut off drain. The upper side of the cut off drains should be stabilized with trees, shrubs and grasses. The trees are spaced at 10 m while in between two consecutive tree shrubs are planted at 2m spacing. The area between trees and shrubs should be covered by grasses. This grass – belt will contain the silt that is escaping through the tree and shrubs rows along the levelled land.

(i) Contour Buffer Strips

Contour buffer strips are strips of perennial vegetation alternated down the slope with wider cultivated strips that are farmed on the contour. Contour buffers strips are at least 50 cm at most one-meter width. Vegetation in strips consists of adapted species of grasses, trees and shrubs. They are applied on the average in 20m spacing to each other in 4 - 6% slopes. With frequent cutting and harvesting, the grass strip develops naturally into bund enough to effectively obstruct the sheet erosion that may occur in this flat to gentle slope.

(ii) Contour Bunds

Contour bunds are established to slow down the runoff water on 6-12% slope. Contour bund technique reduces water runoff and controls soil erosion through ridges made up of heap of soil that follow positions located at the same altitude. Those ridges should be covered with perennial grasses and stabilized by agroforestry trees and shrubs. The spacing between the bunds is made with Vertical Interval 1 meter.

(iii) Biological measures

The ditch or soil bunds embankments should be planted with two rows of grasses separated by 50cmX50cm. The plantation should be done in staggered fashion in the way to cover properly the soil.

(iv) Contour ploughing

Contour ploughing or contour farming or Contour ploughing is the farming practice of ploughing and or planting across a slope following its elevation contour lines. These contour lines create a water break which reduces the formation of rills and gullies during times of heavy water run-off; which is a major cause of soil erosion. The water break also allows more time for the water to settle into the soil. In contour ploughing, the ruts made by the ploughing run perpendicular rather than parallel to the slopes, generally resulting in furrows that curve around the land and are level.

2.4.3. Lime/travertine and compost application.

One of the most important conditions, for ensuring agricultural crops will grow, is the condition of the soil, including the pH balance. Soil pH affects the availability of plant nutrients. Lime is to be used for increasing the soil pH. The optimal pH range for most plants is between 5.5 and 7.0; however, many plants have adapted to thrive at pH values outside this range. Results from laboratory analysis revealed that the soil pH of Ndego command area ranges between 4.3 and 8.5. The lime application is recommended on the pH ranging from 4.3 to 5.4. Lime requirements per as FAO guidelines (2006)² is presented in next table.

Table 11: Example of the relation of soil pH and texture with lime requirement

Soil PH	Lime needed in soils of different texture		
	Sandy loam	Loam	Clay loam
5.0	5,550	6,000	6,450
5.2	4,650	5,100	5,500
5.4	3,750	4,200	4,650
5.6	2,850	3,300	3,750
5.8	1,950	2,400	2,850
6.0	1,050	1,500	1,950
6.2	650	850	1,050

Source: FAO Fertilizer and Plant nutrition bulletin, 2006

The lime/travertine should cover the soil of some 5 – 10 cm depth. Preferably, apply burnt lime two weeks before sowing to maximize its effectiveness in reducing soil acidity and enhance nutrient uptakes by crops. To mitigate negative impacts on environment especially fauna in the soil, it is recommended to combine the use of lime with organic compost and farmers should be provided both technical training and inputs for making compost. Based on soil acidity in the project area, soil texture but also financial implication the recommended rate per ha is 2 to 3 tones/ha.

The quantity of good quality compost recommended is 10 tons per Ha. It must contain at least 0.4 % of N, 0.6 % of P and K nutrients. The compost to be used should be exhibiting more than 80% decomposition and friable. Make sure that the compost is applied and covered to avoid loss of its volatile nutrients.

2.5. Resettlement and Land requirement

So far, the location of some project components such as borrow pits, quarry, postharvest and access roads have not yet identified. However, it is clear that the construction of irrigation infrastructures (BS and canals networks) and post-harvest facilities, some crops, trees and land will be affected. Based on current design 122 households will be affected by losing lands, trees and perennial crops where pumping stations, water balance storage and pressure pipeline will be constructed.

- At water, balancing storage 37 households will lose permanently their land and will need compensation.
- In pressure Pipe pipeline it is expected that small strips of land will be affected and 65 households were identified;
- At pumping station, 8 private plots and two government plots were identified as affected.

² FAO Fertilizer and Plant nutrition bulletin, 2006, guidelines for the management of plant nutrients and their sources

Further, the command area was delineated on agriculture lands with both seasonal and perennial crops including woodlots. During the construction phase especially during land husbandry work, landowners will be requested not to use their land for a given period to free the area reserved for land husbandry works and construction of irrigation and post-harvest facilities. This implies that some farmers lose the produce that they could have obtained in that particular missed season; hence, a loss in home income and in most cases domestic food. It also affects targets of crop production set by local government officials for their respective district sectors.

Furthermore, during field survey few grazing area were observed inside command area with some cattle sheds. With the establishment of irrigation system, grazing in these areas will not be possible and the project management will discuss with owners on the possibility of relocating grazing areas outside the command area and cattle sheds will be compensated. The next tables show the number of grazing area and cattle shed identified in command areas of three blocks

Table 12: Grazing plots and Cattle sheds identified in Command areas

Name of block	No. of Cattle-shed	No. of Grazing Plots
Kibare	21	23
Ihema	5	6
Nasho	13	9

Source: BESST LTD Field Survey, 2020

In addition, to the above grazing areas and cattle sheds the next below provides an indication of resettlement and compensation associated with the proposed project. It is, therefore, recommended to prepare and implement a resettlement plan before project implementation. It's worth to note that there is no physical resettlement expected give that all people in project are living in grouped settlements and these areas are out of targeted area

Table 13: Resettlement Impacts associated with Ndego irrigation schemes

Type of Loss	No of PAPs	Estimated size (m2)	Eligibility Criteria	Entitlement
Loss of private lands on water balance reservoir	37	9,966 ³	Owners of land where regulation reservoir will be constructed	Cash compensation for loss of land
Loss of private lands along pressures pipes	65	51,446 ⁴	Owners of land along main pressure canals	Cash compensation for loss of land
Loss of lands at water pumping stations	9	10,000 ⁵	Current users of lands at pumping station sites	Cash compensation for loss of land
Loss of perennial trees and food crops	Not identified		Various rights and interest holders Share croppers and Lessees	Cash compensation for loss of perennial crops
Vulnerable people	Not identified		Older, handicapped, marginal and others	Employment during construction and technical training
Loss of income during land husbandry	Not yet identified		Land owners	Cash for work as source of income

Source: Field survey

³ The size of land is calculated for 9 balancing storages with different volume ranging from 1,000 m³ to 6,000m³ and a buffer area of at least 2m was added. Final RAP will provide actual size

⁴ The affected area is estimated for 42,8 km of main pipe and the required land for installation would be maximum 2m.

⁵ 4 pumping station are planned and the land to be affected at each is estimated at 250m²

CHAPTER THREE: POLICY, LEGAL AND REGULATORY FRAMEWORK

3.1. Overview

One of the objectives of preparation of Environmental and Social Impact Assessment is to ensure that the proposed project is aligned with and contributes to national and international development objectives. Further, the ESIA process includes identification and description of pertinent regulations and standards governing environmental quality, safety and health, protection of sensitive areas, protection of endangered species, siting and land use control at the national and local levels. In Rwanda, the national development objectives and environmental management targets are well established in both long term and short-term strategic plans. The Vision 2050 aspiration provide national targets by 2050 in terms of developments and environmental sustainability. Similarly, the National Transformation Strategy (NST1, 2018-2024) breaks down the long-term targets into medium-term targets. The short-term targets are, achieve by sectoral policies, sector strategic Plans and enforced through regulations implemented by various institutions. Therefore, this chapter presents national development objectives and targets, pertinent policies and regulations and how the proposed complies or will comply with them. The chapter also provides key international best practices and Policies that the proposed irrigation project will comply with.

3.2. National agriculture policy framework

3.2.1. Rwanda Vision 2050 aspirations

Rwanda is moving from Vision 2020 to Vision 2050 which aspires to take Rwanda beyond high income to high living standards. Its income targets are to attain upper middle-income country status by 2035 and high-income status by 2050 with an objective of providing high quality livelihoods and living standards to a Rwandan.

One of the key area of the Vision 2050 is to ensure the quality of life and expected standards for all Rwandans: (i) Sustained food security and nutrition for all households and age groups, (ii) Universal, sustainable and reliable access to water (in houses) and sanitation, (iii) Affordable, sustainable, reliable and modern energy, (iv) Universal access to quality health care and services, quality education, financial services, dignified and SMART housing with high speed internet, pension, medical insurance and savings, (v) Environmentally friendly and climate resilient surroundings, and (vi) Sustained national security. The Proposed project contributes to this vision by ensuring sustained food security and nutrition for all households especially those living in targeted area.

3.2.2. Short term development Strategy (NST 1, 2024)

The National Strategy for Transformation (NST1), under the outcome 6.1 on increased productivity, quality and sustainability of crop, targets to enhance farmers' access to fertilizers and improved seeds whereby fertilizer application is projected to increase from 32 kg/ha per annum (2016/17) to 75 kg/ha per annum by 2024 and the use of improved seeds to increase from 52 % (2016) to 75% (2024) on consolidated lands. The strategy also targets to review and strengthen the system of management of distribution of inputs to ensure efficiency and timeliness in delivery, working with the private sector and other stakeholders.

In addition, the NST1 under outcome 6.3 on increased resilience of agriculture to climate change, targets to implement specific actions that promotes a sustainable intensification of agriculture and strengthens its resilience to limit environmental degradation. This entails enhancing input-use efficiency through adaptive inputs for agricultural production, sustainable and environmentally friendly use of plant genetic resources and the use of Integrated Soil Fertility Management (ISFM) technologies to improve soil structure and water retention capacity, leading to resilient agricultural ecosystems. Furthermore, in partnership with the private sector, effective and innovative irrigation systems will be implemented to increase the area under irrigation to 102,284 ha in 2024 from 48,508 ha in 2017. The priority will be the scale-up of cost-effective marshland and small-scale irrigation technologies. The Proposed Ndego irrigation project is aligned with objective of NST one as it contributes to the increased productivity, increased resilience of agriculture to climate change but also in achieving the targeted area under irrigation.

3.2.3. National Agricultural policy

The Rwanda's vision for agriculture sector as reflected in the 2018 National Agriculture Policy is to become "a nation that enjoys food security, nutritional health and sustainable agricultural growth from a productive,

green and market-led agricultural sector”⁶. The overall objective of the Rwanda’s agriculture policy is fourfold:

- **Increased contribution to wealth creation:** Rwanda is committed to halving poverty by 2025 through inclusive agriculture and growth transformation and increasing value addition and technological upgrading;
- **Economic opportunities and prosperity - jobs and poverty alleviation:** Committed to generating jobs and ensuring the participation of women and youth in the work force and boosting intra-African trade in agricultural commodities with better functioning national and regional markets;
- **Improved food security and nutrition:** Committed to ending hunger in Africa by 2025 through increased agricultural production and productivity while decreasing dietary gaps to fight childhood wasting and stunting;
- **Increased resilience and sustainability:** Committed to enhancing reliance of livelihoods & production systems and climate variability through an increased access of productive safety nets and efficient management of natural resources.

According to the policy, the government of Rwanda will act as a market enabler to leverage private sector investment and to harness its full potential to meet the policy objectives of the National Strategy for Transformation (NST1) and Vision 2020/50. More specifically, the government investment will be focused towards projects with positive economic return (desirable) but undersupplied by the private sector due to negative financial return (unprofitable). Therefore, the government may invest either through direct provision, subsidies, or Public-Private-Partnerships⁷. Policy actions towards achieving this include, but not limited to: Partner with private sector to invest in business operations that are not purely attracting the private sector investment as well as addressing market failures by providing targeted interventions.

The policy also envisages that subsidies will be targeted and ensure that the private capital is attracted to invest in input supply and in the acquisition irrigation and erosion control, Infrastructure and logistics, mechanization, post-harvest management and cold storage facilities, food processing and ICT for Agriculture. The use of fertilizers is described in the fourth pillar of the national agriculture policy stated as “Inclusive markets and off-farm opportunities”.

The pillar mainly focuses on: Efficient value chains are a decisive factor for a competitive sector that ensures nation-wide food safety and food security. This includes key input markets such as fertilizers, insurance, and finance as well as upstream activities such as aggregation, value addition, food availability, and export readiness.

3.2.4. Strategic Plan for Agriculture Transformation (PSTA4)

Though the fourth Strategic Plan for Agriculture Transformation (PSTA 4), Rwanda seeks to transform its agriculture from a subsistence to a knowledge-based value creating sector, that contributes to the national economy and ensures food and nutrition security in a sustainable and resilient manner⁸. It is therefore clear that the PSTA 4 intends to support the overarching objective of the Economic and Social Transformation Pillars of the NST1 to ‘accelerate inclusive economic development founded on the private sector, knowledge and Rwanda’s natural resources’, and to ‘develop Rwandans into a capable and skilled people with quality standards of living.

PSTA4 reflects the government of Rwanda’s aspirations for developing the agriculture sector over the next five years (2018/19-2023/24). PSTA4 is structured around the following four priority areas: (i) innovation and extension, (ii) productivity and resilience, (iii) inclusiveness and value chain addition, and (iv) enabling environment and responsiveness.

The proposed Ndego irrigation schemes contribute to the PSTA 4 especially priority area 2: productivity and resilience. This include (i) developing water resources to enhance the sustainable and resilient productivity of

⁶ Republic of Rwanda (2018). National agriculture Policy

⁷ Idem

⁸ Ministry of Agriculture and Animal Resources (2018). Strategic plans for agriculture transformation 2018-24

agriculture and enable the development of new value chains and Sustainable land husbandry and crop intensification.

3.2.5. National Irrigation Master Plan and irrigation Policy

The Rwanda irrigation master plan was adopted in 2010 while its corresponding national irrigation policy was approved by the cabinet in 2013. The overall objective of the policy is to bridge fundamental performance gaps in the irrigation sector and to propose key reforms necessary to structure a highly modern and productive irrigation sector that contributes effectively to the national economy. One of the main reforms proposed by the policy is to ensure that the government of Rwanda formulates productivity linked subsidies for irrigation energy costs and agro-ventures, including irrigation equipment⁹.

On the other hand, the 2010 Rwanda Irrigation Master Plan proposes to lessen the financial burden on smallholder farmers and provide monetary support that could be considered through the provision of government subsidies as one of desirable elements of modern irrigation in Rwanda¹⁰. To implement this policy, the Government of Rwanda in the Cabinet resolution of 27th July 2014, adopted the Subsidized Farmer owned Small Scale Irrigation Development Program whose objective is to develop 10,000 ha of farmer owned, affordable irrigation systems by 2017/18. This is in line with its objective for maximizing the potential to develop over 100,000 ha of small Scale Irrigation Systems targeting small scale farmers¹¹. The Master Plan is under review and update and the proposed project will adopt the revised requirements as appropriate.

3.3. National environmental Policy and legal framework

National long-term environmental and climate change targets are included in both Vision 2050 aspirations and National Strategy for Climate Change and Low Carbon Development (2011-2050). These long term vision are translated into short-term strategies in NST1 and into strategic actions included sectoral Policies and sector strategic Plans.

3.3.1. National environnement aspirations in Vision 2050

Environmental and climate change considerations are reflected in key priority areas named High Quality and Standards of Life. That is moving beyond meeting basic needs to ensuring a high standard of living to transform the lives of households and individuals. The above Environment Vision is supplemented by climate change vision, which is for Rwanda to be a developed climate-resilient, low-carbon economy by 2050 (National Strategy for Climate change and Low Carbon development). This vision is to be achieved through the following strategic objectives:

- To achieve Energy Security and a Low Carbon Energy Supply that supports the development of Green Industry and Services
- To achieve Sustainable Land Use and Water Resource Management that results in Food Security, appropriate Urban
- Development and preservation of Biodiversity and Ecosystem Services
- To achieve Social Protection, Improved Health and Disaster Risk Reduction that reduces vulnerability to climate change.

This long term vision are were translated into short term targets in NST1 as cross cutting issues but also in sectoral policies and sector strategic Plans(SSPs, 2018-2024).

3.3.2. Environmental and Climate change targets and NST1 (2024)

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

⁹ Government of Rwanda (2013). Rwanda Irrigation policy and strategy

¹⁰ Government of Rwanda (2010). Rwanda Irrigation Master Plan

¹¹ Minagri (2014). Feasibility study on the farmers led SSTI Irrigation Program

3.3.3. National Policy on Environment and Climate Change, 2019

The first environmental Policy was adopted by the cabinet in November 2003 and was recently revised (June 2019) to include Climate Change and other emerging issues and Opportunities. The Policy goal is Rwanda to be a nation that has a clean and healthy environment, resilient to climate variability and change that supports a high quality of life for its society. The Policy objective are:

- Greening economic transformation;
- Enhancing functional natural ecosystems and managing biosafety;
- Strengthening meteorological and early warning services;
- Promote climate change adaptation, mitigation and response;
- Improve environmental well-being for Rwandans;
- Strengthen environment and climate change governance; and,
- Promote green foreign and domestic direct investment and other capital inflows.

This Policy is relevant to the proposed projects given that is targeting natural resources such as water and land but also is contributing to climate change adaptation response. Further, the proposed options may have impacts on environment and natural resources.

3.3.4. National Determined Contribution (NDC) by 2030

NDC document presents the Government of Rwanda's update of its first Nationally Determined Contributions (NDCs) for mitigation and adaptation for the period to 2030. The Government of Rwanda is committed to taking urgent action to mitigate and adapt to the effects of climate change. As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), the country seeks to contribute to the ambitious goal of limiting temperature rise to 2oC with efforts to reach 1.5oC agreed under the Paris Agreement. Because Rwanda is highly vulnerable to climate change, adaptation is a key concern and a priority for the country. Key priority area relevant to the proposed Ndego irrigation project include:

- Develop climate resilient crops and promote climate resilient Livestock
- Develop climate resilient post harvest and value addition facilities and technologies Strengthen crop management practices;
- Develop sustainable land use management practices
- Expand irrigation and improve water management
- Expand crop and livestock insurance
- Development of Agroforestry and sustainable agriculture

3.3.5. National Biodiversity Strategy (NBS), 2015

The revised and updated Rwanda National Biodiversity Strategy (NBS) of 2015 has a long-term vision which is in line with the Convention on Biological Diversity (CBD) strategic plan to 2020 and states that: "by 2040, national biodiversity be restored and conserved, contributing to economic prosperity and human well-being through delivering benefits essential for Rwandan society in general." NBS as a 'living document', responsive, flexible and practical, including biodiversity conservation in economic decisions and turn it into a driver for national development. Relevant economic development sectors such as agriculture and animal resources, fisheries, forestry, mining and infrastructures will incorporate biodiversity conservation activities into their planning systems as well as in the annual budgets of upcoming years. The Master Plan will comply with this policy given that the proposed infrastructure may have both negative and positive impacts on biodiversity.

3.3.6. Integrated Water Resources Policy, 2018

The IWRP is the latest development in Government's consistent and continuous efforts to strengthen the water resources management sub-sector. It replaces the 2004 policy and has been necessitated by the ill-alignment between the 2004 policy and water law No. 62/2008, which embraced many modern and cutting-edge principles of sustainable water resources. Additionally, the government has been introducing reforms in the water sector that have significantly changed the context for water resources management and rendered the 2004 policy out of date. With the promulgation of a law establishing the Rwanda Water and Forestry Authority (RWFA) with the mandate to lead the management of water resources across sectors, there is

potential to achieve a coordinated approach to water resources management, in line with the integrated water resources management concept. In order to address the capacity limitations being faced by the sector, it will require concerted efforts in resource mobilization, human resource development and institutional capacity building.

The Water Resources Policy is very relevant to the proposed project given that it is the one providing guidance on water source management and allocation of water to various users. Further, water abstraction permit will be required for selected projects.

3.3.7. Integrated water Resources Master Plan, 2015

This is an important tool when it comes to irrigation projects. The integrated Water Resource Master Plan focuses on conserving and protecting Rwanda's water, restoring its water reservoirs, ensuring efficiency and equity in allocation and use of water. Internal pressures need to be controlled and IWRM needs to assure that developments and envisaged interventions affecting sustainable water resources use are anticipated, where possible entirely avoided or otherwise controlled by Integrated Water Resources Management. A thorough analysis of developments that may affect water resources needs to be carried out regularly.

Changes in land use practice and developments in all sectors that may or will affect water resources need to be evaluated by environmental impact assessment (EIA): Major construction works infrastructure development, mining, development of irrigation schemes, urbanization and the impact these activities have on water resources in terms of quantity and quality need to be assessed by EIAs. EIAs need to follow thorough standards and be carried out with public participation and independent institutions not having specific interest in the results or outcomes of EIAs (avoiding conflicts of interest).

3.3.8. Land Policy in Rwanda, 2004

The National Land Policy of Rwanda approved in 2004, seeks to establish a land tenure system that guarantees tenure security for all Rwandans and give guidance to the necessary land reforms with a view to good management and rational use of national land resources. The policy seeks to ensure this through the following objectives.

- To put in place mechanisms which guarantee land tenure security to land users for the promotion of investments in land;
- To promote good allocation of land in order to enhance rational use of land resources according to their capacity;
- To avoid the splitting up of plots and promote their consolidation in order to bring about economically viable production;
- To establish mechanisms which facilitate giving land its productive value in order to promote the country's socio-economic development;
- To focus land management towards more viable and sustainable production by choosing reliable and time-tested methods of land development;
- To develop actions that protect land resources from the various effects of land degradation;
- To establish institutional land administration arrangements that enable land to have value in the market economy;
- To promote the involvement and sensitization of the public at all levels in order to infuse land use practices that are favourable to environmental protection and good land management. To promote conservation and sustainable use of wetlands As such, this policy bears the responsibility of allocating and planning land use activities in Rwanda including housing activities.

The Land Policy is relevant to the Master Plan, given that the proposed infrastructure will need land and hence may change land tenure and may require expropriation. Further, the project should be aligned with other land use master Plans.

3.4. Key regulations relevant to Ndego irrigation schemes.

To comply with this constitutional statement and to ensure that the country development is done in sustainable manner, the government has adopted different regulations. These regulations are aligned or complemented Multilateral Environmental Agreements (MEAs) ratified Rwanda including the United Nations Framework Convention on Climate Change (UNFCCC); the Kyoto Protocol, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Basel Convention, the Montreal Protocol on Substances that Deplete the Ozone Layer, the Rotterdam Convention, among others. The development of present Master Plan and its implementation has and will comply with these regulations.

3.4.1. Constitution of the Republic of Rwanda of 2003 revised in 2015

The Constitution of the Republic of Rwanda of 2003 revised in 2015 clearly provides the binding legal framework which shall guide the Master Plan and this SEA:

- Article 22 on “Right to a clean environment”: Everyone has the right to live in a clean and healthy environment.
- Article 53 on “Protection of the environment”: Everyone has a duty to protect, safeguard and promote the environment. It also indicates that The State ensures the protection of the environment. Lastly it stipulates that a law determines modalities for protecting, conserving and promoting the environment.

3.4.2. Law n°48/2018 of 13/08/2018 on environment and its ministerial orders

- **Environmental law, 2018**

The new environmental law approved No 48/2018 of 13/08/2018 determines modalities of protection, conservation and promotion of environment in Rwanda and regulates the Environmental Impact Assessment. Article 33 on Consideration and approval of environmental studies, states that the environmental impact assessment, environmental audit and strategic environmental assessment must be approved by the Authority or another State organ authorized in writing to do so by the Authority.

If the approval is made by an authorized organ, such an organ does so on behalf of the Authority which is also responsible for its audit. Currently the EIA approval process is done on line via RDB one stop center and is done as follows:

- Project proponent /developer request EIA terms of reference by submission of project brief;
- RDB review the project brief and conduct field visit before issuance of terms of reference;
- Once terms of reference are approved and sent to the project developer, this one is allowed to hire one of the certified expert based on the list approved by Ministry of Environment;
- The hired consultant conducts the EIA study and submit the EIA report to the developer and this one send the report to RDB if is satisfied with the report;
- RDB review the report and issues the EIA clearance letter with approval condition if is satisfied with the report. Once the conditions of approval are signed by the developer, then RDB issue the original certificate and the developer is allowed to start the project;
- If RDB is not satisfied with the report, the report is reject and the developer together with the consultant addresses comments issues by RDB;
- If the developer is not satisfied with RDB decision, he/she can appeal to the Minister of natural resources having environment in his attribution.

Article 30 states projects that must undergo an environmental impact assessment and its procedure. The list of projects that must undergo an environmental impact assessment before they obtain authorization for their implementation is established by an Order of the Minister. An Order of the Minister also issues instructions and procedures for conducting environmental impact assessment.

Article 31 of this law state that “every policy, strategy, plan and programme must undergo a strategic environmental assessment. Procedures for conducting strategic environmental assessment are determined by an Order of the Minister”. Guidelines for SEA preparation were prepared and published in June 2011. While EIA studies are approved by RDB, Terms of Reference and SEA report as well as Environmental audit report are approved by REMA.

Article 32 on Environmental Audit requires every project that may have significant impact on the environment to undergo an environmental audit during and after its implementation. The list of projects that must undergo environmental audit is established by an Order of the Minister. An Order of the Minister also issues instructions and procedures for conducting environmental impact assessment.

- **Ministerial order N°001/2019 of 15/04/2019 establishing the list of projects that must undergo an environment impact assessment, instructions, requirements and procedures to conduct environmental impact assessment**

The Ministerial Order No 001/ 2019 of 15/04/2019 establishes the list of projects that must undergo environmental impact assessment, instructions, requirements and procedures to conduct environmental impact assessment. Article 3 of this ministerial order states that No public institution is authorized to take a decision, to warrant a certificate, approve or authorize the commencement of a project mentioned in the annexes of this Order without prior environmental impact assessment. The list of works, activities and projects that must undergo a full environmental impact assessment before being granted authorization for their implementation is in Annex I of this Order. Article 4 provides the List of works, activities and projects that must undergo a partial environmental impact assessment The list of works, activities and projects that must undergo a partial environmental impact assessment before being granted authorization for their implementation is in Annex II of this Order.

Annex I of this ministerial order provide the list of works that shall undergo a full EIA study and those include all buildings classified as residential, commercial, administrative or institutional sports facilities, social, cultural, and assembly and religious buildings, hotels, health facilities, educational buildings, or other publicly accessible facilities fulfilling at least two of the following conditions:

- a) having capacity to host more than five hundred (500) people;
- b) having a total floor area exceeding one thousand and five hundred square meters (1500 sqm);
- c) built in plot size exceeding one thousand square meters (1000 sqm).

Annex 2 of this ministerial order provides the list of projects that shall undergo a partial Environmental Impact assessment and those include:

- 1) towers and antennas;
- 2) all types of buildings, except those qualified for full environmental impact assessment fulfilling at least two of the following conditions:
 - a. with a capacity to host more than two hundred (200) people but not exceeding five hundred (500) people,
 - b. with a total floor area exceeding one thousand and five hundred square meters (1500 sqm);
 - c. built in a plot size exceeding one thousand square meters (1000sqm).
- 3) micro hydroelectric power plants

The proposed project falls under projects that should undergo full environmental impact assessment

3.4.3. Biodiversity law in Rwanda and Associated Ministerial order

- **Biodiversity law, 2013**

The Law N° 70/2013 of 02/09/2013 governing biodiversity in Rwanda determines modalities for management and conservation of biological diversity within Rwanda and provide guidance on biodiversity planning and monitoring, management of ecosystems, endangered and invasive species, bioprospecting-access and benefit sharing as well as permitting provisions. The law indicates a number of ministerial order that facilitated the implementation of the law. These include: (i) Ministerial order determining a geographic region as a bioregion if that region contains whole or several nested ecosystems and is characterized by its landforms, vegetation cover, human culture or history;(ii) An Order of the Minister that I set out a national list of ecosystems that are threatened and in need of protection and their location; (iii) An Order of the Minister that set out a list of activities prohibited in an ecosystem(including critically endangered species, endangered species and vulnerable species;(iv) An Order of the Minister that set out a list of invasive species and the list shall be subject to review every two (2) years and whenever necessary; and (v) an Order of the Minister that

determines the time limits within which the person applying for a permit must be notified of the issuance, suspension and cancellation of the permit.

- **Ministerial Order N°007/2008 of 15/08/2008 establishing the list of protected animal and plant species**

Chapter II Article 2 of this order classifies protected animals in three categories as Mammals, birds, and reptiles. The list is published in Appendix 1 of this Order as follows:

Animals: Gorilla, Chimpanzee, Black rhinoceros, Elephant, Roan antelope, Sitatunga, Lions, Leopard, Klipspringer, Buffalo, Cheetah, Zool mongoose, Cephalophus, Zoolseval, Wild dog, Bushbuck, Hippopotamus, Burchell's zebra Birds: Black-headed Heron, Cattle Egret, Grauer's Swamp Warbler, Owls, All Lemoroids, Grey Crowned-Crane, wallow, Arrow-marked Babbler, Cape Robin-Chat, All pangolins, Vulture, Bee eater, Scimitar bills, Hamerkop, Sunbirds.

Reptile: Tortoises (all species), Python, Crocodile, Viper.

Plants: Ficus thonningii, Prunus africana, Pentades mareindersii, Myrianthus holstii, Thonningia sanguine, Hypoestetrifolia ,Aloe sp., Syzygium guineens, Erythrina abyssinica, Fagarachalybea, Kigelia africana, Orchidaceae, Eulophiastreptopetala, Eulophiahorsafalli, Diaphananthebilosa, Disaemili, Disperis kilimanjarica, Euggelingialigulifolia, Polystachyiahastate, Tridactyleanthomaniaca, Entandophragma sp, Podocarpus usambarensis, Albizzia sasa, Piptadenia africana, Podocarpus milinjianus, grandiflora, Strombosia, Scheffleri.

The ministerial order specifies that the listed animals and plant species shall not be destroyed without permission of the competent authorities. Although none of these species were observed in the project area, this project will endeavour to respect and protect these organisms, their habitats and the regulation enforcing the measures of their protection where they are present.

3.4.4. Land law(2013) and Expropriation law(2015)

- **Law N° 43/2013 of 16/06/2013 governing land in Rwanda**

The land law was initially adopted in 2005 and then revised in 2013 and was gazetted in the official gazette no special of 16/06/2013. It determines the use and management of land in Rwanda. It also institutes the principles that are to be respected on land legal rights accepted on any land in the country as well as all other appendages whether natural or artificial.

According to the law, land in Rwanda is categorized into two: individual land and public land. The latter is subdivided into two categories: the state land in public domain and the state land in private domain. State land in public domain includes national land reserves for environment conservation; land over which administration building are erected, state roads, land containing lakes, rivers, stream and springs. State land in private domain include swamps that may be productive in terms of agriculture, vacant land with no owner, land purchased by the State, donation, land acquired through expropriation and land occupied by state owned forests.

The land law also provides two types of formal land tenure: full ownership/ freehold and long term leasehold. So far, all land in the country has been registered and land titles issued to citizens. According to article 10 of new land law of June 2013, private individual land shall comprise land acquired through custom or written law. That land has been granted definitely by competent authorities or acquired by purchase, donation, inheritance, succession, ascending sharing, and exchange or through sharing. This law offers equal protection to rights over land resulting from all channels stipulated in the preceding paragraph. All types of land tenure must be in compliance with the designated land use and environmental protection measures as outlined in the Land Use Master Plan.

- **Law n° 32/2015 of 11/06/2015 relating to expropriation in the public interest**

This law determines the procedures relating to expropriation of land in the interest of the public. The law stipulates that the government has the authority to carry out expropriation. However, the project, at any level, which intends to carry out acts of expropriation in the public interest, shall provide funds for inventory of assets of the person to be expropriated and compensation exercise. According to the law, no person shall

hinder the implementation of the program of expropriation on pretext of self-centred justifications and no land owner shall oppose any underground or surface activity carried out on his or her land with an aim of public interest. In case it causes any loss to him or her, he or she shall receive just and fair compensation for it.

Eligibility for compensation is enshrined under the Rwandan constitution (article 29) and the expropriation law. The two laws regulate and give entitlement to those affected, whether or not they have written customary or formal tenure rights. The person to be expropriated is defined under article 2(7) of the expropriation law to mean any person or legal entity who is to have his or her private property transferred due to public interest, in which case they shall be legally entitled to payment of compensation.

There is no physical resettlement expected from the Ndego irrigation and land will be acquired at pumping station, main irrigation canals/pipes and water regulation reservoir. Further, loss of income is expected during land husbandry works. Given the low level of anticipated impacts, an abbreviated resettlement action Plan and livelihood restoration plan are the recommended social safeguards instruments.

3.4.5. Law and Regulations governing water supply services in Rwanda

The law No 49/2018 of 13/08/2018 determines the use and management of water resources in Rwanda (N° 49/2018 of 13/08/2018) and places strict regulations governing the protection and use of Rwanda's wetlands and water resources. Specifically, according to Article 21, the use of water resources that may modify the flow rates, reduce water levels, degrade water quality, or threaten related ecosystems, wetlands, and the environment, are subject to water use permits. Water users must pay a fee for permits, which is to be deposited in the National Fund for Environment (FONERWA). Other water permitting and license procedures are provided under water user's association law and water law 2018.

The use of water resources in different activities and installations susceptible to modify the flow or the level of water or to degrade their quality, or to threaten water related ecosystems, wetlands and the environment are subjected to water use permit. According to this law, the person requesting to be a holder of water use permit, get this permit renewed or transferred pays fees whose amount is determined by a Ministerial Order. Such a Ministerial Order also determines the basis of calculation and amount of annual fees to be paid for water use. A law on water fees is under discussion. This law is applicable to this project given that water permit is required but also farmers will be required to pay water fees.

3.4.6. Mining and quarry regulations.

The construction irrigation facilities require some material including stones and sand. Therefore, the mining and quarry exploitation laws provide the process of acquiring quarries for mining activities, the licensing process and the environmental consideration in exploiting a quarry. Nevertheless the quarry component will be conducted by a contractor who will be required to fully respect strictly the process. Actually, an EIA Certificate is required for each quarry to be exploited. Thus, the contractor will be requested to acquire material from a certified mines and quarry and in respect to environmental requirements. It's therefore the responsibility of quarry/mines owner to develop and implement an ESMP including Borrow Pits Closure Plan (BPCP). If the contractor open new query or borrow pits will be required to prepare and implement the BPCP before the handover the project facilities.

3.4.7. Regulations related to the use of agriculture inputs

- **The law governing agrochemicals in Rwanda**

This law no 30/2012 of 01/08/2012, was published in the 'Official Gazette' n 0 37 of 10 September 2012. It focuses on both pesticides and mineral fertilizers and aims to regulate manufacturing, importing, distribution, use, storage, sale, disposal and burial of expired agrochemicals. MINAGRI has the responsibility for its implementation. Key provisions of the law include:

- ✓ **Pesticide registration**

This is done following previsions in the law indicated above and through a number of steps and organs as described in the next paragraphs. The Ministerial order No 001/11.30 of 15/02/2013 as published in the 'Official Gazette' n0 9 of 04/03/2013 determines powers and responsibilities of the registrar of agrochemicals. Similarly, a Ministerial order n0 002/11.30 of 15/02/2013 published in the same Official Gazette as above, indicates powers and responsibilities of an inspector of agrochemicals.

✓ **Publication of registered agrochemicals and prohibited agrochemicals**

Any agrochemical for which registration certificate has been denied, withdrawn or cancelled upon request of the manufacturer or his legal representative, will be recorded on the list of prohibited agrochemicals in Rwanda and a Ministerial order will publish the list of registered and the list of prohibited agrochemicals (Article 16).

✓ **Authorization for selling agrochemicals**

The article 20 of this law says that any person willing to sell agrochemicals shall have to apply for an authorization to do so. A Ministerial order specifies the requirements for the sale of agrochemicals among them the showing a formal qualification (Diploma or Degree in Agricultural sciences). According to the article 21, when the conditions contained in the certificate relating to agrochemicals are not complied with, the registrar of agrochemicals may, where necessary and for the purpose of protecting human health and environment, suspend in writing the certificate for a period not exceeding twenty one (21) days. He/she shall notify the decision to the Advisory Council. Should the reasons which prompted the certificate suspension persist, the registrar of

✓ **Importation or exportation of agrochemicals**

No agrochemical shall be imported or exported except in a legally accepted ways. Any person who imports or exports an agrochemical shall produce to the competent inspector the documents relating to such an agrochemical (Article 23).

✓ **Examination of agrochemicals and their residues**

Based on the Article 30, the ‘Advisory Council’ designates a legal or natural persons to examine the quality of agrochemicals and their residues whether in soil, in food or other agricultural products in order to enforce and improve controls. For this purpose, the Rwanda Agriculture Board (RAB) and the Rwanda Standard Board (RSB) have been assigned the task to examine the quality of agrochemicals and carry out the assessment for residues, respectively. The relations between the registrar of agrochemicals and legal or natural examiners are defined by the ‘Advisory Council’. The certificate that the examiner submits to the registrar of agrochemicals shall state that he/she has analysed or examined an agrochemical or its residues and indicate also the results of examination and be considered as a prima facie evidence when it comes to criminal proceedings.

This law is supplemented by two ministerial order:

- The Ministerial order n0 001/11.30 of 15/02/2013 as published in the ‘Official Gazette’ n 0 9 of 04/03/2013 which determines powers and responsibilities of the registrar of agrochemicals; and
- The ministerial order n0 002/11.30 of 15/02/2013 published in the same Official Gazette and determines powers and responsibilities of an inspector of agrochemicals.
- Ministerial instructions No 0003/2016 of 01/07/2016 governing the distribution of subsidized inorganic fertilizers and improved seeds during Agricultural season A&B 2017.

3.5. Institutional arrangement for the environmental management in Rwanda

The institutional framework for environmental management is currently enshrined in the Organic Law determining the modalities of protection, conservation and promotion of the environment in Rwanda, published in the Official Gazette RWA N° 9 of the 1st May 2005, particularly in its chapter III relating to the establishment of the institutions.

3.5.1. Ministry of Agriculture and Animal Resources

MINAGRI is the leading government institution for agriculture and animal husbandry and its mission is to initiate, develop and manage suitable programs of transformation and modernization of agriculture and livestock to ensure food security and to contribute to the national economy. One of the key pillars of the ministry vision is the transformation of Agriculture from subsistence to a productive high value; market oriented farming that is environmentally friendly and has an impact on other sectors of the economy. The policy of the Ministry of Agriculture and Animal Resources is to increase animal production, modernize farming, reduce poverty, ensure food security and have surplus for the market. This will ultimately result in the increase of the standard of living of the population. The transformation of the animal resources industry can only be achieved if the constraints to animal production are reversed. The Ministry has four priority programmes including:

- Agriculture and Animal Resource Intensification;
- Research, Technology Transfer and Professionalization of Farmers;
- Value Chain Development and Private Sector Investment;
- Institutional Development and Agricultural Cross-Cutting Issues.

3.5.2. Rwanda Agriculture Board (RAB)

RAB will play essential role in the successful implementation of the project. RAB is entrusted with the implementation of agriculture and livestock policies and plans. The vision of RAB is to improve food security and livelihoods of all Rwandans by transforming agriculture from subsistence into modern farming through generating research and extension innovations that generate sustainable crop, animal husbandry and natural resource management. RAB has the mission of developing agriculture and animal husbandry through their reform, and using modern methods in crop and animal production, research, agricultural extension, education and training of farmers in new technologies. Key responsibilities of RAB include the implement the national policy of agriculture and animal husbandry, contribution in determining policy in agriculture, animal husbandry, agricultural and animal husbandry research and technology and to provide farmers and consumers of agricultural products with information, techniques and services meant for improving their profession and supplying the internal market with increased and quality production thereby raising their agricultural and animal husbandry incomes.

3.5.3. Environmental Regulation and Management institutions

- **Ministry of Environment (MoE)**

MoE is responsible for the development of environmental policies and procedures (including impact assessments), protection of natural resources (water, land, flora, and fauna), environmental legislation, biodiversity, and other environmental aspects. The Chapter IV of the Organic Law on Environmental Protection, Conservation and Management, Article 65, clearly calls for the need to subject projects to mandatory Environmental Impact Assessment. The Article 65 further specifies that every project shall be subjected to Environmental and Social Impact Assessment prior to its commencement. It shall be the same for programs, plans and policies likely to affect the environment. Specific details of projects referred to in this Article shall be spelt out by the order of the Minister in charge of environment. MoE is one of the lead Agencies / Line Ministry as provided by the General Guidelines and Procedure for ESIA.

- **Rwanda Environment Management Authority (REMA)**

REMA was established in 2004 to act as the implementation organ of environment related policies and laws in Rwanda. Under supervision of the Ministry of Environment, from the Law n°63/2013 of 27/08/2013 determining the mission, organization and functioning of Rwanda Environment Management Authority (REMA), REMA has the legal mandate for national environmental protection, conservation, promotion and overall management, including advisory to the government on all matters pertinent to the environment and climate change. Key responsibilities of REMA are as follows:

- Advise the Government on policies, strategies and legislation related to the management of the environment as well as the implementation of environment related international conventions, whenever deemed necessary;
- Conduct thorough inspection of environmental management in order to prepare a report on the status of environment in Rwanda that shall be published every two (2) years;
- Put in place measures designed to prevent climate change and cope with its impacts;
- Conduct studies, research, investigations and other relevant activities in the field of environment and publish the findings;
- Closely monitor and assess development programs to ensure compliance with the laws on environment during their preparation and implementation;
- Participate in the preparation of activities strategies designed to prevent risks and other phenomena which may cause environmental degradation and propose remedial measures;

- Provide, where it is necessary, advice and technical support to individuals or entities engaged in natural resources management and environmental conservation;
- Prepare, publish and disseminate education materials relating to guidelines and laws relating to environmental management and protection and reduce environmental degradation risks;
- Monitor and supervise impact assessment, environmental audit, strategic environmental assessment and any other environmental study. REMA may authorize in writing, any other person to analyse and approve these studies. The EIA review has been delegated to Rwanda Development Board.

- **Rwanda Water Resource Board**

The Rwanda Water Resource Body was recently formed after splitting Rwanda Water and Forestry Authority. The Body is responsible:

- To implement policies, laws, strategies and Government decisions related to the management of natural water resources;
- To advise Government, monitor and coordinate the implementation of strategies related to the management of natural water resources;
- To assist public and private institutions in charge of management of natural water resources in a bid to fight erosion;
- To prepare appropriate management and support districts in the management natural water resources;
- To assist in the establishment of standards and regulations relating to the management of natural water resources.

Before project implementation, the body will be responsible to issue water abstraction permit and allocation of water resources for various users.

- **Rwanda Land Management and Use Authority (RLMUA)**

RLMUA is responsible for putting in place and operationalizing an efficient system of land administration, use and management that secures land ownership, promotes investment in land for socio-economic development and poverty reduction. Responsibilities of RLMUA are:

- Put in place mechanisms which procure security of land tenure for the promotion of investments in land.
- Promote proper allocation of land, and proper use of land resources, according to their potential.
- Avoid the splitting up of plots, and to promote their regrouping in order to bring about optimum production.
- Establish of mechanisms which facilitate an optimum exploitation of land, targeting the social-economic development of the country.
- Orient land management towards a more profitable and sustainable production, by making good choices among methods of land development.
- Develop methods that protect land resources from various types of land degradation.
- Establish institutional frameworks, which enable land to become more valuable in the economy or at the market.
- Promote research as well as the education of the public on all aspects concerning land tenure, management, and transactions.
- Establish order and discipline in the allocation of land, as well as in land transactions in order to control the pressure on land, inappropriate development, speculation and trafficking of land.
- Involve and sensitize the public at all levels in order to ensure protection of the environment and good management of the land.
- Ensure the sustainable use of wetlands.

- **Rwanda Development Board (RDB)**

RDB was created by Organic Law N° 53/2008 of 02/09/2008. It has a mission of improving the well-being of all Rwandans by fast-tracking development, catalysing sustainable economic growth, and creating prosperity for all. This is a one stop institution bringing together several government bodies in Rwanda focused at

promoting investment in Rwanda. Initially the responsibility for reviewing and approving ESIA reports was entrusted to REMA, this duty has now been transferred to the newly created Rwanda Development Board (RDB) where a department of ESIA has been created and tasked with review and approvals of all ESIA reports for proposed projects and programmes before they are approved for implementation. The Key responsibility of ESIA department under One Stop centre in RDB is to:

- Receive and register ESIA Applications (Project Briefs) submitted by developers;
- Identify relevant Lead Agencies to review Project Briefs and provide necessary input during screening,
- Review Project Briefs and determine project classification at screening stage,
- Transmit Project Briefs to relevant Lead Agencies and concerned Local Governments to provide input on Terms Of Reference (ToR),
- Publicize Project Briefs and collect public comments during development of ToR,
- Receive ESIA documents submitted by a developer and verify that they are complete,
- Transmit copy of ESIA Reports to relevant Lead Agencies, Local Governments and Communities to review and make comments,
- Review ESIA reports and make decision on approval, organize and conduct public hearings, appoint an officer from Authority to chair public hearings, receive public comments and compile public hearing reports,
- Appoint the Technical Committee and its representative to the Technical Committee,
- Forward ESIA Documents (ESIA Report, Environment Monitoring Plan and Public Hearing Report) to the Technical Committee,
- Chair the Executive Committee which makes final decision on approval of a project,
- Communicate decision on whether or not a proposed project is approved,
- Issue to developers ESIA Certificate of Authorization if their projects are approved.

- **Kayonza district and Ndego sector**

Decentralized entities are responsible for the implementation of laws, policies, strategies, objectives and programmes relating to protection, conservation and promotion of the environment in Rwanda. Article 61 of environmental law state that in the framework of conservation and protection of the environment, decentralized entities are particularly responsible for:

- ensuring activities related to better management of land, especially controlling soil erosion and tap rain water;
- afforestation, protection and proper management of forests;
- efficient management of rivers, lakes, sources of water and underground water;
- efficient management and effective use of swamps;
- Protection and proper management of reserved areas, historical sites, endangered animal and plant species.

Under the General Guidelines and Procedure for ESIA, Local Governments including Gicumbi and Gatsibo Districts and their respective sectors are tasked to perform the following functions:

- At the request of RDB, review Project Briefs so as to advise on Terms of Reference,
- Provide information or advice to developers and ESIA Experts when consulted during ESIA process,
- At the request of RDB, review ESIA reports and provide comments to RDB,
- Assist RDB in organizing public hearings,
- Host public hearings,
- Host individual consultations,
- Gather written comments from public and transmit them to RDB.
- Facilitate the land acquisition process through Land bureau office;
- Plan and complaints resolutions.

3.6. IFAD environmental and social safeguards

IFAD requires borrowers to comply with both national and IFAD environmental and social safeguards policies and this section summarizes the most relevant to the proposed project.

3.6.1. IFAD's Social, Environmental and Climate Assessment Procedures

IFAD is committed to mainstreaming environmental and social safeguards and climate change solutions in its operations. It has adopted the Social, Environment and Climate Assessment Procedures (SECAP) in 2017. The SECAP endeavours to ensure that IFAD's goal of enabling poor rural people to improve their food and nutrition security, increase their incomes and strengthen their resilience, particularly to climate change, is done in an environmentally and socially responsible manner. The procedures set the minimum standards for the assessment of social, environmental and climate change risks of IFAD funded projects which apply throughout the project cycle.

Ndego project triggers the following safeguards policies (minimum standards): (i) Environmental and Social Impact Assessment, (ii) Natural Habitats, (iii) Involuntary Resettlement, (iv) Pest Management, (v) Physical cultural resources, (vi) Safety of Dams, and (vii) Accountability and Grievance systems.

The procedures help (i) in identifying potential social, environmental and climate risks and their significance and determine the level of management required to address potential risks impacts on IFAD-supported investment projects and global and regional grant-funded programmes; (ii) supporting borrowers and IFAD in improving decision-making and promoting the sustainability of project outcomes through ongoing stakeholder engagement; (iii) assisting borrowers in fulfilling their international and national social, environmental and climate obligations; (iv) ensuring IFAD's practices are aligned with similar procedures of other multilateral financial institutions, and with its own environment and natural resource management policy and climate change strategy; and (v) enabling IFAD to continue accessing environmental and climate financing, such as the Global Environment Facility and the Green Climate Fund or other similar funds.

SECAP provides a step-wise description of the processes and guidance to assess risk at each phase of a project or programme cycle, as follows:

- ✓ **Step 1:** Project Concept: environmental and social categorisation and criteria, climate risk classification, nature and sensitivity of project location, significance of impacts, cumulative and induced impacts;
- ✓ **Step 2:** Early Design: environmental and social impact assessment, climate risk analysis;
- ✓ **Step 3:** Late Design: Review of ESIA and Climate Risk Analysis reports and incorporation of recommendations into design;
- ✓ **Step 4:** Loan Negotiations: financing agreement, including clauses, covenants, and provisions for environmental, social and climate related actions;
- ✓ **Step 5:** Board Approval: final ESIA/ESMP report disclosed;
- ✓ **Step 6:** Project Implementation: implementation of social, environmental and climate adaptation/mitigation actions/measures contained in the ESMP, RAP, IPP and other relevant loan covenants;
- ✓ **Step 7:** Project completion and ex-post ESIA: analysis of the impact of social, environmental and climate issues arising from project implementation.

The IFAD funded projects can be assigned:

Category A projects have significant environmental and social consequences that are sensitive, irreversible or unprecedented, affect an area broader than the sites or facilities subject to physical interventions, and are not readily remedied by preventive actions or mitigation measures. KIIWP is categorised as Category A because the Project's activities may:

- ✓ Develop wetlands;
- ✓ Result in the loss of natural habitat and loss of biodiversity or environmental services provided by a natural ecosystem in sensitive areas – protected areas (Akagera National Park) and their buffer zones, ecologically sensitive areas such as wetlands, coral reefs, mangroves swamps, small
- ✓ Involve the construction of large-scale irrigation schemes rehabilitation/development (above 100 hectares per scheme);

- ✓ Require significant abstraction or diversion/containment of surface water leaving the river flow below 20 per cent environmental flow plus downstream user requirements.
- ✓ Necessitate economic or physical displacement (ie. land, potable water and water for other uses), or physical resettlement of more than 20 people, or impacting more than 10 per cent of any one community's or individual farmer's or household's assets.

Category A projects require one or combination of a formal Environmental and Social Impact Assessment (ESIA) or Environmental and Social Management Framework (ESMF), Resettlement Action Framework (RAF)/ Resettlement Action Plan (RAP), free, prior and informed consent (FPIC)/FPIC implementation plan and Indigenous People Plan.

Category B projects are those that may have some adverse environmental and/or social impacts on human populations or environmentally significant areas but the impacts are less adverse than those for Category A, are site-specific and few are irreversible in nature, and can be readily remedied by appropriate preventive actions and/or mitigation measures.

While no formal ESIA is required for Category B programmes/projects, in many cases further environmental analysis could be undertaken during project preparation or implementation. In some cases, an ESMF is developed during project preparation or implementation. Category B projects require an ESMP.

Category C projects generally do not require additional environmental analysis because the activities have positive environmental impacts, or negligible or minimally adverse environmental impacts. They would include, for example, technical assistance grants for agricultural research and training, grants to generate global environmental impacts, research, capacity building and institutional strengthening. SECAP also provides for climate risk classification based on available information about historic climate hazard occurrences, current climate trends, and future climate change scenarios, as follows:

- **High risk projects or programmes** can be expected to be highly vulnerable to climate-related hazards and thus would benefit from an in-depth climate risk analysis as part of the design or initial implementation stage. This analysis should include an analysis of greenhouse gases (GHG) emissions and present recommendations for risk management – for example, practical climate risk management measures that can be integrated into the project design and implementation phases and could be used to mobilize climate finance for the co-financing of targeted risk reduction and adaptation/mitigation measures.
- **Medium risk projects or programmes** can be expected to be moderately sensitive to climate risks and thus requires a basic integration of climate issues to be undertaken during the project design phase. This process should result in practical adjustments under the project to reduce losses and damages from climate hazards to IFAD's client group and capitalize on opportunities to strengthen local risk-management capacities.
- **Low risk projects or programmes** are unlikely to be vulnerable to climate risks and thus voluntary measures could be incorporated into the detailed design and implementation phases based on the SECAP project assessment recommendations. These projects generally focus on investments which do not have a direct physical or geographical interface with climate hazards.

KIIWP was categorized as high risk project due to the recent droughts and the vulnerability of the Eastern Province to extreme events.

3.6.2. Policy on Improving Access to Land and Tenure Security

The IFAD land policy provides a conceptual framework for the relationship between land issues and rural poverty, and identifies the major implications of this relationship for IFAD's work. The policy acknowledges the complexity and dynamics of evolving rural realities and articulates guiding principles for mainstreaming land issues in the Fund's main operational instruments and processes. It also provides a framework for the subsequent development of operational guidelines and decision tools. The main principles of the policy are:

- Align with national priorities and support to poverty reduction strategies;
- Adhere to the "do-no-harm" principle at all times;

- Appreciate the diversity and dynamic nature of existing agrarian structures and tenure systems;
- Support the centrality of the empowerment of poor rural people and the organizations that represent them;
- Forge complementary partnerships with like-minded actors;
- Focus on the gender dimension of land rights;
- Adhere to the principle of free, prior and informed consent;
- Support to production services and market linkages to maximize the positive effects of access to land and tenure security.
- Anchored in this policy are the tenets of Free Prior and Informed Consent (FPIC).

3.6.3. Policy on Disclosure of Documents, 2010

IFAD's Policy on the Disclosure of Documents enables project design documents to be disclosed prior to the Executive Board session at which the project is to be considered. The Consultation also directed the Executive Board to review policy provisions with regard to the disclosure of previously undisclosed documents. Under IFAD's current disclosure policy, the following documents are disclosed to the public at the same time that they are made available to Executive Board representatives and Governors:

- All documents submitted to the Governing Council (including its Replenishment Consultations);
- All documents submitted to the Executive Board (including the Evaluation Committee);
- Information/status notes on projects being developed for presentation to the Executive Board following internal approval of the inception memorandum;
- Agreements for loans and grants once they are signed and effective;
- Amendments to loan and grant agreements once signed and countersigned;
- Previously undisclosed documents that are eligible for disclosure under the current policy (upon request or as necessary)

All evaluation reports and documentation submitted to the Evaluation Committee are made available to the general public on the website of the IFAD Office of Evaluation (IOE), which is part of IFAD's corporate website. Project/programme design documents are disclosed to the public in their original language prior to the Executive Board session at which the project/programme is to be considered.

The policy also discusses the process for disclosure of previously undisclosed documents, the language of disclosure and appeals.

3.6.4. IFAD Strategy and Action Plan on Environment and Climate Change(2019-2025)

IFAD Strategy and Action Plan on Environment and Climate Change 2019-2025 approved in 2018 replaced the 2010 climate change strategy. The main objective underlying this strategy is enhanced resilience of smallholder farmers and rural communities to environmental degradation and climate change impacts. This will ultimately provide the foundation for more prosperous livelihoods today and in the future. IFAD will contribute to meeting this objective through the following outcomes:

- Governments are increasingly effective in integrating environment and climate change objectives and considerations into smallholder agriculture and other rural development policies and programmes.
- IFAD has the skills, capacity, partnerships, systems and resources needed to fully support governments in integrating environment and climate change into rural development policies and programmes;
- IFAD investments contribute to the generation of environmental assets and services, and global public goods that make the livelihoods of poor rural people more prosperous and resilient, and IFAD's own operations more environmentally sustainable;
- IFAD becomes a global leader in generating knowledge on managing sustainable rural livelihoods
- enabling IFAD to play a greater advocacy role in supporting global efforts to build a healthy planet

This policy is much relevant to Ndego project given the vulnerability of the area to climate change and the proposed interventions will help local communities to adapt to the climate change effects.

3.6.5. Environment and Natural Resources Policy, 2012

IFAD's Environment and Natural Resources Policy aims to enable poor rural people to escape from and remain out of poverty through more-productive and resilient livelihoods and ecosystems, by integrating the sustainable management of natural assets across its activities and its partners' activities. The Policy sets out 10 core principles to guide its support, namely:

- Scaled-up investment in multiple benefit approaches for sustainable agricultural intensification;
- Recognition and greater awareness of the economic, social and cultural value of natural assets;
- 'Climate-smart' approaches to rural development;
- Greater attention to risk and resilience in order to manage environment- and natural-resource related shocks;
- Engagement in value chains to drive green growth;
- Improved governance of natural assets for poor rural people by strengthening land tenure and community-led empowerment;
- Livelihood diversification to reduce vulnerability and build resilience for sustainable natural resource management;
- Equality and empowerment for women and indigenous peoples in managing natural resources;
- Increased access by poor rural communities to environment and climate finance; and
- Environmental commitment through changing its own behaviour.

3.6.6. Gender Equality and Women's Empowerment Policy, 2012

IFAD's Gender Policy goal is to deepen the impact and strengthen the sustainability of IFAD-supported development initiatives, in order to increase IFAD's impact on gender equality and strengthen women's empowerment in poor rural areas. The Policy has three strategic objectives:

- Strategic objective 1: Promote economic empowerment to enable rural women and men to have equal opportunity to participate in, and benefit from, profitable economic activities.
- Strategic objective 2: Enable women and men to have equal voice and influence in rural institutions and organizations.
- Strategic objective 3: Achieve a more equitable balance in workloads and in the sharing of economic and social benefits between women and men.

To achieve these objectives, the Policy outlines five action areas aiming to:

- Systematically address gender equality and women's empowerment issues in IFAD-supported country programmes and projects;
- Improve IFAD contributions to advocacy, partnerships and knowledge management on gender equality;
- Strengthen capacity of partners to address gender issues in agriculture and rural development;
- Develop corporate approaches and procedures with IFAD that support gender and diversity; and;
- Ensure IFAD's corporate human and financial resources, and monitoring and accountability systems fully support gender equality and women's empowerment

3.6.7. Targeting Policy

IFAD's mandate defines its "target group" as rural people living in poverty and experiencing food insecurity in developing countries. Within this broad group, IFAD proactively strives to reach extremely poor people (as defined by MDG 1) who have the potential to take advantage of improved access to assets and opportunities for agricultural production and rural income-generating activities. IFAD's Targeting Policy focuses on improving livelihoods through: ensuring national and international resources are used effectively, policy support is dedicated to rural and agricultural development; encouraging local and national governments to focus on enabling the rural poor to improve their livelihoods; economically and socially empowering rural poor; and encouraging national ownership of interventions. The Policy's guiding principles are to:

- Focus on rural people who are living in poverty and experiencing food insecurity, and who are able to take advantage of the opportunities to be offered;

- Expand outreach to proactively include those who have fewer assets and opportunities, in particular extremely poor people;
- Include marginalized groups, such as minorities and indigenous peoples, and address their specific needs;
- Address gender differences and have a special focus on women within all identified target groups – for reasons of equity, effectiveness and impact – with particular attention to women heads of household, who are often especially disadvantaged;
- Recognize that relative wealth or poverty can change rapidly due to external shocks and that this vulnerability needs to be addressed;
- Clearly identify at the programme or project design stage who the intended target groups are and why, and consistently apply these categories, during implementation, in monitoring and evaluation (internal and external) of targeting performance;
- Identify and work with like-minded partners at local, country, regional and international levels to develop a shared understanding of both the dynamics of rural poverty in different contexts and successful targeted approaches;
- Pilot and share learning on successful approaches to targeting hard-to-reach groups; and
- Build innovative and complementary partnerships with actors that can reach target groups that IFAD cannot reach with the instruments at its disposal

3.7. International Conventions and agreements relevant to the project

3.7.1. EAC protocol on environment and natural resources

This Protocol applies to the East Africa Partner States' cooperation in the management of the environment and natural resources within their jurisdiction including trans boundary ecosystems and natural resources. In regard to article 3 of this Protocol, it is a protocol of general application and shall apply to all activities, matters and areas of management of the environment and natural resources of the Partner States, including the following: (i) sustainable environment and natural resources management; (ii) management of trans boundary resources; (vi) management of water resources.

3.7.2. Framework Convention on Climate Change

This convention takes into account the fact that climate change has trans-boundary impacts. The basic objective of this convention is to provide for agreed limits on the release of greenhouse gases into the atmosphere so as to prevent the occurrence of climate change. It also aims to prepare countries to minimize the impact of climate change, should it occur.

3.7.3. KYOTO protocol (1997) and Paris agreement (2015) to the UNFCCC

The Kyoto Protocol aims to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. On the other hand, Paris agreement (2015) seeks to accelerate and intensify the actions and investment needed for a sustainable low carbon future. Its central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. The Agreement also aims to strengthen the ability of countries to deal with the impacts of climate change

The Project will comply with all national standards for GHG emissions in order to contribute to Rwanda targets set in line with the adoption of the Kyoto Protocol. Further, KIIWP focusses on climate smart agriculture and requires a climate risk assessment to be undertaken in order to guide Project design in coping with climate-related impacts on livelihoods.

3.7.4. United Nations Convention to Combat Desertification (UNCCD, 1994)

Aims to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels, supported by international cooperation and partnership arrangements. It specifically addresses the arid, semi-arid and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found.

This convention is relevant to the proposed project given that it targets drought prone areas of Kayonza district.

3.7.5. Rotterdam Convention

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade is a multilateral treaty with as objective to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties (Article 1). Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting countries are obliged to make sure that producers within their jurisdiction comply.

The proposed project is relevant to the convention given that it involves use of chemical fertilizers and pesticides. Agrochemicals used on the schemes must be those that are registered with, and approved by, the MINAGRI and properly labelled for safe handling, disposal, etc. In addition, farmers must be trained on the hazards of these agrochemicals and how to store, handle and use them. Further, the law no 30/2012 of 01/08/2012, was published in the 'Official Gazette' n 0 37 of 10 September 2012. It focuses on both pesticides and mineral fertilizers and aims to regulate manufacturing, importing, distribution, use, storage, sale, disposal and burial of expired agrochemicals will be complied with.

3.7.6. Convention on Biological Diversity

This is one of the international agreements under the United Nations dating from 1992 and has as objectives, the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding (Article 1). The convention on biological diversity has three goals. These are

- Conservation of biodiversity;
- Sustainable use of the components of biodiversity; and
- Fair and equitable sharing of the benefits arising from the use of genetic resources. Rwanda has ratified this convention and all project developer is urged to implement the convention during project implementation.

The convention is relevant to the proposed project given its proximity to ecosystems with rich biodiversity and proposed irrigation system may require the clearing of vegetation but also may affect aquatic ecology if environmental flow is not maintained.

3.7.7. Stockholm Convention on Persistent Organic Pollutants (1992)

Aims to eliminate or restrict the production and use of persistent organic pollutants (POPs). Agrochemicals used in KIIWP schemes must be those that are registered with and approved by MINAGRI.

3.7.8. CITES, Washington(1975)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Washington Convention, 1975), aims to protect endangered plants and animals and to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild. It accords varying degrees of protection to more than 35,000 species of animals and plants.

KIIWP schemes' proximity to the Akagera National Park may indirectly encourage poaching and trade in endangered species.

3.7.9. The Basel Convention, 1989

The Basel convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (the Basel Convention, 1989) is Designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It does not, however, address the movement of radioactive waste. Also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate. Of particular relevance to KIIWP is the provision of assistance in the management of hazardous and other wastes – in this case it applies to the disposal of expired agrochemicals and their containers.

Based on the above assessment of legal and institutional framework both national and international, the consultant is the view that development of Ndego Irrigation schemes has a comprehensive legal and regulatory framework that can enable the project implement in sustainable manner. However the consultant recommend to implement the proposed project in consider of both national laws and policies but also international policies and standards.

The gap analysis between IFAD safeguards policies and national regulations conducted during the preparation of Environmental and Social Management Framework (ESMF), did not show major gaps between both frameworks. The main differences are that the GoR policies do not specifically provide for climate risk categorisation and livelihood restoration where physical and economic displacement may occur. However, the new Environmental Policies (2019) addresses climate changes issues in project development.

Table 14: Gap analysis between National regulations and IFAD Safeguards requirements

Requirements	GoR Policy Requirements	IFAD SECAP and Other Policies
Environmental and Social Screening and Categorisation	<p>Rwanda EIA guidelines define 3 Impact Level (IL) categories that are determined through the screening process:</p> <p>IL1: Projects believed to have minimal adverse impacts, that can easily be identified through a Project Brief and not requiring further environmental analysis. IL1 project are exempt;</p> <p>IL2: Projects believed to have adverse, but not irreversible environmental impacts and for which mitigation and management measures can be readily designed and incorporated into the project.</p> <p>IL 3: Projects for which it is evident that there will be significant and adverse environmental impacts whose mitigation measures cannot readily be prescribed, and thus, must undergo through a complete EIA process.</p> <p>The guidelines do not provide quantitative parameters for IL categorization of irrigation schemes. However, the guidelines indicate that proposed projects will not be exempted if among other criteria, the project will result in and/or “Changes in water use through irrigation, drainage promotion or dams, changes in fishing practices”. It is therefore expected that the KIIWP irrigation projects will require a full EIA.</p>	<p>SECAP assigns Category A to projects located in, or proximate to, ecologically sensitive areas such as wetlands, national parks, buffer zones, areas of global/national biodiversity significance; projects that will require significant use of agrochemicals; water based development where it is believed that significant depletion and/or reduce flow ma have occurred from the effects of climate change or from overutilization; risk of project-induced pollution on sensitive ecosystems; dam construction more than 15m high wall or more than 500m crest or with a reservoir exceeding 3million m3; construction of irrigation schemes above 100 ha per scheme in area; affecting more than 20 people or impacting more than 10% of a community’s or individual farmer’s assets.</p> <p>For Category A projects a formal ESIA, RAP and/or IPP, as applicable, are required with ESMP elaboration.</p> <p>Category B projects include irrigation below 100 ha of land per scheme; dam projects with capacity less than 3million m3; natural resource-based value chain development; watershed management or rehabilitation; those physically or economically displacing fewer than 20 people. Category B projects do not require formal ESIA, but in many cases further environmental analysis is requested during project preparation or implementation in the form of an ESMP which may be a stand-alone document or an output from environmental analysis</p>
Climate Risk Classification	<p>The Rwanda EIA guidelines do not have a climate risk classification methodology. However, Rwanda’s guidelines for Strategic Environmental Assessment suggests climate risk analysis during the analytical development of qualitative profile of areas affected by a policy, programme or plan.</p>	<p>SECAP provides a Climate Risk Classification methodology which specifies that projects that have high vulnerability to climate risk are for example: those that promote agricultural activity on marginal and/or highly degraded areas; projects that establish infrastructure in areas with a track record of extreme weather events; and projects in areas in which rural development projects have experienced weather-related losses and damages in the past. IFAD requires that projects classified as high risk undertake an in-depth climate risk analysis.</p> <p>Examples of medium risk projects include projects that make use of climate-sensitive resources, but do not focus on these resources as a main commodity (such as irrigation projects); projects which invest in infrastructure not directly exposed to extreme weather events but have potential to become more</p>

		resilient through adaptation of green technologies; and projects which focus on institutional development and capacity building for rural institutions in climatically heterogeneous areas, where opportunities exist to strengthen indigenous climate risk management capabilities. Low risk projects are those that are not likely to be vulnerable to climate risks (eg. development of a micro-finance institution). Projects under KIIWP are therefore considered to lie within the high and medium climate risk category.
Consultations and FPIC	<p>The environmental regulation framework is provided for in the 2008 Ministerial Order relating to the requirements and procedure for Environmental Impact Assessment. Article 6 of the Ministerial Order stipulates that the EIA shall be done with due consideration of the opinion of all the relevant stakeholders. This provision is elaborated the Country's EIA guidelines that emphasise public participation as a valuable source of information on potential impacts, mitigation measures and viable alternatives. Public participation aims at improving project design, environmental soundness and social acceptability.</p> <p>EIA guidelines recommend that consultations involve a minimum of government ministries and local government bodies relevant to the proposed development, private sector organizations, local communities, the general public and NGOs.</p> <p>EIA experts are required to conduct local community consultations during the EIA study, particularly during the scoping process.</p>	<p>SECAP emphasises the need for greater consultation by communities (especially the marginalized poor) and stakeholders that are likely to be affected by IFAD's operations during the respective programme/project cycle, in order to provide input to the project design, receive feedback on the draft ESIA report, ensure broad community support to the project, and to ensure that affected people endorse the proposed mitigation/ risk reduction and management measures.</p> <p>In addition to public consultations, SECAP requires FPIC for all projects that are likely to affect land or user rights to land, whether or not the affected people belong to historically underserved groups or minorities. Some schemes being considered under KIIWP may therefore require FPIC.</p>
Public Disclosure	REMA, in consultation with the lead agency determines whether or not a public hearing is necessary based on the submitted project brief of the proposed development. REMA arranges and facilitates at least 3 public consultations on the final report from which justified objections may result in the refusal to proceed.	IFAD's Policy on the Disclosure of Documents (2010) requires full disclosure to the public, and includes information notes on projects being developed for Board presentation, agreements for approved loans and grants, and project/programme design documents which include ESIA's, ESMFs, RAPs and RAFs.
Compensation and Resettlement	<p>Rwanda's National Land Policy of 2004 in reference to the constitutional principle of equality of all citizens, states that all Rwandans enjoy the same rights of access to land without any discrimination whatsoever.</p> <p>The policy elaborates the principle by stipulating that women, married or not, should not be excluded from the process of land access, land acquisition and land control, and female descendants should not be excluded from the process of family land inheritance.</p> <p>However, Article 3 of Organic Law No. 08/2005 of 2005 determining the</p>	IFAD's Policy on Improving Access to Land Tenure Security stresses the need for Free Prior Informed Consent and the "Do no Harm" Principles. These principles are also reflected in other IFAD policies including the Targeting Policy, Engagement with Indigenous Peoples Policy and Gender Equality and Women's Empowerment Policy. The core tenets of IFAD's principles on compensation and resettlement are that wherever possible, any physical or economic resettlement that could negatively impact affected people should be avoided or minimised; that all land and natural resource users with a legitimate claim will be recognised including people having

	<p>use and management of land in Rwanda stipulates that state also has rights to expropriation due to public interest, settlement and general land management through procedures provided by law and prior to appropriate compensation.</p> <p>Expropriation is implemented under Law No. 32-2015 of Relating to Expropriation in the Public Interest. Rwandan laws provide for fair compensation only for legal land property owners and land tenants in recognition of existing written and unwritten rights and civil and original customary rights. However, registration of these ownership rights is now mandatory under Section 4 of Article 29 of the Land Law.</p>	<p>informal/customary rights; and that no affected person should be left worse off, and preferably in a better position through proper and timely compensation and other mitigation measures.</p>
Grievance Mechanisms	<p>Article 19 of the national Expropriation Law provides for an application to revoke a public interest expropriation within 15 days of publication and that a decision must be provided within 30 days of receipt of the application.</p> <p>Further, Articles 33 and 34 provide for contestation of valuation results for land and property by the person to be expropriated with 7 days of the approval of a valuation report at own cost and that the contestant should provide a counter valuation report within 10 days of application.</p> <p>The Government of Rwanda as the borrower has indicated that the KIIWP will be implemented for target community beneficiaries in cooperative frameworks. Target community consultations indicated that grievance addressing mechanism were integral in cooperative governance framework such as cooperative constitutions. Consensus was apparent that the cooperative grievance mechanisms worked well and that escalation mechanisms were also provided for through local government structures and court systems. It is also common practice in development projects that grievance mechanisms are formulated during project design for all stages of the project in order that affected parties present grievances to the project authorities without cost and with assurance of satisfactory and timely solutions. They commonly include institution of a grievance resolution committee and its working procedures as well as grievance logging and monitoring systems.</p>	<p>IFAD has developed a Complaints Procedure for “Alleged Non-Compliance with its Social and Environmental Policies and Mandatory Aspects of Its Social Environmental and Climate Assessment Procedures”. Parties adversely or potentially adversely affected by IFAD-funded projects and programmes may bring issues to the Fund’s attention using SECAPcomplaints@ifad.org. Complaints must be put forward by at least two people who are both nationals of the country concerned and/or living in the project area. Complaints from foreign locations or anonymous complaints will not be taken into account. Complaints must concern projects/programmes currently under design or implementation. Complaints concerning closed projects, or those that are more than 95 per cent disbursed, will not be considered. IFAD does not provide monetary compensation to resolve complaints. The IFAD website provides a clear summary of the steps involved and guidance on how to report issues.</p>
Physical Cultural Resources	<p>EIA guidelines indicate criteria for EIA compliance requirements to include location and potential to affect environmentally sensitive areas including National Parks and Protected Areas, wetlands, productive</p>	<p>In cases where physical cultural resources are found, IFAD assists borrowers in avoiding, minimising or mitigating adverse impacts on PCR in the development programmes/ projects that it finances. Due diligence is carried</p>

	agricultural land, important archaeological, historical and cultural site and areas containing rare or endangered flora or fauna.	<p>out through applying SECAP to ensure that PCR are properly identified and adequately addressed and that any measures to protect PCR comply with the borrower's national legislation as well as with its obligations under relevant international treaties and agreements.</p> <p>SECAP prescribes general steps for programmes/ projects that apply in cases involving PCR: screening; collecting data; assessing impacts; and formulating mitigating measures.</p>
Safety of Dams	Small Dams Safety Guidelines of 2012 developed by MINAGRI to provide owners of small dams with the requirements that they must meet to construct and operate a small dam. The guidelines utilize the World Bank distinction between small and large dams for application of its policy on safety of dams, OP 4.37, that states that small dams are normally less than 15 meters in height that include farm ponds, local silt retention dams, and low embankment tanks. The guidelines provide dam safety principles on responsibility for dam safety; role of government; leadership and management for safety; justification for dams and reservoirs; optimization of protection, limitation of risk to individuals; protection of present and future generations, prevention of accidents; and emergency preparedness and response.	SECAP's Guidance Statement #8 on Dams categorises dam sizes in relation to the level of environmental investigation required (see above). Since the risk of small dams failing is higher than that for large dams, the Guidance Statement recommends following international best practices based on the World Commission on Dams recommended procedures (including gaining public acceptance, an options assessment, ensuring sustainability of rivers and livelihoods), as well as ensuring adequate planning, quality of the design and construction, optimum use of storage infrastructure after construction, and safety monitoring.

Source: National regulations& IFAD SECAP and Other Policies

CHAPTER FOUR: ENVIRONMENTAL AND SOCIAL BASELINE DATA

4.1. General overview

The purpose of Environmental and Social Impact Assessment (ESIA) is to ascertain the baseline environmental and social conditions, assess the environmental and social impacts as a result of the proposed project development during various phases of its cycle, identify significant factors or geographical areas likely to influence decisions about any future development and propose mitigation measures. The identification of environmental parameters, data collection, impacts predictions and mitigation and monitoring measures are the core of ESIA process. In order to review and update the environmental and social aspects, the data has been collected, compiled and analysed for the following:

- Physical receiving environment (land, water and air);
- Ecological receiving Environment (flora, and fauna);
- Socio-Economic Environment (demography, livelihood, income socio-economic etc.).

Based on project setting and field assessments, the attributes likely to be affected are identified for baseline data generation. Secondary data on geology, soils, air and noise, etc were also collected. Further, ecological and socio-economic data were collected from different sources including field observations, secondary data and interviews with key informants. Formal and informal discussions held with the local people, project affected people and local government/non-government organizations and other stakeholders, SPIU IFAD funded projects Managers, together with published reports, have provided very useful information for the preparation of this document. Information on project facilities, size, magnitude and cost of the construction activities, geology and soils of the project sites have been taken from the feasibility study report of February 2020. This section provides baseline information on the physical, biological and socio-economic elements of the project area which shall be used as benchmarks for future environmental and social monitoring. The area considered for assessment of baseline conditions of Ndego irrigation schemes in Ndego Sector, Kayonza District.

4.2. Physical environment baseline data

4.2.1. Geology and Soils

The geology of Rwanda generally comprises metamorphic rocks and granitic rocks of the Precambrian period. Metamorphic rocks are mostly schists produced by low to medium pressure metamorphic actions of sandy to muddy sediments, while the granitic rocks are intrusive rocks originating from metamorphic actions. Metamorphic rocks of quartzite and schist and sedimentary rocks of mudstone and sandstone run in a north-south direction through the middle of Kayonza District. The lakes and wetlands marshes have sediment alluviums, and alluvial layers composed of clay, sand and gravel layers are distributed along rivers and valley floors. The soil study was carried out to investigate on the current status of physical-chemical characteristics of soils in the study area and carry out a suitability analyses of the soil units for irrigated agriculture. The results by SMEC (2020) revealed the following:

- 1) The soil in the study areas are grouped into the following orders: Oxisols covering 1,453.06 ha, Vertisols with 526.79ha, Mollisols with 155.25 ha and Inceptisols with 382.95 ha

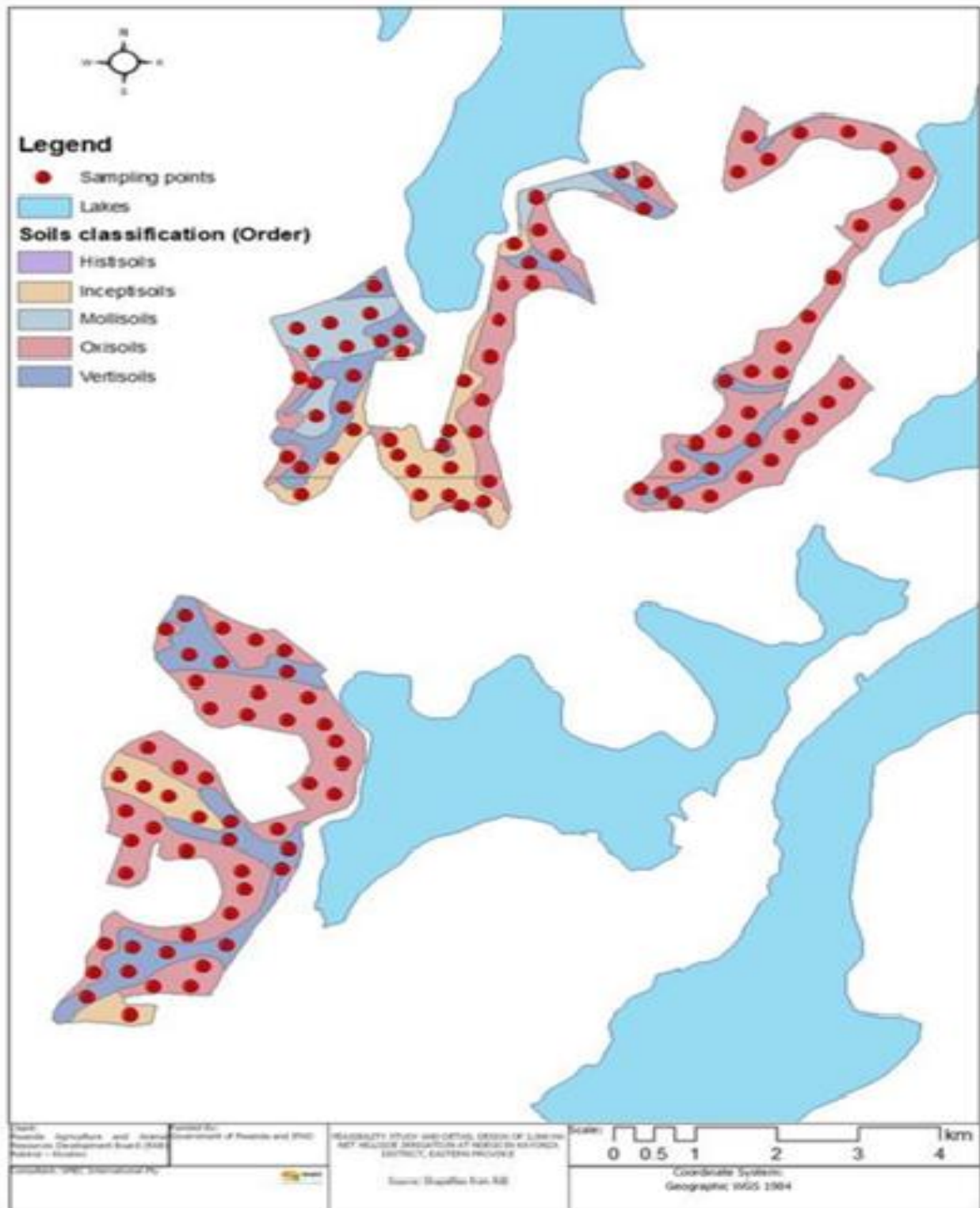


Figure 5: Soil in the study area

The undisturbed soil samples were collected from all sampling zones. These were taken at two different depths, i.e. 0-30, 30-60cm depths, to ensure adequate observation within two depths. The samples were taken to the RAB laboratory in Huye for analyses of various physical and chemical properties. The following are results:

- Twelve soil units were identified in the command area and studied. The soil texture in the command area varies from sand to loamy sand and loamy sand to sandy clay loam. This indicates that soils are mostly dominated with sand and their water holding capacity is low (or infiltration rate is high).
- The average bulk density in soils of the command area range from 1.3 to 1.6 g/cm³. According to Moore (2001), this rating is medium to high. Medium bulk density soils were observed in Vertisols and Oxisols (1.3 g/cc), while Mollisols and Inceptisols had high bulk density (1.6 g/cc).

- (iii) The infiltration rate measured using a double ring infiltrometer ranges from 0.2 to 5.6 cm/hr for RN and KSA soil series respectively. The large values are mainly due to the land preparation (plowing) and the presence of cracks that create large pores that drain water quickly from the surface of the soil. However, there is almost no risk of stagnation for the soils observed since the rates are comparable to the lower limit given by the literature (less than 1 cm per hour). On the other hand, for sandy soils with infiltration rates exceeding 6 cm per hour, surface irrigation is discouraged in favour of localized irrigation methods that bring water in small quantities in a relatively short time interval compared to surface irrigation.
- (iv) The soil pH (water) for the topsoil (0-30 cm) and sub-soils (30-60 cm) varies from 4.75 to 7.12 and 4.64 to 7.20 respectively. These values are very acidic to neutral but there is no significant difference with soil depth. The high and low pH values are recorded in Vertisols and Oxisols respectively. The Al³⁺ content varies from 0 to 0.51 meq/100gr and 0- 0.65 meq/100gr soil for topsoil and subsoils respectively. These contents are low to medium.

The cation exchange capacity (CEC) of the soils in the CA oscillates between 8.8 and 30.76 meq/100gr with an average of 14.73meq/100gr for topsoils and 9.39 and 30.20 meq/100gr with an average of 14.69 meq/100gr for subsoils. The CEC in Ndego site is low to high. However, the CA is generally moderate in CEC.

The soil organic levels in command area remain low to moderate for both topsoil and subsoil layers with high values in the topsoils. The topsoils hold 1.27 to 3.24 % with low content in Mollisols, Inceptisols and Oxisols. The same trend is observed in subsoil layers and the levels vary from 1.20 to 2.57%. The organic materials usually positively impact soil fertility through an increase in available negative charges, nutrients supply and water retention. The soil organic matter is increased through regular application of good quality of organic materials (compost, farmyard manure, green manure, etc) so as to enhance inorganic fertilisers for more sustainable and increased crop production. Quantities of manure used by farmers range from 1,300 - 3,800 Kg/ha but manure rates in most on-station experiments are between 5-20 t/ha (Williams et al, 1995).

While the total nitrogen content in CA is low (0.05 to 0.07% for topsoils and 0.04 to 0.08% for subsoil layers), the available P and Potassium are low to moderate. The low level of major nutrients and other important nutrients needed by the selected crop will be addressed by the application of good quality organic manure alone or complemented with straight fertilisers, which contain one nutrient, or a compound fertiliser, which contains two or more nutrients. Many farmers have been familiar with an application of 300 kg/ha NPK17x17x17 or DAP, but the actual rates need to be determined through crop requirements and yield response trials in the study site.

4.2.2. Ndego topography(slopes)

The slope categories for each bloc site were overlaid and intersected to produce one layer from which computations of hectares of particular Land Husbandry technologies were obtained. In general the area has low to moderate slopes. The slope of the area is dominantly characterised by gentle slopes ranging from 0 to 16%. A number of technologies were proposed to support the irrigation scheme while protecting the entire catchments from siltation and also improving soil status.

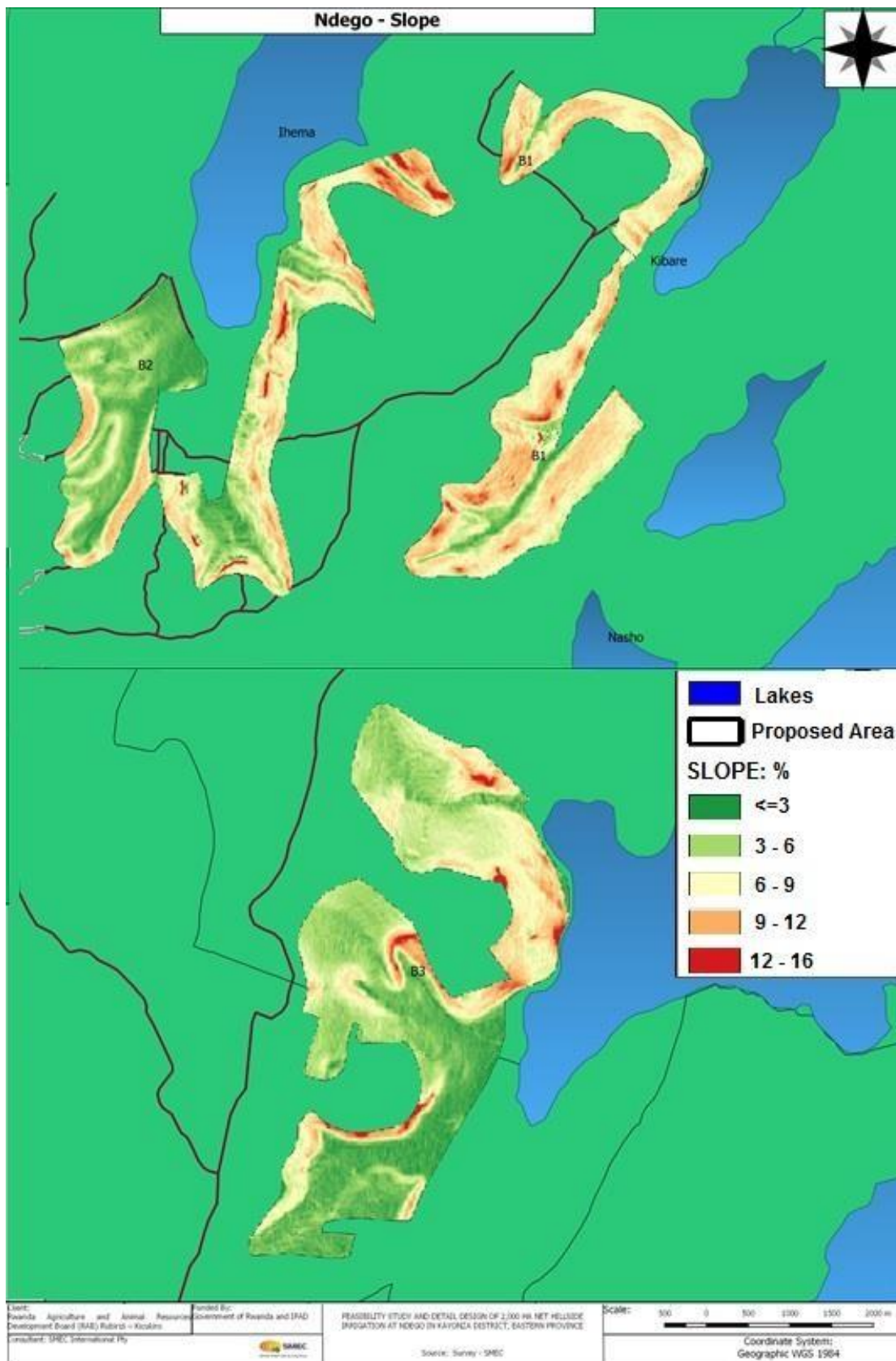


Figure 6: Ndego Slope Map
Source: Feasibility study

4.2.3. Land Use of the District

Kayonza District covers an average area of 1,954 km². The relief of Kayonza District is made of many hills and slopes whose altitude varies between 1400 and 1600 masl, generally decreasing towards the East. The Project area is characterized by a series of hills with soft slopes except in the East where one finds some slopes stiff and stony. The hills roughly run North to South through the middle of the district (the Eastern Plateau) and give way to valleys where floodplains and wetlands are found. To the east of this line of hills is a large gently undulating expanse – the Eastern Savannah which slopes towards the Akagera wetlands system.

In Ndego sector land use comprises settlement, agricultural and forestry. The land use is dominated by agriculture (60.6%), settlements (24.5%) with residential use (19.7%) and public administrative, institutional and services (4.8%), followed by forestry (9.3%). Other land use type occupies less than 6% of the total area. In relation to forests, the savannah emerges as the main type of forest in district with 2,172 ha in 2007. Other types of forests include Eucalyptus plantations (151.8 ha).

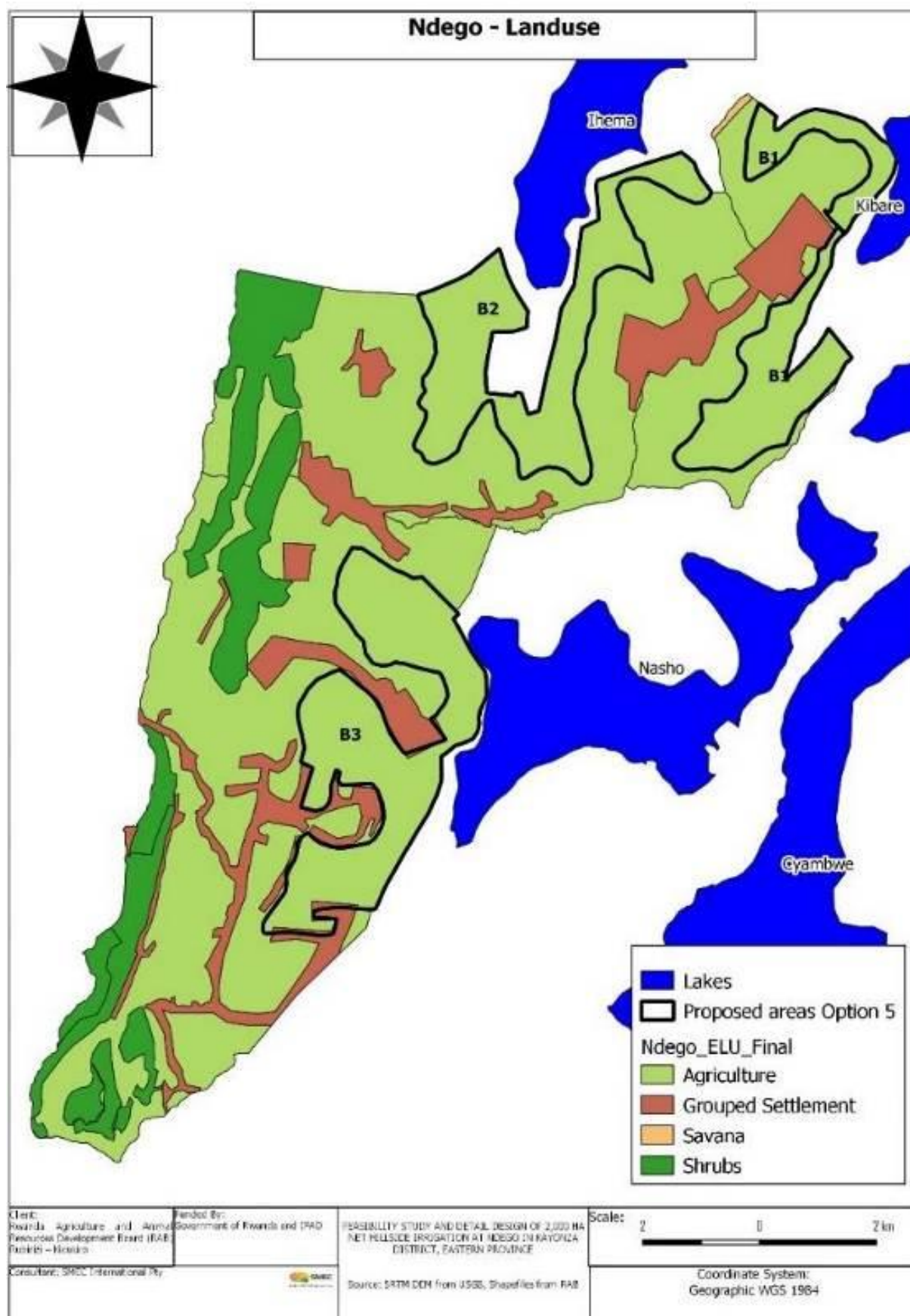


Figure 7: Land cover in Project area

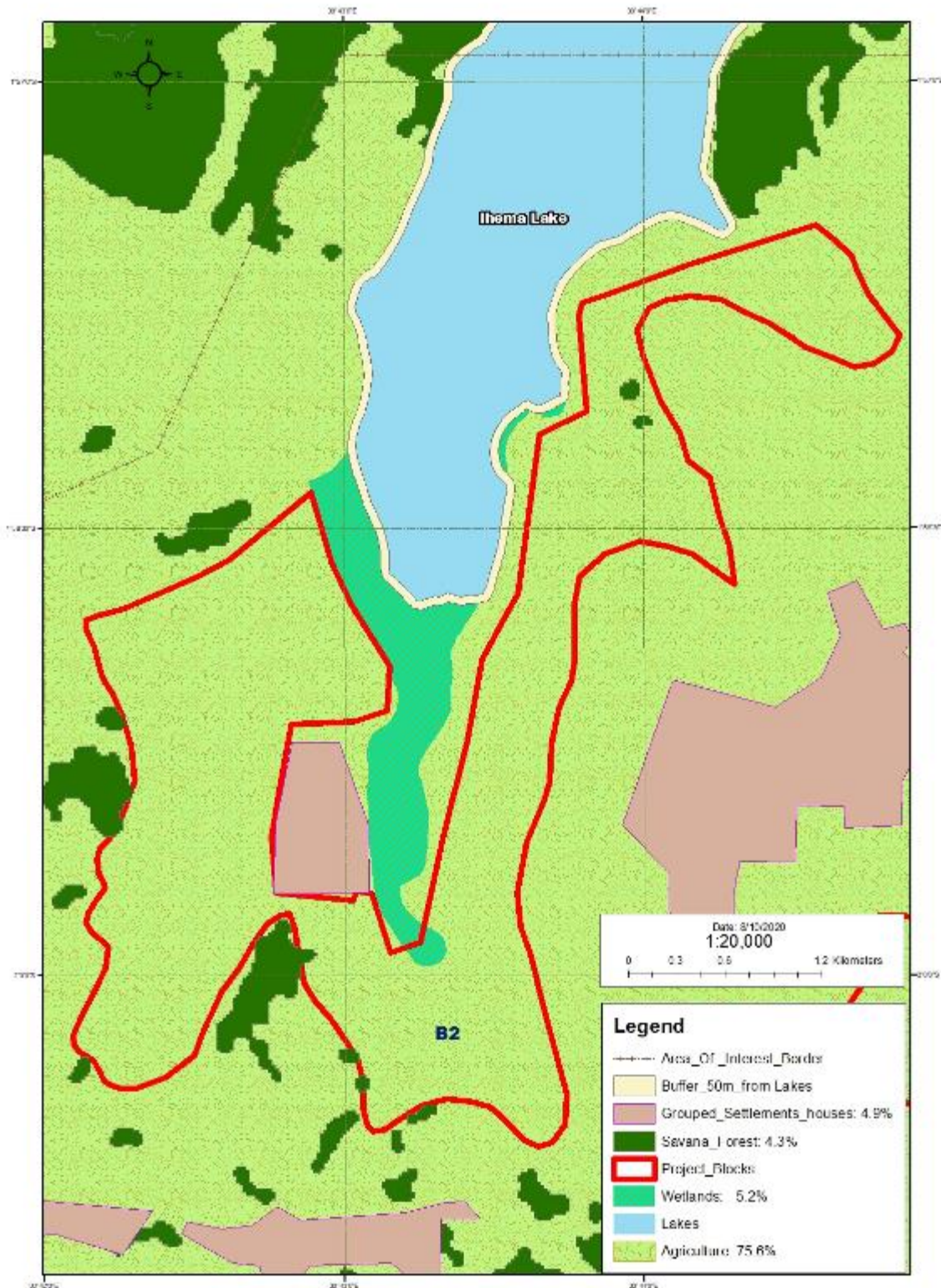
4.2.4. Land use and land Cover in command area and Catchment command area

Ndego sector was reserved for Akagera National Park until 1994 when it was converted into agricultural land to settle Rwandans who were repatriated to their native country from neighbouring countries. The site also attracts internal migrants from other areas of the country. On the other hand, some of the members of households left Ndego for other areas of the country because of the food shortage problems linked to the lack of rain. The land is still productive and residents are happy to harvest whenever rains are sufficient. With regard to land availability, the residents of Ndego sector are among Rwanda citizens who have sufficient land to cultivate. The study by SMEC (2020) show that 37.9% possess land varying between 0.5 to 1 hectare while 26.3% of Ndego population have between 1 to 2 hectares. In addition, about 14.7% hold less than 0.5 hectares, 11.6% of respondents hold between 2 to 5 hectares when 2.1% own above 5ha.

The land use/ land cover situation was analysed employing DEM, ortho-photos and maps generated using GIS software. Both command area and command area Catchment are dominated by agriculture, the rest is occupied by woodlots, settlement and built environment

a) Ihema block

As shown on the below map, the Command area is used for agriculture at almost 100%, only small woodlots was included in the block. There is no settlement inside the Command area and this was done to avoid physical resettlement. This was also made easier by the fact that in the project area like in other areas in Eastern proving people are living in settlement. In the Command area Catchment, the land use changes slightly as the major land use include also settlements, infrastructure and woodlots. Agriculture land represent 75.6%, wetlands 15.2% woodlots and Savana forest 4.3% and Settlement areas 4.9%. Both Command area and Command area Catchment include a wetland, which is used for agriculture and livestock. The rest of the project area is covered by water and wetlands.



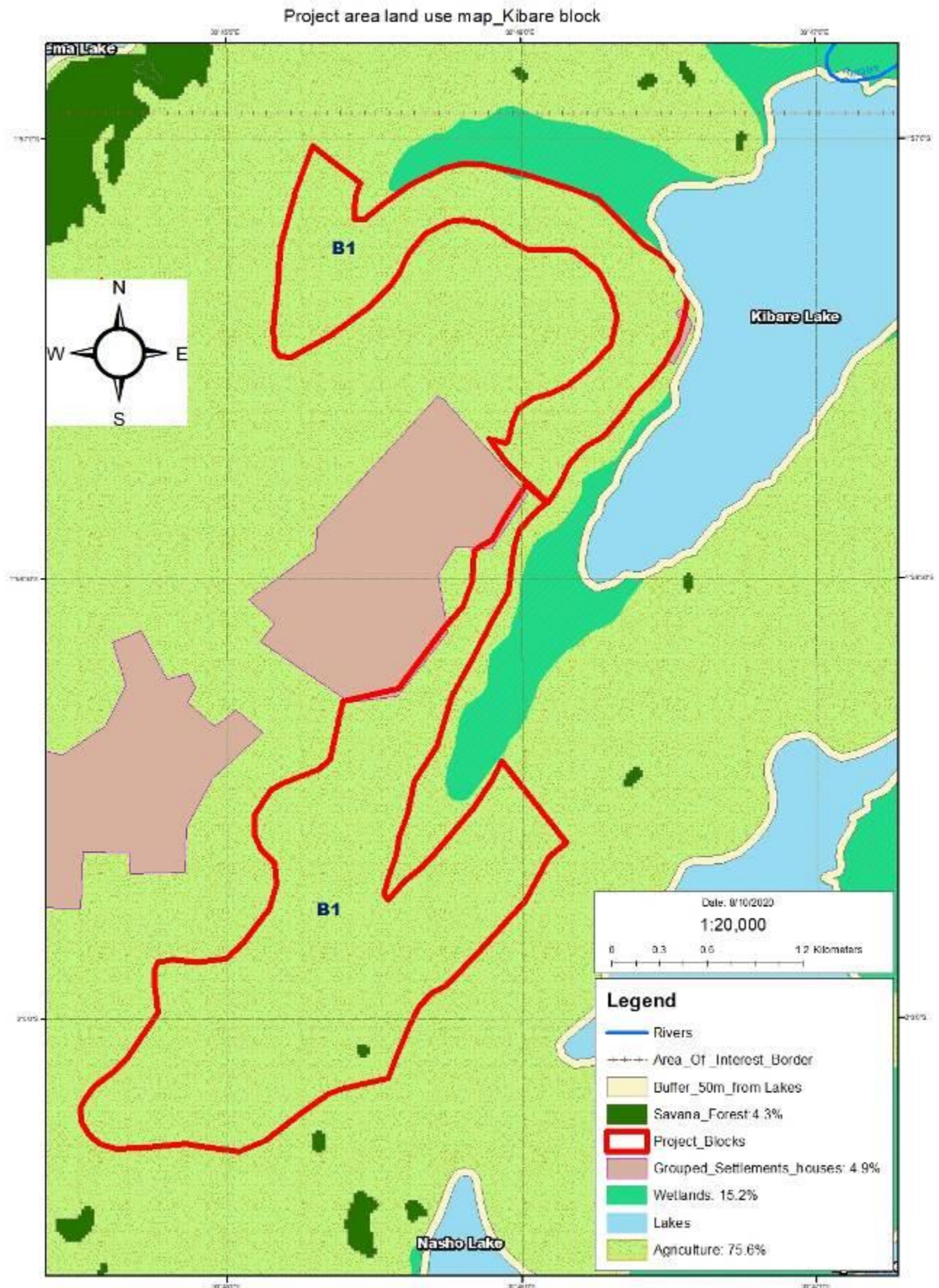


Figure 9: Land use in Kibare area

b) Nasho Block

The same as Kibare and Ihema block, the targeted Command area is used for agriculture at 100% . The Command area catchment is divided into agriculture land with 75%, settlement area 4.9% and woodlots/Savanna forest occupies less than 4.3%. Settlement area is very important given that all households are leaving in grouped settlements (Imidugudu) and the area for settlement is well delineated

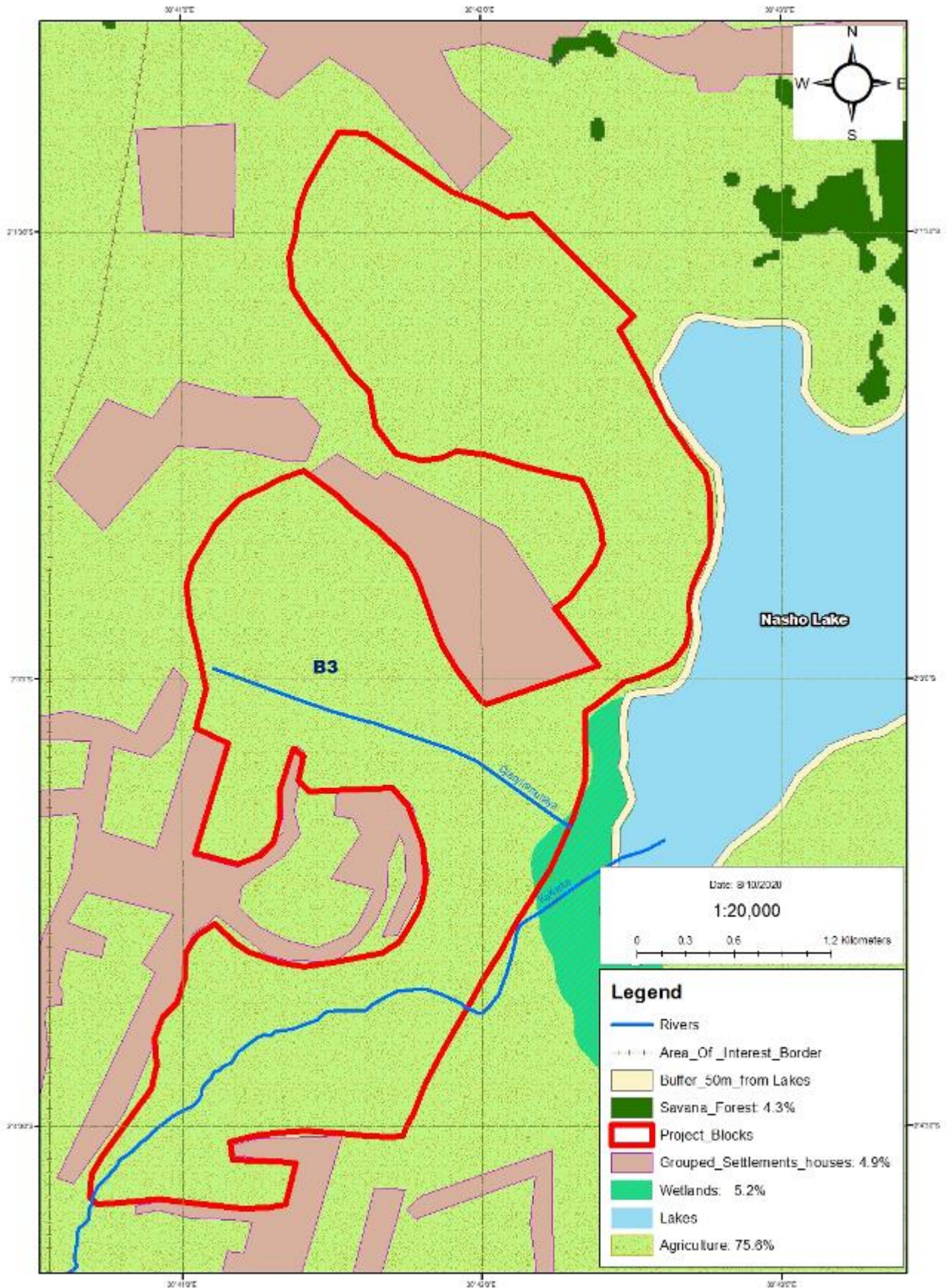


Figure 10: Nasho Block land use map

4.2.5. Land use and land ownership for Key sitting structure

Key sitting infrastructure in the proposed irrigation system included pumping stations, water balancing storages and main pipe lines especially the one especially pipe from Kibare Pumping Stations towards Ihema blocks. The Next table summarizes the location and current land use and land cover.

Structure	Block	Location	Land use	Land ownership
Pumping station –PS K1	Kibare	40m from wetlands and 70m from lake	Agriculture land	Private land
Pumping station –PS K2	Kibare	30 from wetland and 477 from lake	Agriculture land	Private land
Pumping station –PS K2	Ihema	Edge of lake Kibare	Buffer zone	Government land
Pumping station – PS N1	Nasho	Edge of lake Nasho	Buffer zone	Government land
BS 1	Nasho	Hillside	Agriculture	Private land
BS 2	Nasho	Hillside	Agriculture	Private land
BS 3	Nasho	Hillside	Grazing land	Private land
BS 4	Nasho	Hillside	Agriculture land	Private land
BS 1	Kibare	Hillside	Agriculture land	Private land
BS 2	Kibare	Hillside	Agriculture land	Private land
BS 3	Kibare	Hillside	Grazing land	Private land
BS 1	Ihema	Hillside	Agriculture land	Private land
BS 2	Ihema	Hillside	Agriculture land	Private land
BS 3	Ihema	Hillside	Agriculture land	Private land
BS 4	Ihema	Hillside	Agriculture land	Private land
Main pipe From Kibare pumping station to Ihema block	Kibare PS K2- to Ihema BS	Hillside	Agriculture and residential land	Private land & government land

Source: Field survey

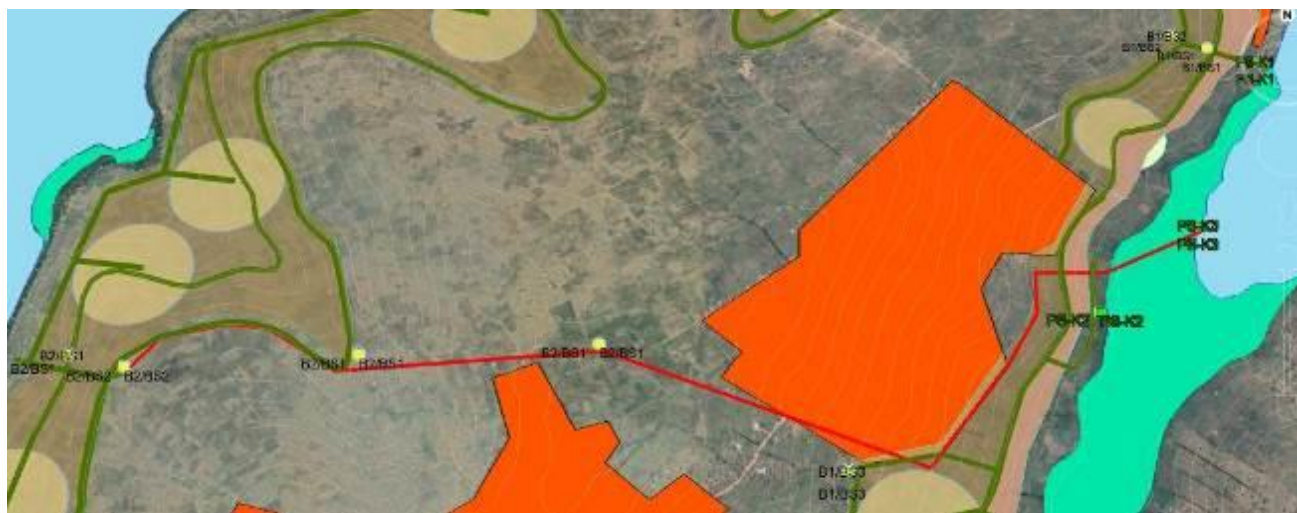
Based on the above observations, it is recommended to the design team:

1. Explorer the possibility of shifting the pipeline from Kibare pumping station Ihema block outside residential area;
2. Identify other location of Pumping station PS N1 and PS K3 and preferably put them outside the buffer zone;
3. Explorer the possibility of having only one pumping station for Kibare Block instead of pumping station
- 4.

From the above table, two sitting infrastructure are located in sensitive area including Pumping station K2 proposed on the edge of Kibare lake to pump water to Ihema block and PSN1 to pump water to Nasho block. The rest of structures are located on either agriculture with both perennial and seasonal crops land and grazing land with some shrubs and woodlots . Main pipe from Kibare pumping station to Ihema block crosses both agriculture land, grazing land and residential land.



Figure 11: Location of key sitting infrastructure for Nasho block



4.2.6. Land ownership and use patterns

As shown in next table, 91.1% of the households in project area own farmland within the three project sites with 55% owning one (39%) or two (16%) land titles for the farmland. However, 35.7% of the landowners claim that they do not have land titles for the land on which they live and derive their economic livelihood, mainly from agriculture. This is most common in Humure (Ihema Block) where nearly half of the households (48%) do not have land title. Most of those who claim to own the land but do not have land titles explain how they have purchased land but not gone through the title transfer (*mutation*) process for various reasons with most attributing this to the seller not being available after receiving payment. During interviews with local people, informants identified several cases of landowners selling land and migrating to other districts or crossing to Uganda and Tanzania without initiating or completing the land title transfer processes. There are also various cases of land fragmentation, whereby households with mostly more than 1 ha have sold pieces of their land to households that have migrated into the area. Because the fragmentation process is illegal, they have not processed any land titles for the sold pieces of land. This practice is informally referred to as “*Tugabane*” or land sharing.

Only 2.8% of the households report not owning any farmland in the irrigation sites but reside in the targeted areas. These affected households are considered mainly as squatters with most living in very vulnerable conditions on very small pieces of land (less than 0.25 ha). Most of these households are found to be among those that have only recently moved into the affected areas within the last 1 to 3 years.

Table 15: Land ownership and land use patterns

Land ownership	Kibare Block	Ihema block	Nasho Block	Tot. %
Own Farmland title in affected area	60.7	47.0	54.7	55.4
Own Farmland in affected area but NO title	30.6	48.0	35.0	35.7
Lease land in affected area	6.1	4.0	6.8	6.1
Have no Farmland in affected area	2.6	1.0	3.5	2.8
Number of titles per household				
Own one farmland title	44.4	27.0	39.9	39.2
Own two or more farmland titles	16.3	20.0	14.8	16.1

Source: Socio-economic survey, 2020

Most of the households (50%) have lived and owned land in the targeted area for between one to ten years. 43% have owned the land for more than 10 years, while 7.4% have only been in the area for less than a year. Most of the households that have been in the area for less than one year are found to have migrated from other districts within Rwanda, especially from the Northern province, many of the new residents report having moved into the area for economic opportunities given the presence of the Bramin Farm⁸. There is also a considerable proportion of households that report having been resettled in the areas in the last 3 years by the GoR after being evicted from Tanzania⁹.

Table 16: Amount of time that landowners have lived and owned land in the affected area

Duration in affected area	Kibare Block	Ihema block	Nasho Block	Tot. %
Less than 1 year	8.7	11.0	5.5	7.4
1 - 10 years	48.0	57.0	48.2	49.6
More than 10 years	43.4	32.0	46.3	43.0
Total	100.0	100.0	100.0	100.0

Source: Socio-economic survey, 2020

The median and average land size holding affected household across all the sampled areas is 0.52 ha and 0.82 ha respectively, considerably higher than the national average of 0.61 ha. This larger than average land size per capita in the area is mainly attributed to the land distribution process where land that was formerly part of the Akagera national park was gazetted for settlement of communities in the late 1990's. This large land size has resulted in villages and cells that are larger than average village and cell sizes in Rwanda. As shown in Table below, more than 50% of the population own more than half a hectare with at least a quarter of the households owning more than 1 ha each.

Table 17: Household land sizes

Land Sizes Ha	Kibare Block	Ihema block	Nasho Block	Tot. %
Less 0.25	31.1	20.0	28.6	28.0
0.26 - 0.49	8.7	11.0	10.9	10.2
0.50 - 1.00	23.5	26.0	26.4	25.4
1.01 - 4.90	25.0	36.0	20.9	24.7
More than 5.0	1.0	0.0	0.3	0.5
Total	89.3	93.0	87.1	88.8

Source: Socio-economic survey, 2020

In addition to the privately owned and leased land, at least 10% of the households' report using communal (8.6%) or government owned (1.6%) land for agricultural purposes. Most of this land has been lent to farmers' cooperatives and associations engaged in different farming activities by the sector authorities as an endeavour to commercialise some production activities such as maize and cassava cultivation. 1.3% of the households also mention using abandoned land for farming. The landless households that are currently using abandoned farmland comprise a potentially vulnerable group that may be at odds with the real owners once the KIIWP turns such land into more productive farmland.

Table 18: Household's usage of public land

Use of non-personal land	Kibare Block	Ihema block	Nasho Block	Tot. %
Yes, communal land for cooperative	6.1	7.0	10.6	8.6
Yes, government land	2.0	1.0	1.6	1.6
Yes, abandoned land	1.0	0.0	1.9	1.3
No such land	90.8	92.0	85.9	88.5
Total	100.0	100.0	100.0	100.0

Source: Socio-economic survey, 2020

Though there are no lands registered officially as rangelands, it is important to note that during field survey few grazing area were observed inside command area with some cattle sheds. With the establishment of irrigation system, grazing in these areas will not be possible and the project management will discuss with owners on the possibility of relocating grazing areas outside the command area and cattle sheds will be compensated. The next tables show the number of grazing area and cattle shed identified in command areas of three blocks

Table 19: Grazing land identified in command area

Name of block	No. of Cattle-shed	No. of Grazing Plots
Kibare	21	23
Ihema	5	6
Nasho	13	9

Source: BESST LTD Field Survey, 2020

4.3. Climatic conditions and climate risk

4.3.1. Climate and weather conditions

Rainfall data were provided by Rwanda Meteorology Agency for Kigali Airport, Rwamagana, Kayonza and Kwangire stations and are assessed for missing data. The selected stations do not have the most complete records of data even though geographically close to the project area. All stations have good data quality. The Lake Ihema rain gauge has daily rainfall for a period from 1971 to 2001, a record length of 31 years, whereas the Kigali rain gauge has a longer record length of daily rainfall from 1960 to 2018 a period of 59 years, Kawangire rain gauge has 8 years of daily rainfall data from 1970 to 2008, Rwamagana has records from 1962 to 2018 and Kayonza has 8 years of record (2010 to 2018). However, all the gauges have missing data years

and periods with missing daily rainfall data during the wet season months. None of the stations' complete daily rainfall data and data are missing from 1994 to 2010 at all stations.

Available data indicate the project area is characterised by two rainy seasons from March to May and from October to December (bimodal pattern). There are also two dry season, long dry season (June-September) and short dry season(January-February). On average 71% of the annual total rainfall falls during the wet seasons. Observed daily rainfall data from rain gauges in the Kagera basin are interpolated to areal rainfall using Thiessen polygon techniques. Areal rainfall is required for HEC-HMS rainfall-runoff model of the entire Akagera basin. Daily rainfall data are available for 30 stations within the basin. The rain gauges were selected to estimate areal rainfall. The data were processed for the purpose of modelling. The data from those stations were short but highly reliable. Rainfall and temperature data are also available online from the Princeton Climate Analytics9 (PCA) centre. PCA dataset consists of a 50-year high resolution global dataset of meteorological forcing that can be used to derive models for land surface hydrology.

- **Climate Data**

Data on wind speed, relative humidity and solar radiation was available at Ndego station whereas data on maximum and minimum temperature were available from Kayonza station. The sunshine hour duration data was missing at both stations and CLIMWAT database was consulted to pull data on sunshine hour's duration. These data are summarised into monthly data and are plotted in next figure

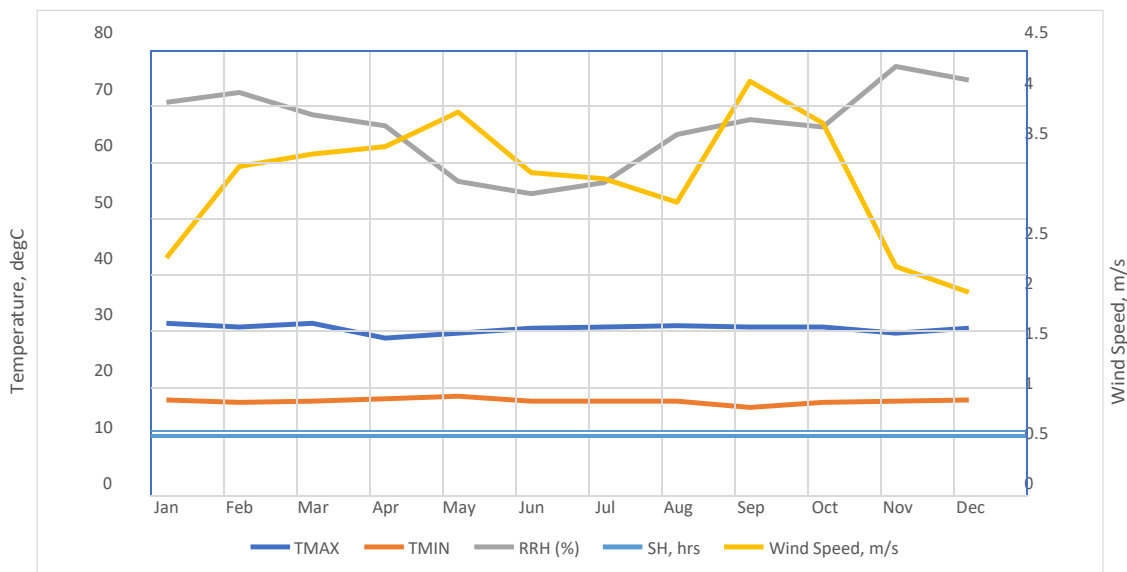


Figure 13: Average monthly Climate data at Lake Ihema station

From the above figure, the minimum average temperature in the project area is 17°C while the maximum goes up to 31°C.

- **Reference Evapotranspiration**

Reference evapotranspiration (ET_{ref}) was computed using Hargeaves, Penman-Monteith and Blane Criddle formula. The computations were carried out using the Hydrognomon software and results are presented blow.

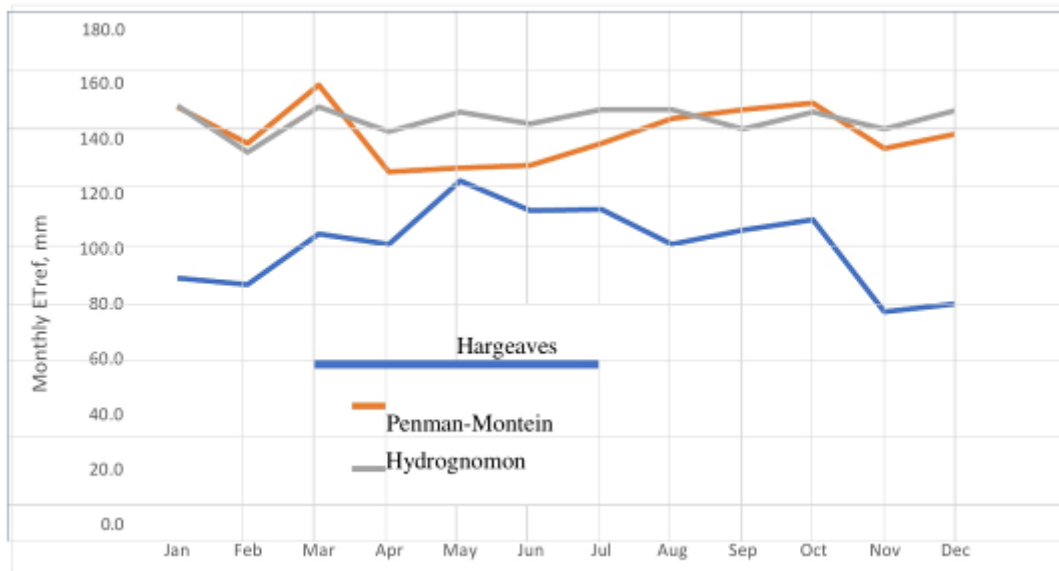


Figure 14: Average annual reference Evapotranspiration at lake Ihema station

- **Open Water Evaporation**

Open water evaporation data were obtained from Rwanda-DSS database. This data were available for Lake Ihema. The maximum evapotranspiration are observed during long dry season between June and September and the minimum is observed during long rain season between April and May.

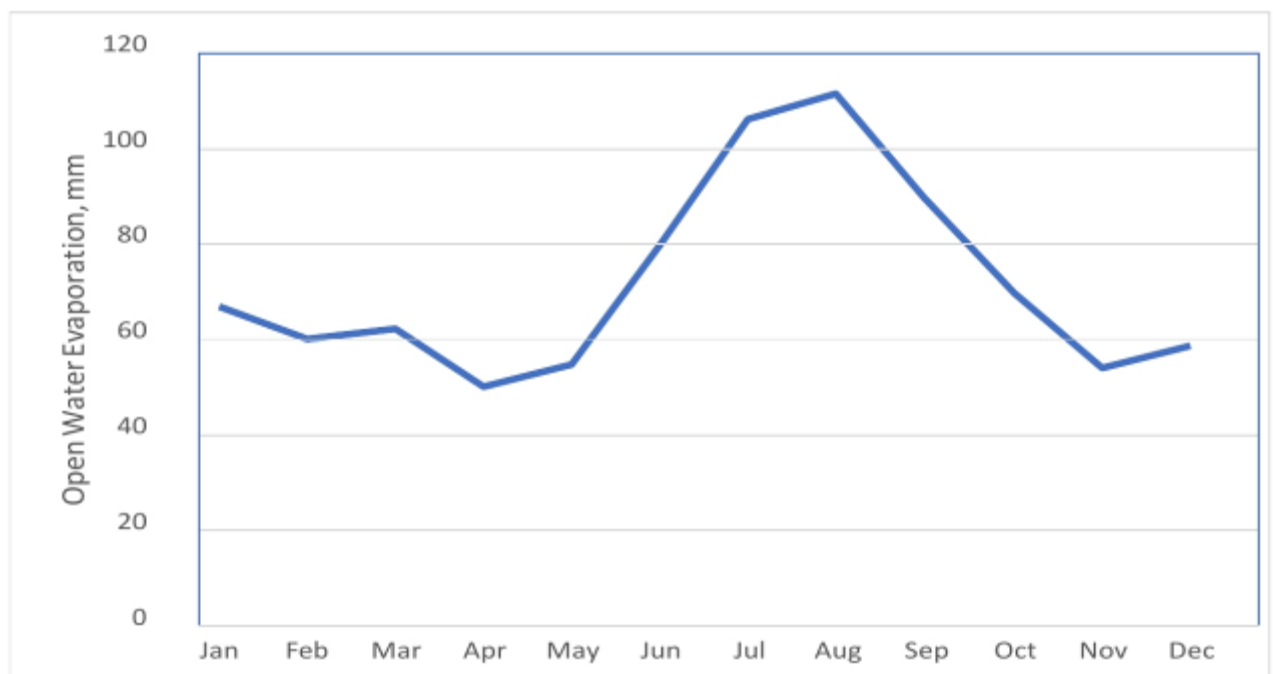


Figure 15: Average Annual Open Water Evaporation data at Lake Ihema station (Rwanda-DSS)

- **Annual Rainfall Analysis**

For the project area, the annual rainfall is derived based on data of the station at Lake Ihema. The average annual rainfall is estimated at 999 mm over 1971 to 1999 period with a standard deviation of 148 mm. The minimum annual rainfall was recorded in 1992 with value of 687 mm whereas the maximum annual rainfall rises to 1357 mm observed in 1979.

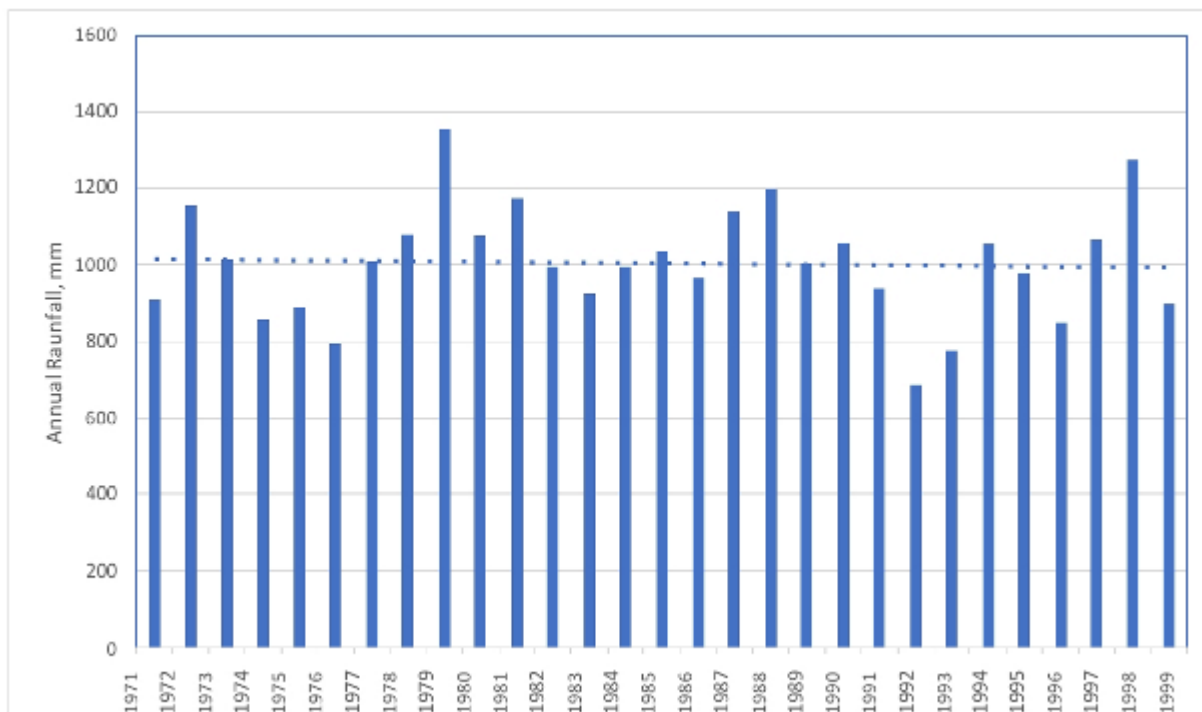


Figure 16: Annual Rainfall at Lake Ihema stations (1971 - 1999)

For the project area, the key rainfall station selected is located at Lake Ihema. The total annual rainfall at Lake Ihema station. The data covers the years 1971 to 2000. The monthly rainfall varies from nil to a maximum of 317 mm recorded on the month of April 1985. The mean monthly rainfall amounts to 83.5 mm with a standard deviation of 58.7 mm. The dependable monthly rainfall is of importance in the computation of irrigation demands. Here it is defined as the rainfall which is available 80% of the time. It was computed using duration analysis in MS Excel through assigning a plotting position for each data point after arranging the data month by month.

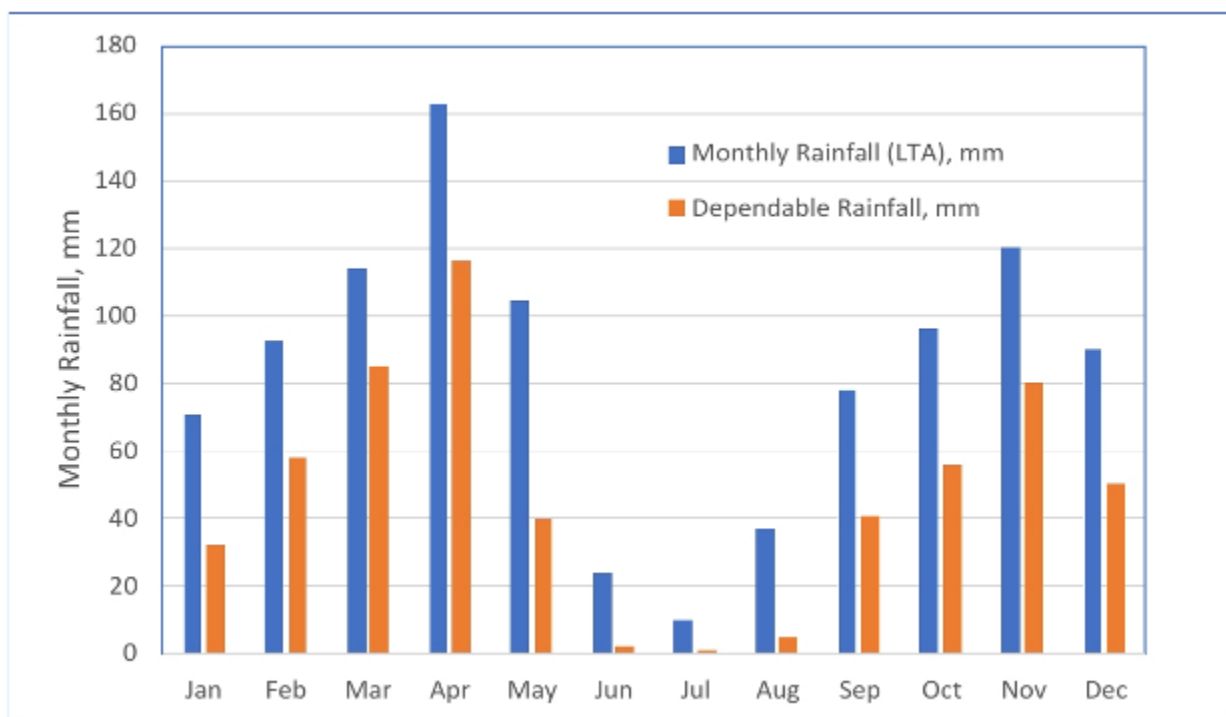


Figure 17: LTA monthly average rainfall and dependable rainfall at Lake Ihema station, mm

From the above figure, both monthly rainfall and dependable rainfall are limited in dry season while the maximum is observed in April which is in long rain season.

4.3.2. Climate change risk in the project area

The project area is located the lowlands where temperatures are higher and the extreme can go beyond 30°C in February and July-August. On the other hand, the eastern region of the country has been experiencing rainfall deficits over the last 20 years.

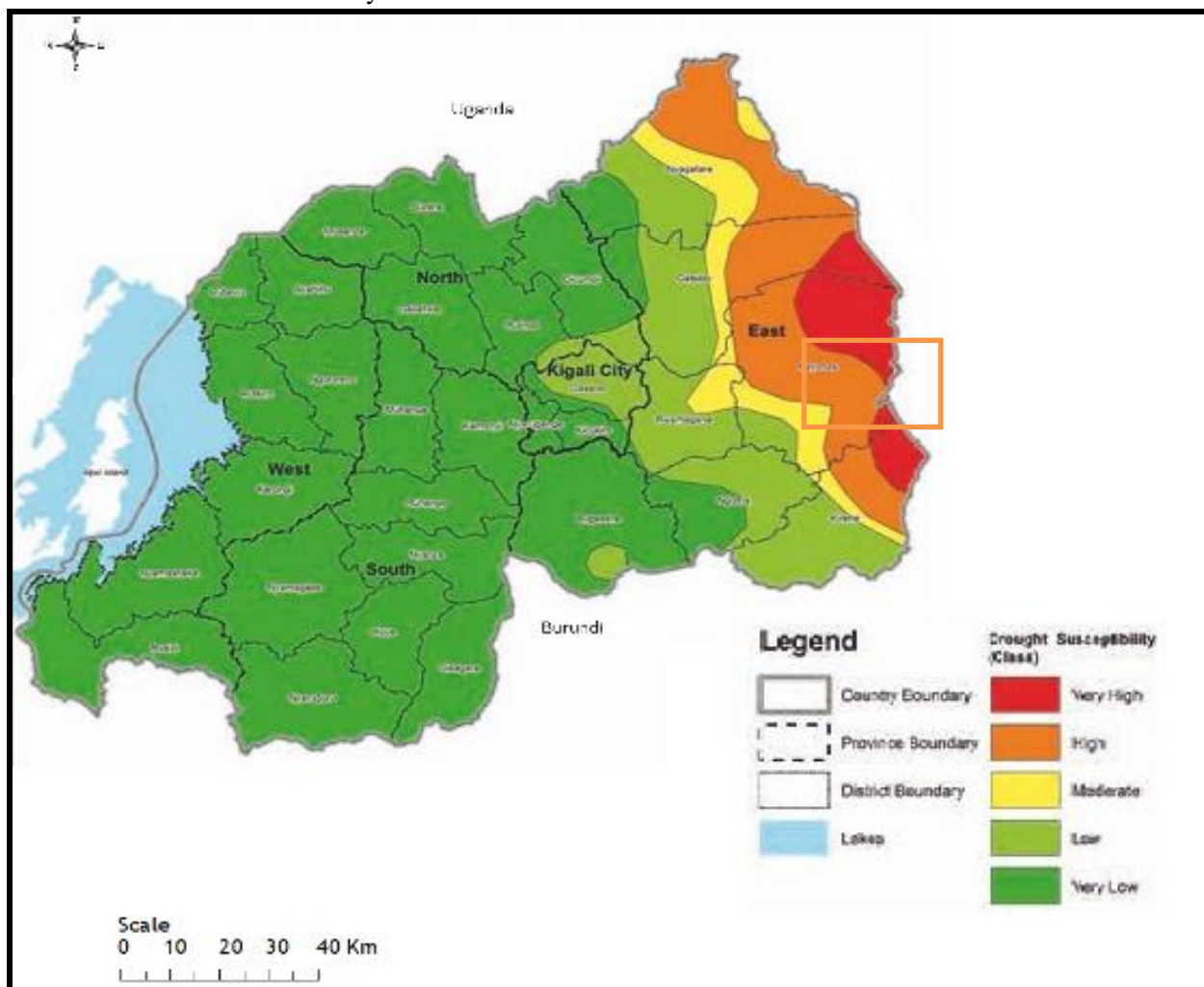


Figure 18: Drought prone areas in Rwanda

Source: Rwanda Climate change country profile, 2016

The area is characterized by high frequency of rainfall deficit, late rainfall onsets, early rainfall cessations, a significant number of dry spells and are prone to drought. Prolonged droughts are frequent in the region and they tend to be cyclical and can be persistent. Droughts are often responsible for famine, food shortages, a reduction in plant and animal species and displacement of people in search of food and pasture. The time series (1980 to 2017) of rainfall, minimum temperature and maximum temperature at Lake Ihema meteorological station shows an increment of the extreme events with higher peaks of precipitation during the wet season and with long periods of drought; maximum temperature data do not reveal particular differences throughout the period; minimum temperature data have an increasing trend. Although the future scenarios are very variable, some findings are common to different studies, for example: Awange et al (2013, 2014, 2016) points out that future climate change may lead to increases in average mean temperature, and changes in annual and seasonal rainfall. Henniger (2009) analysed air temperature at Kigali using 3 meteorological stations maintained by “Service Meteo du Rwanda” in the period from 1971 to 2008. Data indicated an increasing mean annual temperature of 2.60 C for a period of nearly 40 years.

Haggag et. Al. (2016) investigated past/present climate conditions and future climate projections in some potential hillside irrigation sites in Rwanda and stated that increases in mean air temperature, precipitation and potential evapotranspiration are projected under all models and all emissions scenarios:

- The increase in rainfall intensity are generally small relative to the inter-annual variability currently experienced in Rwanda; there is a trend of precipitation increase of 1 to 29% corresponding to 2010-2019 and 2070-2099 duration;
- The range of warming varies from 0.75 to 4.5°C;

- Potential Evapotranspiration (PET) projections have increasing trend by 3 and 55% corresponding to 2010-2039 and 2070-2099 under the different used models: deficit periods in which potential evapotranspiration exceeds precipitation are extended to 10 months in some parts of the country instead of 4 months at present;

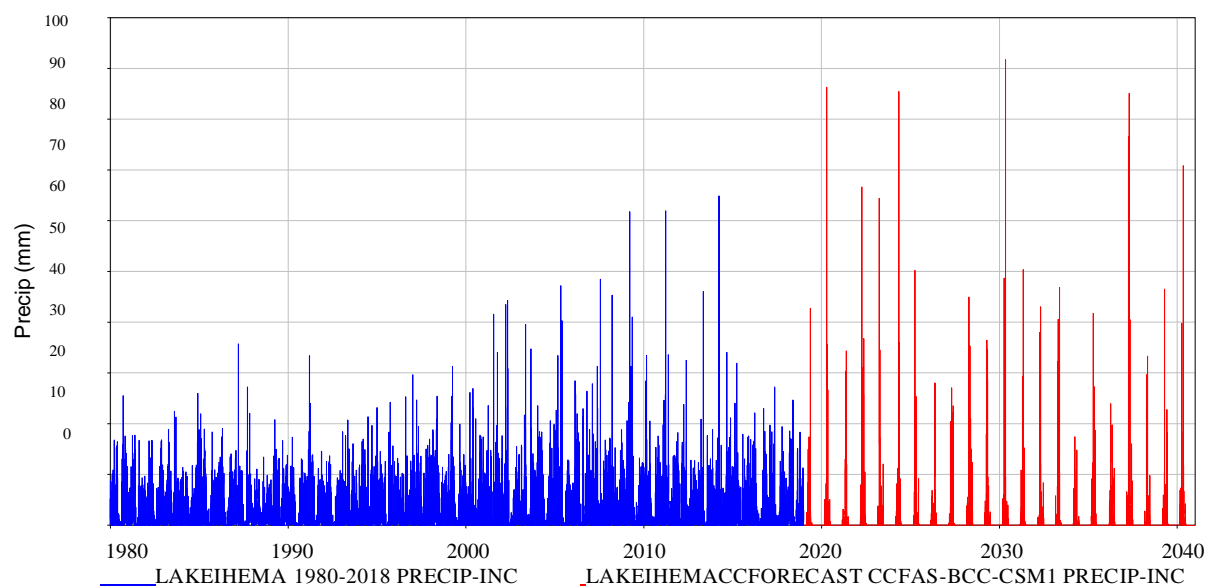


Figure 19: Historical and projected rainfall data at Lake Ihema

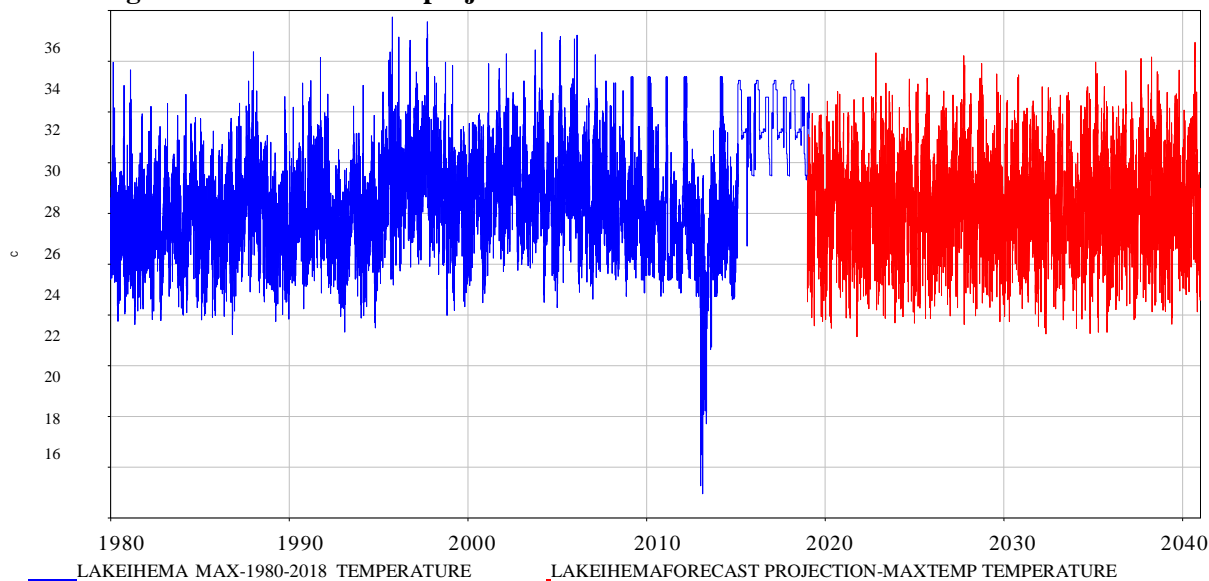


Figure 20: Historical and projected maximum temperature data at Lake Ihema

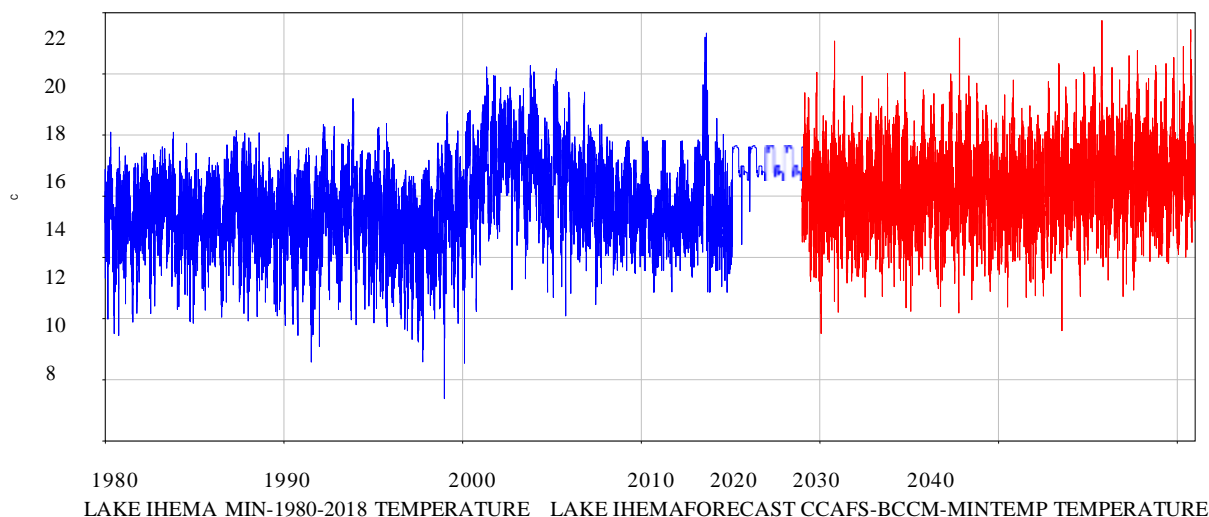


Figure 21: Historical and projected minimum temperature data at Lake Ihema station

In brief, projections indicate that floods and the duration of the dry spells are expected to increase due rainfall intensity that will increase and change in rainfall distribution.

4.4. Hydrological conditions of the project area

4.4.1. Water availability

The hydrographical network of the District is relatively dense and principally made by a multitude of small interior lakes (Ihema, Kibare, Rwibishuhe, Kabigabiro, Gashanda, Cyabatanzi, Shakani, Nasho, Kivumba and Hago), irrigation dams/ reservoirs (Rwinkwavu, Kageyo, Kayonza 4, Gacaca, etc) and valley dams, water courses as well as lakes that separate Kayonza with its neighbouring districts. In addition to these lakes, Kayonza has many vast swamps. The District counts 11 marshlands fully used and protected (20,998ha), 31 marshlands to be used under specific conditions (7,756 ha) and 3 marshlands for use without any specific condition (228 ha). Ndego site is surrounded by lakes, except on its western side. The next table provides annual maximum lakes level for three lakes located in the project area

Table 20: Annual Maximum Lake level

Sr Nr	Year	Annual Maximum Lake level (m.a.s.l.)		
		Lake Kibare	Lake Ihema	Lake Nasho
1	1981	1,283.80	1282.5	1,285.40
2	1982	1,284.90	1283.5	1,287.00
3	1983	1,284.50	1283.0	1,286.30
4	1984	1,284.60	1283.2	1,286.40
5	1985	1,283.20	1281.9	1,284.10
6	1986	1,285.20	1283.7	1,287.30
7	1987	1,284.70	1283.2	1,286.50
8	1988	1,284.60	1283.1	1,286.60
9	1989	1,283.90	1282.5	1,285.10
10	1990	1,284.20	1282.8	1,286.00
11	1991	1,285.40	1283.9	1,287.60
12	1992	1,284.60	1283.2	1,286.60
13	1993	1,283.40	1282.1	1,284.90
14	1994	1,283.40	1282.1	1,284.60
15	1995	1,284.00	1282.6	1,285.40
16	1996	1,283.90	1282.5	1,285.60
17	1997	1,284.00	1282.6	1,285.50
18	1998	1,283.70	1282.4	1,285.00
19	1999	1,287.10	1285.0	1,289.10
20	2000	1,285.00	1283.6	1,287.00
21	2001	1,283.40	1282.1	1,284.70
22	2002	1,283.90	1282.5	1,285.20
23	2003	1,284.90	1283.5	1,287.00
24	2004	1,284.10	1282.7	1,285.80
25	2005	1,284.80	1283.4	1,286.90
26	2006	1,284.40	1283.0	1,286.20
27	2007	1,285.50	1283.9	1,287.60
28	2008	1,285.00	1283.6	1,287.30
29	2009	1,286.70	1283.9	1,289.40
30	2010	1,285.70	1283.6	1,287.40
31	2011	1,287.20	1285.5	1,289.40
32	2012	1,285.40	1283.7	1,287.80
33	2013	1,285.50	1284.0	1,287.90
34	2014	1,284.50	1283.1	1,286.30
35	2015	1,285.90	1283.4	1,288.80
36	2016	1,283.50	1282.2	1,284.70
37	2017	1,283.40	1282.1	1,284.70
38		38	38	38
N		1287.2	1285.5	1289.4
MAX		1284.6	1283.1	1286.4
AVG		1282.9	1281.6	1283.9
MIN		1.03	0.82	1.41
SD				

Source: Rwanda Water Board

Kayonza District falls within two major catchments: the Upper Akagera Catchment and the Lower Akagera Catchment. Based on National Water Resources Master Plan, about 77% of the District falls within the Lower Akagera Catchment, and this comprises 32 % of the total catchment area. The average rainfall in the Lower Akagera Catchment is 835 mm, of which 624 mm (75%) is lost through evaporation and plant transpiration processes. The remaining 211 mm (25%) contributes to the catchment hydrological flow. Of this, 125 mm (15% of rainfall or 59% of flow) is base flow supplied from groundwater recharge.

The Project area lies within the natural drainage of lower Akagera Catchment characterized by high and sharp ridges on the west side and low slope catchments draining to the Lakes of interest as shown in Figure above. The catchment elevation varies from 1276 m.a.s.l. to 1319 m asl. The Akagera ecosystem complex dominates the ecosystem of the project area with smaller lakes and wetlands located on both sides. The Akagera River shows bidirectional flow patterns which depend on the sequence, magnitude and duration of hydrological events in upstream catchments and within the lower Akagera catchment itself. “Reverse flow” occurs when the Akagera River is in flood as a result of rainfall in the upstream catchments (Akagera and Ruvubu) filling up the lakes.

Connections do exist between the Lakes and Akagera River which is a critical factor for recharge of the lakes especially during the dry season when the water level in the river is the lowest. Observations were made during the bathymetry survey providing evidence of hydraulic connection between the Lakes and the Akagera river. The Lower Akagera Catchment Master Plan states that the width and depth of the channels between Akagera River and lakes are a crucial factor for maintaining the hydrological functionality, recommends that abstraction of water for agricultural use between the Akagera River and its lakes should be avoided.

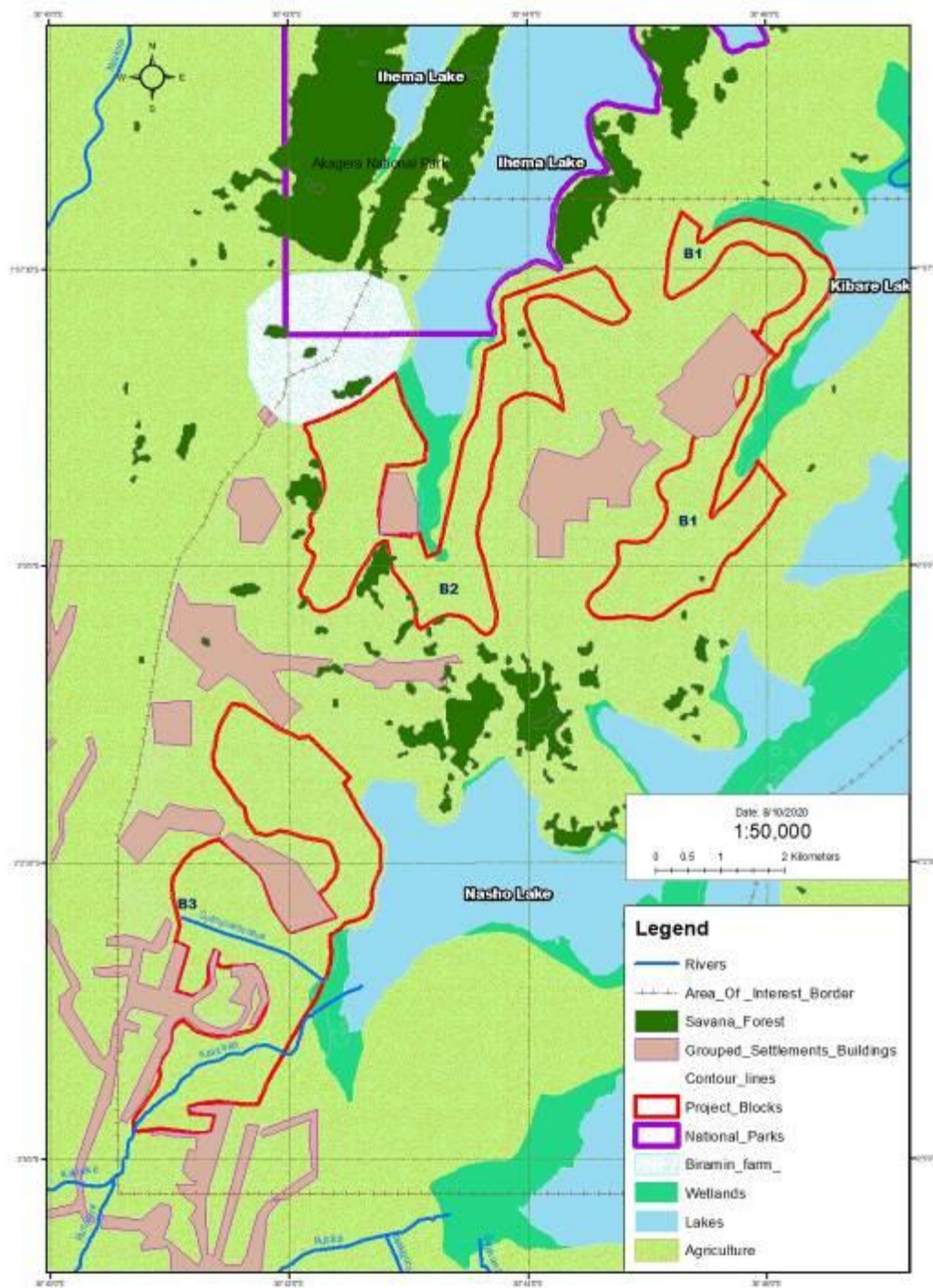


Figure 22: Akagera wetlands complex and lakes in the project area

Lake Kibare is directly connected to Akagera river with both an inlet and outlet to the river as can be seen in the Google Earth image illustrated below. This permanent connection was confirmed during the bathymetric survey by SMEC team. Another evidence of the direct connection with the Akagera River is the brownish colour of Lake Kibare river caused by mixing with sediment laden Akagera River.



Figure 23: Lake Kibare connection with Akagera River

Source: SMEC (2020)

Akagera river also flows along the eastern and north-eastern boundary of Lake Ihema with a 10.6 km long strip of wetland separating them that is 90 m wide at the narrowest point. During the survey on 16th of February 2019 by SMEC, the river flow was observed entering into the lake. This suggests that there is a direct continuous connection between the lake and river even during the dry seasons. The Satellite imagery showing discharge from Akagera river into the lake is presented below.



Figure 24: Satellite imagery showing discharge from Akagera River into Lake Ihema

Nasho lake is adjacent to Lake Cyambwe and both lakes are separated by a 5 km long strip of wetland that is 230 m wide at the narrowest point. Though no clear connection can be seen in Google Earth images, the information collected from local farmers pumping water from the wetland with a diesel moto pump for tomato irrigation ascertains that the two lakes are most likely hydraulically connected and that Lake Nasho gets recharged by Lake Cyambwe.

4.4.2. Water quality in project area

Sustaining agricultural production and agro-food processing is dependent on quality water supplies. Irrigation requires good quality water in order to prevent damage to sensitive crops from pesticides, salts, and trace metals. In the long term, low sodicity in irrigation waters is necessary to maintain soil structural stability. Nutrients are a concern for irrigation conveyance systems and receiving water bodies. Excess nutrients, such as nitrogen and particularly phosphorus, can cause eutrophication of water bodies. The resulting excessive growth of aquatic macrophytes and algae can cause aesthetic issues for recreation and drinking water, difficulty in conveyance of water for irrigation or industrial purposes, and declines in oxygen concentrations that can result in fish kills and loss of biodiversity; that is eutrophication.

In addition, nitrate (NO_3), nitrite (NO_2), and ammonia (NH_3) can be toxic to humans and other organisms. Nitrate from agricultural sources has been identified as a major threat to ground water supplies worldwide. Pesticides are a concern from a human and an aquatic health perspective. Studies have found that a variety of human health problems including cancers, neurological disorders, reproductive problems, and behaviour and developmental concerns may arise from continued exposure to low doses of pesticides. Moreover, most

pesticides have only had toxicological studies completed on a single active ingredient, but are commonly applied in mixtures, which may have synergistic effects. Pathogenic bacteria, such as Vero toxigenic serotypes of *Escherichia coli* and enterococci, can cause a wide array of human health problems and can also jeopardize the safety of water for irrigation, livestock watering, and recreation.

To determine water quality, water samples were collected from Ihema, Kibare and Nasho lakes and analysed for the key elements relevant for irrigation, mainly pH, TDS, EC, Cl, Na⁺, NO₃⁻ and SO₄. The results of the Water Quality (WQ) analysis are shown in the table below. Results were compared with acceptable range for irrigation as provided by FAO

Table 21: Quality of lake water

LAKE	pH	EC(μS/m)	TDS, PPM	Cl (mg/L)	Na, (mg/L)	NO3(mg/L)	SO4(mg/L)
Kibare	7.2-7.3	110-112	53-55	1240-1329	40-42.5	16-27	34-35
Ihema	7.1-7.2	127-134	63-67	1063-1196	44-53	5-9	31-32
Nasho	7.3-7.36	253-287	125-144	1063-1329	155-165	16-29	35-39
Acceptable ¹²	6.5-8.4	0-70,000	0-450	0-1050	0-920	0-44.2	0-960

Source: Feasibility study (2020)

From above results, it appears that most of studied parameters in the project area are within the range acceptable for irrigation water as provided by FAO. Only Chloride(Cl) is slightly above acceptable limit but does not poses issues for irrigation .

4.4.3. Water balance in the project area

The Rwanda National Water Resource Master Plan indicates that the project area is located in Akagera Low catchment(NAKL).According to the National Water Resource Master Plan, observation on water use and unadjusted demand and water balance in Akagera Low(NAKL where ndego project is located, Current registered demand is very modes claiming just 1% of the annually renewable resources which stand at 907 MCM/yr. In terms of its unadjusted water balance which is based on an implementation rate of the development opportunities at about a third per decade (2014-2020, 2021-2030, 2031-2040), the lower Akagera catchment is bound to undergo some limited stress during drier years from 2030 onwards. By 2040 the water supply situation becomes difficult at the end of the dry season for all but the wettest years (once in twenty years wet or better) whence rationing or other measures will be required. The overall water demand is scheduled to reach about 53% of the average renewable resource (477 over 907 MCM/year). It is imperative that especially the irrigation sector demand be examined with the intend to secure a viable water balance for this catchment up to 2040. It is possible to mobilize external resources.

The unadjusted water balance for this catchment clearly indicated that there is need for demand to be reduced in order to maintain a sustainable exploitation in case of full development by 2040. This reduction is specifically sought in the irrigation sector. Due to the important difference between the 2012 census data (~30 % above the projections based on the 2002 census data), the water demand from rural water supply has been revised upward. The changes from the unadjusted demand projections are as follows:

- **rural drinking water supply** has been increased by 31% for every time horizon and demand scenario of the Master Plan to account for the difference between the 2012 census data and the population projection data (from 2002 census) for this catchment. Due to the marginal demand from other categories this correction wasn't applied elsewhere.
- **irrigation by means of rainwater harvesting ponds**: based on an increased estimate of the number of filling cycles of the ponds demand per pond is increased from 1,000 to 2,000 m³/year (10 filling cycles of a 200 m³ pond).
- **irrigation by means of marshland development**: because of the interesting performance and reduced investment and operational costs of this method, the full development potential as identified in the RIMP (33,355 ha) has been allowed for with an annual demand of 2,500 m³/ha. The implementation schedule has been put forward a little bit in order to make optimum use of available resources. (2020 – 2030 - 2040 assumed implementation status is: 10,600 - 25,600 - 33,355 ha).

¹² FAO, Irrigation and Drainage Paper No. 29, 1994

- **irrigation from surface water sources:** this irrigation method is expensive in investment and exploitation costs; the latter especially when irrigating land at higher level from the water source level. For this reason, the 33,000 + ha foreseen in the RIMP report has been separated in 4 altitude classes and only the lower 2 altitude classes (0-25 and 25-50 m lift from source level) for a total of 18,000 ha command area, have been considered for gradual development during the lifetime of the Master Plan. The per hectare water demand for this method (8,000 m³/ha/yr) has not been changed. Adjusted demand from this use category has consequently been reduced to 55 % of the initial demand (from 263 MCM/year to 144 MCM/year).
- **irrigation with surface water storage reservoirs:** this irrigation method is expensive in investment cost (dam development and irrigation command area and an effort has been made to assess the viability of the different sites identified in the RIMP. Eight out of 10 identified sites have been found sufficiently interesting in terms of site configuration and storage volume. A total storage volume of 21 MCM is supported but any further storage volume up to about 115 MCM for the total catchment will be effective and beneficial to the regulation and increased use of water resources. The water demand from this irrigation method progresses from 2, via 21 and 38 to 48 MCM/yr for 2012, 2020, 2030 and 2040 time horizon. This was initially set at 12 MCM/yr.
- **irrigation demand from groundwater:** this irrigation method is also susceptible to bring high exploitation costs for pumping. The area viable for exploitation has been estimated at about 50 60 % of the area identified in the RIMP (8,548 ha). Water demand from this reduced command area (~5,000 ha) is estimated at 40 MCM/year which is gradually implemented over the period from 2012 - 2040.

The lower Akagera catchment requires a dry season transfer of 43 MCM for 2040 once in twenty year dry conditions which can be provided by upper Nyabarongo and Mukungwa catchments under the same conditions along with the transfer to the upper Akagera catchment's transfer of 82 MCM. The adjusted water balance for the NAKL catchment is presented in the table below.

Table 22: Adjusted water balance in Akagera Law Catchment NAKL 2012 - 2020 - 2030 - 2040.

volume data in '000 m ³	annual total	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep
Rs5%	1,285,266	73,080	82,640	97,397	98,981	105,763	115,277	136,037	142,848	134,544	114,129	106,544	78,026
Rs35%	964,603	59,628	65,017	72,784	78,192	78,205	90,840	102,955	107,707	96,775	82,500	68,334	61,665
Rs50%	874,040	56,391	60,588	69,081	71,164	71,196	76,402	91,208	97,439	86,018	75,166	62,834	56,553
Rs65%	814,376	52,479	57,393	61,835	64,558	69,924	71,661	84,199	92,047	79,178	70,200	60,077	50,823
Rs95%	593,775	35,191	40,411	42,008	50,423	56,371	56,287	59,817	68,756	58,442	48,887	40,876	36,306
gr.w.50%	536,000	31,767	36,479	37,921	45,517	50,886	50,810	53,997	62,066	52,756	44,130	36,899	32,773
Dem 2012	22,454	1,605	1,605	1,605	2,050	1,605	1,602	1,165	1,606	2,425	2,384	2,384	2,418
Surpl @ 95%	571,321	33,586	38,805	40,403	48,373	54,766	54,684	58,652	67,150	56,018	46,503	38,492	33,888
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%
Dem 2020-low	128,576	6,864	6,864	6,864	11,852	6,864	6,783	1,959	6,864	18,477	18,436	18,436	18,313
Surpl @ 95%	465,199	28,327	33,547	35,144	38,571	49,507	49,504	57,858	61,891	39,965	30,451	22,440	17,993
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%
Dem 2020-med	129,905	6,975	6,975	6,975	11,963	6,975	6,893	2,069	6,975	18,588	18,547	18,547	18,424
Surpl @ 95%	463,870	28,217	33,436	35,034	38,460	49,396	49,393	57,748	61,781	39,855	30,340	22,329	17,882
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%
Dem 2020-high	130,758	7,046	7,046	7,046	12,034	7,046	6,965	2,141	7,046	18,659	18,618	18,618	18,495
Surpl @ 95%	463,017	28,145	33,365	34,962	38,389	49,325	49,322	57,677	61,709	39,783	30,269	22,258	17,811
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%
Dem 2030-low	260,630	13,036	13,036	13,036	23,219	13,036	12,872	3,017	13,036	39,219	39,116	39,116	38,891
Surpl @ 95%	333,145	22,156	27,375	28,973	27,204	43,335	43,414	56,800	55,720	19,223	9,771	1,760	0
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=65%
Dem 2030-med	264,886	13,390	13,390	13,390	23,574	13,390	13,227	3,372	13,391	39,574	39,471	39,471	39,246
Surpl @ 95%	328,889	21,801	27,020	28,618	26,849	42,981	43,060	56,445	55,365	18,869	9,416	1,405	0
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=65%
Dem 2030-high	268,160	13,663	13,663	13,663	23,847	13,663	13,500	3,645	13,664	39,847	39,744	39,744	39,519
Surpl @ 95%	325,615	21,528	26,747	28,345	26,576	42,708	42,787	56,172	55,092	18,596	9,143	1,132	0
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=65%
Dem 2040-low	370,418	18,955	18,955	18,955	34,093	18,955	18,628	4,146	18,956	54,940	54,775	54,775	54,284
Surpl @ 95%	223,357	16,236	21,455	23,053	16,330	37,416	37,659	55,671	49,800	3,503	0	0	0
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=65%	>=65%	>=50%
Dem 2040-med	381,470	19,876	19,876	19,876	35,014	19,876	19,549	5,067	19,877	55,861	55,696	55,696	55,205

volume data in '000 m ³	annual total	oct	nov	dec	jan	feb	mar	apr	may	jun	jul	aug	sep
Surpl @ 95%	212,305	15,315	20,534	22,132	15,409	36,495	36,738	54,750	48,879	2,582	0	0	0
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=65%	>=65%	>=50%
Dem 2040-high	391,178	20,685	20,685	20,685	35,823	20,685	20,358	5,876	20,686	56,670	56,505	56,505	56,014
Surpl @ 95%	202,597	14,506	19,725	21,323	14,600	35,686	35,929	53,941	48,070	1,773	0	0	0
Reliab.%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=95%	>=65%	>=65%	>=50%

Source: Rwanda National Water Resources master Plan 2015

Under full development by 2040 the main demand categories are expected to be:

- the combined irrigation sector demand for this catchment is very important with a demand of 263 MCM/year from surface water irrigation, 65 MCM/year from marshland irrigation, 68 MCM/year from groundwater irrigation and 12 MCM/year from the development of surface water storage reservoirs. The total demand is about 410 MCM/year which represents about 45% of the average renewable resources
- rural water demand is scheduled to reach 25 MCM/year which may be complemented by demand from urban water supply at a rate of 17 MCM/year for a total demand of 42 MCM/year or some 5 % of the renewable resource.
- water supply for industries and mining is expected not to exceed 12 MCM/yr which represents just 1% of the renewable resource.
- demand from fish ponds is foreseen at a maximum 11 MCM/year; this demand becomes somewhat significant at about 1% of the average renewable resource.
- other demand categories (mainly livestock) present limited demand (under 3 MCM/year or some 3 %) but they are significant drivers for economic development.
- The consumptive demand for environmental water use is de facto zero¹³. However, a minimum flow of about one third of the surface flow should remain available on a monthly basis.

In comparison with the unadjusted water balance discussed previously , the stress conditions do not seem to have been solved:

- current situation without any stress identified; some demand assumptions were adjusted for the 2020 adjusted balance the demand is higher by some 15 MCM/year to about 130 MCM/year. This is related to the somewhat accelerated implementation of development opportunities (irrigation) The environmental flow requirement is a little bit comprised at the end of the dry season under a once in twenty year dry condition. No major issue however.
- for the 2030 adjusted scenario the annual water demand is higher by some 25 MCM/year to about 270 MCM/year and for the same reason as above. There is significant impact on the environmental flow which is however in practice not the case because of storage facilities and transfer of resources from upper catchments.
- for the 2040 scenario the adjusted water balance demand is lower by some 85 MCM/year which is due to the more realistic development levels of especially hill side and borehole irrigation. The impact on the environmental flow is less extreme in the balance but remains evident. In practice the balance will be fitting due to storage reservoirs and inter-basin transfers.

In conclusion, while the table still highlights stress conditions, the additional measures, transfer and carrying over of resources from the wet to the dry season, assure a sustainable and manageable water balance up to 2040 under the high growth scenario. The overall water demand is scheduled to reach about 53% of the average renewable resource (477 over 907 MCM/year). It is imperative that especially the irrigation sector demand be examined with the intend to secure a viable water balance for this catchment up to 2040. During the feasibility study, the water balance for the catchments draining to the lakes was done with HEC-HMS calibrated model.

¹³ The water resource Master plan only considers water abstracted from water source, environmental demand is maintained, and other uses should be considered once this amount is ensured.

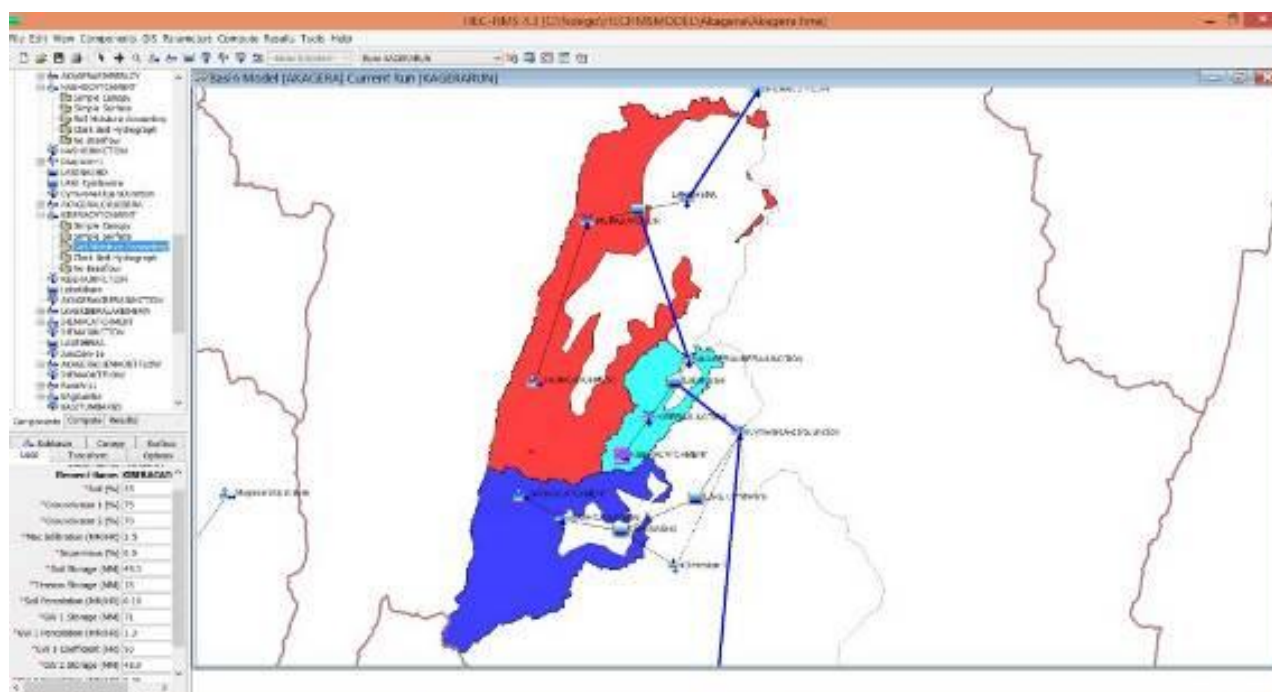


Figure 25: HEC-HMS Catchment Model

Source: Feasibility study

- **Lake Kibare catchment**

The water balance components computed include surface, canopy and tension storages which are eventually lost to evapotranspiration. The water balance components consist of rainfall, losses to evapotranspiration, base flow and streamflow. The project area watershed is not gauged. Hence, catchment parameters were derived from the calibrated Akagera basin model developed under this consultancy. The rivers feeding the lakes are all seasonal except Akagera river. Assessing the contribution of Akagera river to the Lakes is a challenge as there is no separate gauging. From limited measurements and lake level variation of Lake Ihema (Section 8.1.10), the major source of recharge water for Lake Kibare is from Akagera River. However, only 0.08% of the flow of Akagera at Rusumo is needed to recharge the lake.

Table 23: Lake Kibare catchment annual water balance (in mm)

Water Balance component	Depth, mm
Rainfall	963
PET	1212
Losses	834
Surface Runoff	128
Baseflow	0

- **Lake Nasho catchment**

Lake Nasho catchment is recharged from watershed runoff. The nearby Lake, Lake Cymabwe, also recharges the Lake provided that there is difference in lake elevation. When water will be pumped from Lake Nasho, there will most likely be a gradient from Lake Cyambwe. The water balance components of the watershed are estimated from the calibrated model and are given hereunder.

Table 24: Lake Nasho catchment water balance

Water Balance component	Depth, mm
Rainfall	971
PET	1212
Losses	897
Surface Runoff	74

Source: Feasibility study

The proposed irrigation schemes at Rwinkwavu and Kabarondo will involve the construction of dams for water storage, which will have to be filled with water. The Ihema and Kibare Irrigation scheme will draw water from lakes. There is a need for maintaining an environmental flow to sustain aquatic ecosystems and to support human, agricultural, livestock and industrial demand downstream. Thus, while the dams are being filled, and when the irrigation schemes are drawing water from the lakes, a prescribed environmental flow will have to be released downstream. The Lower Akagera Master Plan proposes an environmental flow of 33% of the average monthly flow. This means that the amount of water released downstream will have to be

adjusted according to monthly flow patterns. However, ultimately RWFA will propose a suitable environmental flow for each site, which will be stipulated in the Water Abstraction Permit for that site.

4.4.4. Environmental flow

Demands on water resources arise mainly from irrigation. Three irrigation Blocks through pumping are envisaged under this project. The irrigation demands need to be computed based on the cropping pattern expected. Moreover, demands arise from water supply for livestock watering, domestic water supply and fishery. The RWB issues water permits allowing water user to abstract specific volumes of flow from Lakes and rivers. Data on water permits were obtained but they are aggregated over the Eastern Province. Moreover, environmental flow requirements are specified to guarantee that ecosystem services of the rivers and lakes are not compromised.

- **Methodology**

Environmental flows or Ecological flows describe the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well being that depend on these ecosystems (National Water Resource Master Plan, 2015). Therefore, in the implementation of environmental flows, water managers strive to achieve a flow regime, or pattern, that provides for human uses and maintains the essential processes required to support healthy ecosystems. For Ndego irrigation schemes, the Environmental flow is calculated to meet ecological requirements but also to determine the effect of pumping irrigation water from two lakes may have on other users. Environment flow targets are set using the FDC Shift function implemented within WEAP. The FDCShift function is an implementation of the Global Environmental Flow Calculator (GEFC), a software package for rapid assessment of environmental flows developed by International Water Modelling Institute (IWMI). GEFC defines different Environmental Management Classes (EMC) as shown in table hereunder.

Table 25: Environmental Management Classes

EMC	% Places to shift	Description	Management Perspective
No change	0	Pristine Condition	Protected rivers and basins. Reserves and national park. No new water projects (dams, diversions) allowed.
A: Natural Flow	1	Minor modification of instream and riparian habitat	Water supply schemes or irrigation development present and/or allowed
B: Slightly Modified	2	Largely intact biodiversity and habitats despite water resources development and basin modifications	Multiple disturbances associated with socio-economic development, e.g. dams, diversions, transfers, habitat and water quality degradation
C: Moderately Modified	3	The habitats and dynamics of the biota have been disturbed, but basic ecosystem functions are still intact. Some sensitive species are lost or reduced in extent. Alien species present.	Significant and clearly visible disturbances associated with basin and water resources development, including dams, diversions, transfers, habitat and water quality degradation
D: Largely Modified	4	Large changes in natural habitat, biota and basic ecosystem functions have occurred. A clearly lower than expected species richness, Alien species prevail	High human population density and extensive water resources exploitation. Generally, this status should not be acceptable as a management goal.
E: Seriously Modified	5	Habitat diversity and availability have declined. A strikingly lower than expected species richness. Only tolerant species remain. Indigenous species can no longer breed. Alien species have invaded the ecosystem.	Management interventions are necessary to restore flow pattern and to 'move' the river to a higher management category
F: Critically Modified	6	Modification have reached a critical level and ecosystem is completely modified with almost total loss of natural habitat and biota. In the worst case, the basic ecosystem functions have been destroyed and the changes are irreversible.	This status is not acceptable from the management perspective. Management interventions are necessary to restore flow pattern and river habitats (if still possible/feasible) to 'move' a river to a higher management category.

Source: International Water Management institute

For Ndego irrigation schemes, Environmental flows consist of spills from the lakes, uninterrupted flows of Akagera river and setting operation levels for the lakes. Operating levels of the lake consist of minimum lake level beyond which it should not be allowed to drop normal operating level which allows spill to the rivers

- **Catchment description**

The project area lies in the lower Akagera sub basin and is characterized by high and sharp ridges on the west side and low slope catchments draining to the Lakes of interest. The Akagera river dominates the plan form of the project area with smaller lakes and wetlands located on both sides. It is no doubt that there is a strong connection between the Lakes and Akagera River, which is a critical factor for recharge of the lakes especially during the dry season when the water level in the river is the lowest.

- **Lake Kibare**

The feasibility study results show that lake Kibare has an obvious direct connection to Akagera River with both an inlet and outlet to the river. From the bathymetric data analysis the flow into and out of the lake to the river is very strong and the depth of the inlet and outlet channels are such that even when the river level drops during the dry season, flows are not blocked from entering the lake.

- **Lake Nasho**

Nasho lake is adjacent to Lake Cyambwe and both lakes are separated by a 5 km long strip of wetland that is 230 m wide at the narrowest point. According to the information collected through local population, it can be confirmed that the wetland area has significant amount of water, that the two lakes are most likely hydraulically connected and that Lake Nasho is recharged by Lake Cyambwe which in return is connected to Akagera River through a swamp area at the north end of the lake. The table below shows the source of recharge for lakes of the project area

Table 26: Source of Water recharge in two lakes

Lake	Lake area(km ²)	Storage capacity (MCM)	Catchment area (km ²)	Source of recharge
Kibare	4.0	17.6	25.7	Catchment and Akagera River
Ihema	96.3	325	142.8	Catchment and Akagera River
Nasho	16.0	37.4	83.9	Catchments of Lakes Nasho and Cyambwe and Akagera River

- **Estimate of Inflows into the Lakes**

The inflows to the Lakes were estimated based on the rainfall-runoff model. The model runoff resulted in annual runoff coefficient of 10.5 % for Lake Kibare and 10.4 % for Lake Nasho catchment. The annual runoff varied from a minimum of 0.0 MCM to a maximum of 19.9 into Lake Nasho whereas it varies from 0.0 MCM to a maximum of 6.6 MCM in Kibare. EMC A allows minor modification of the inflow hydrograph and this assumption was adopted herein. Moreover, the lake levels in Lake Kibare should not be dropped below 283.79 m.a.s.l. while in Nasho lake, the lake level should not be allowed to drop below 1285.9 m.a.s.l.. Setting the thresholds depends on the purpose of water abstraction. If we are abstracting for irrigation, the minimum lake levels shall be set at a higher level than if the abstraction is for domestic water supply. The instream flow requirements at nodes downstream of each lake are depicted next Figure and EMC C was selected as the threshold to meet the instream flow requirements whereas for Akagera river EMC B has been selected where slight modification is allowed.

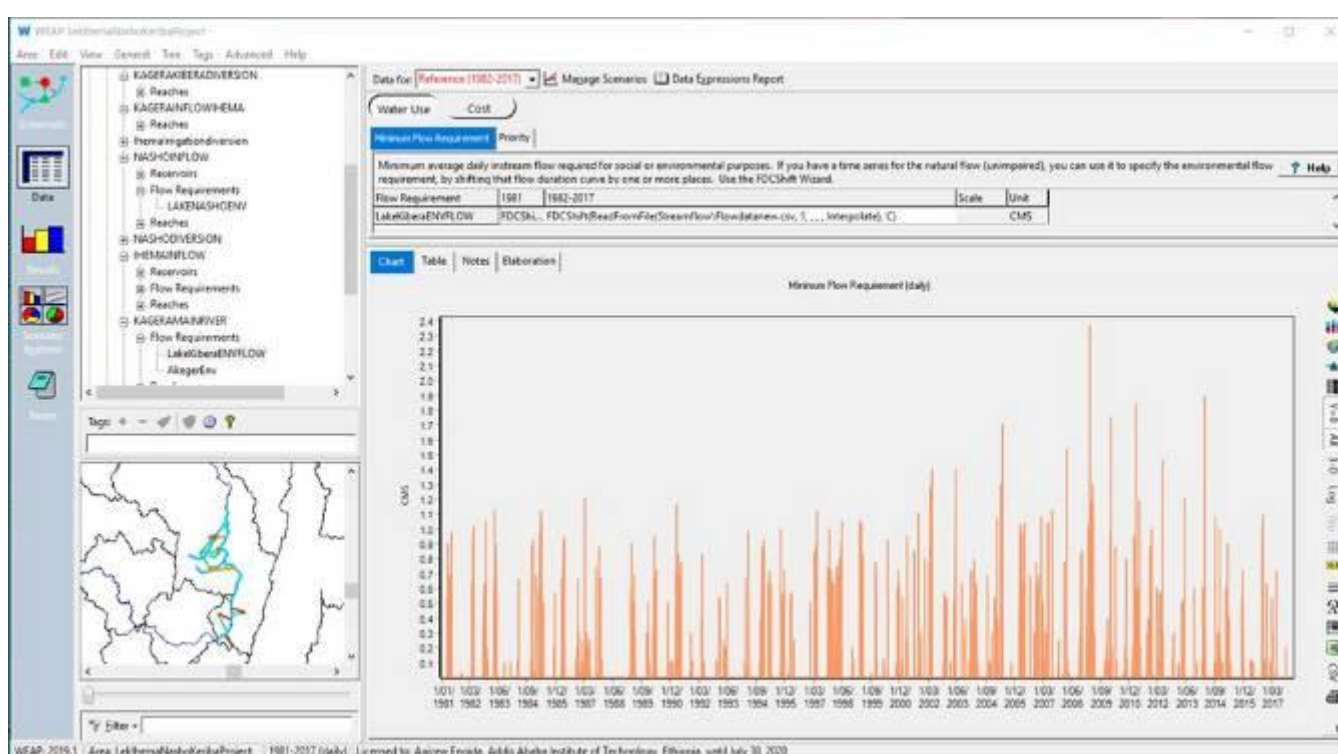
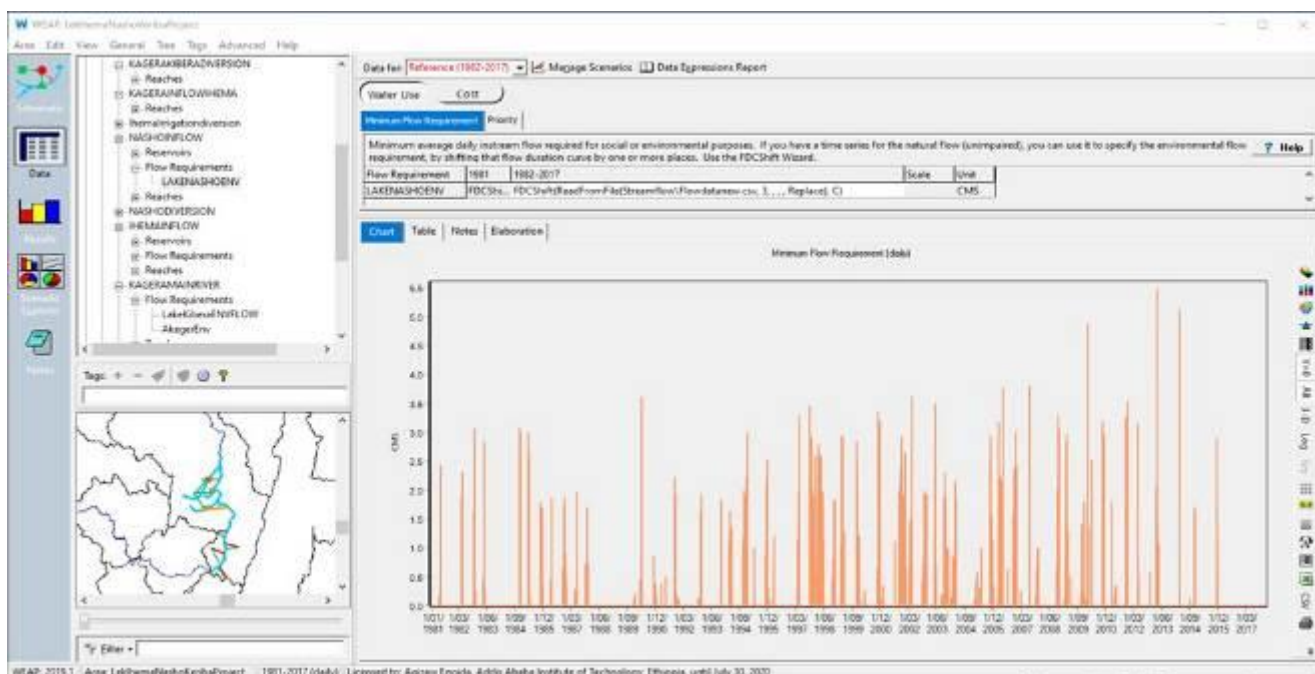


Table 27: Annual water demands of the existing water users

	Water Use	Annual water demand (MCM)
1	Industrial	316.9
2	Domestic Water supply	147.0
3	Irrigation	139.0
4	Aquaculture	0.2
	Total	603.1

Source: Rwanda Water Board,2020

- **Domestic Water demand**

It is assumed that domestic water supply is met through abstraction of water from the lakes and wetlands through pumping and tube wells. The domestic water supply demand was then assessed based on the premise that the base population size for Ndego in 2016 was 24000. The annual population growth rate was assumed to be 3.1% a typical figure for African rural areas). The function GrowtFrom function within WEAP was applied to hind cast and forecast the population size of Ndego. Moreover, a per capita consumption of 40 l/c/d was taken as reasonable figure for rural water demand assessment. Growth From (3.1%, 2016, 24000) is an implementation of the population growth model the results and the water supply demand in next figures

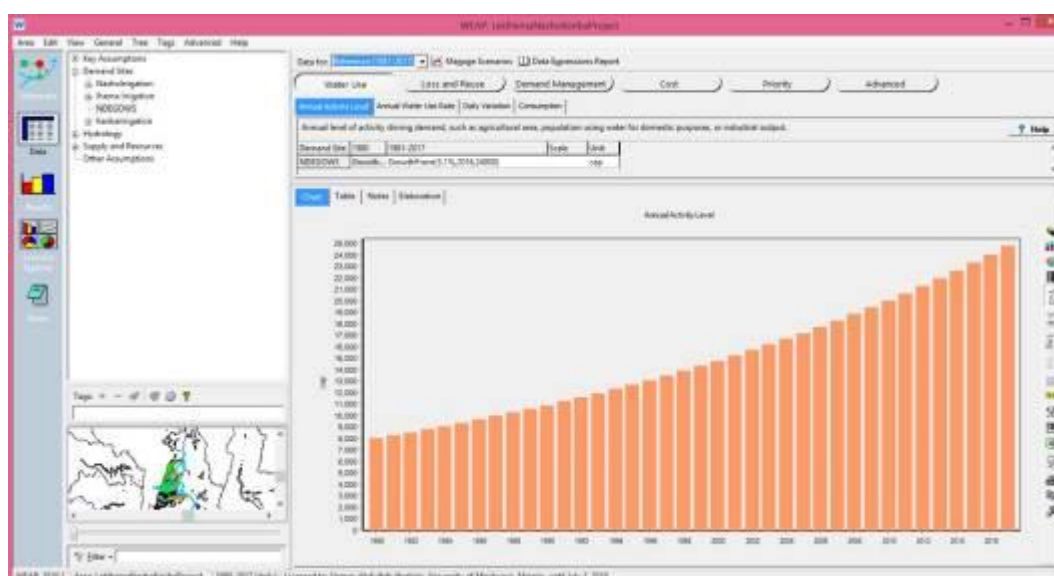


Figure 28: Population size in Ndego sector (1980 to 2018)

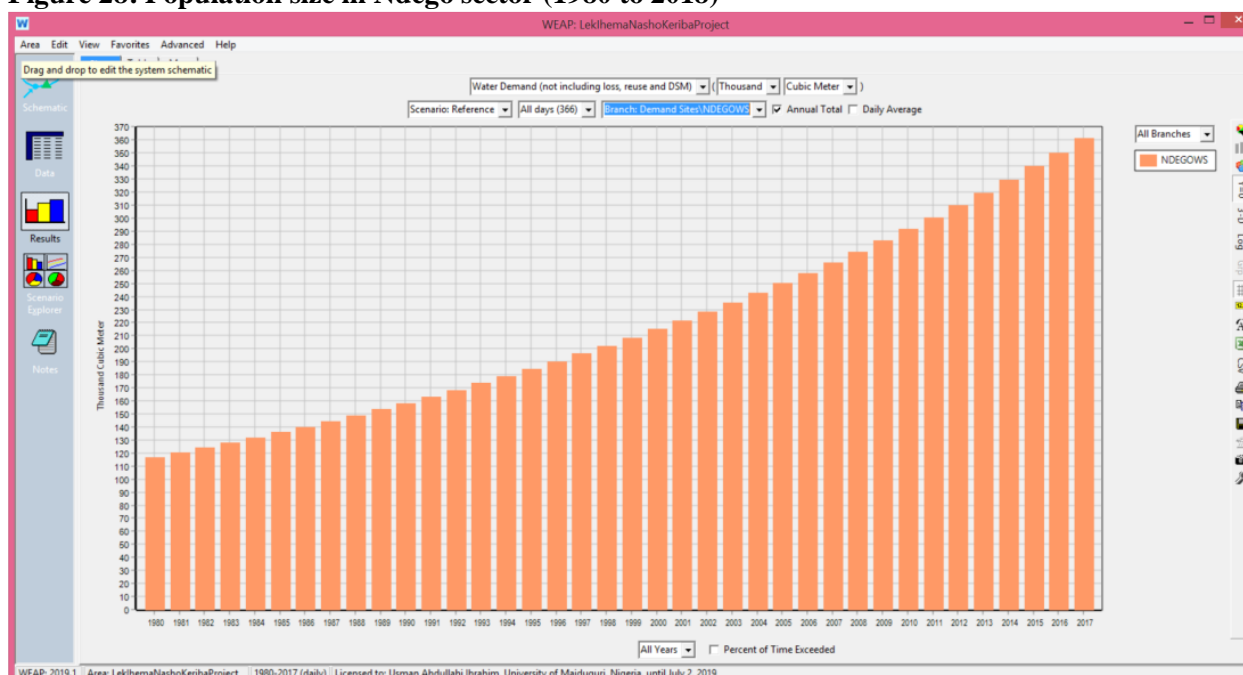


Figure 29: Annual domestic water supply demand (Thousands M3)

- **The Irrigation Water Demand**

The irrigation water requirements were estimated based on the two rain seasons of the project area as well as to the all proposed crops for the project area and taking into consideration that two or three growing periods are envisaged. The total irrigation water requirements for all crops and in all seasons is summarized in the table below and it is important to note that the irrigation demands vary with rainfall seasonality. For pressurized irrigation, the irrigation efficiency could be safely assumed to be 85%. In terms of water demand for irrigation it was estimated at 50,614(m³/ha) Season A, 28,612(m³/ha) Season B and 25,798(m³/ha in Season C

- **Estimation of Environmental Water flow**

It was determined that the lakes are connected to Akagera River which provides significant amount of recharge. Here, it was assumed that 0.0 m³ /s to 0.2 m³ /s of Akagera river flow recharges, Lake Kibare and Lake Nasho. Under this scenario, reliability of water supply for irrigation is over 99% for all blocks. The environmental flows considered all water users and the water balance components include net evaporation, inflow into the reservoirs, seepage losses and downstream releases. Downstream releases include irrigation water releases and environmental flow releases. If the inflow exceeds the outflow, there will be an increase in lake volume and vice versa. The catchment runoff appears not to be sufficient to replenish the lakes. This operation mode is unacceptable and diversion from Akagera river shall be required to refill the reservoirs.

The FDC Shift function is used to estimate the recommended streamflow in a modified stream, by uniformly reducing (shifting) the natural (unregulated) flow duration curve by a fixed number of percentile places, and further disaggregating it into a complete time series of modified flows. This estimated time series represents the environmental flow requirement to maintain the stream in a given ecological condition (environmental management class) and would typically be used to set the requirement for a flow requirement object (in this case Lake Nasho, Lake Kibare and Akagera Environmental flow on WEAP model).

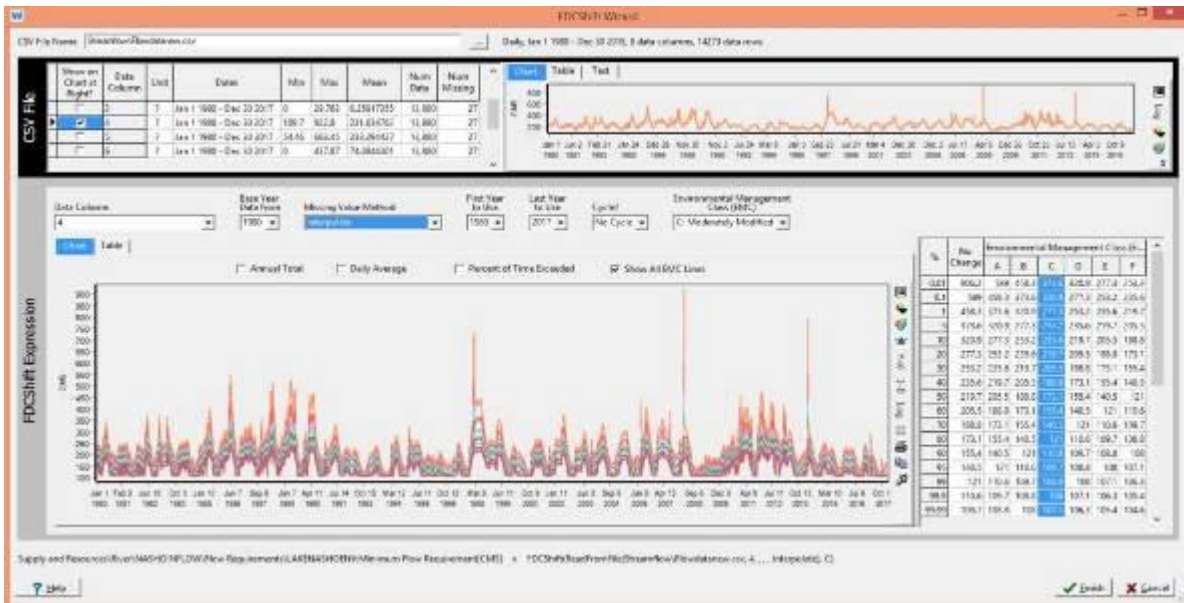


Figure 30: Environmental Flow Requirements of various EMC at Akagera river

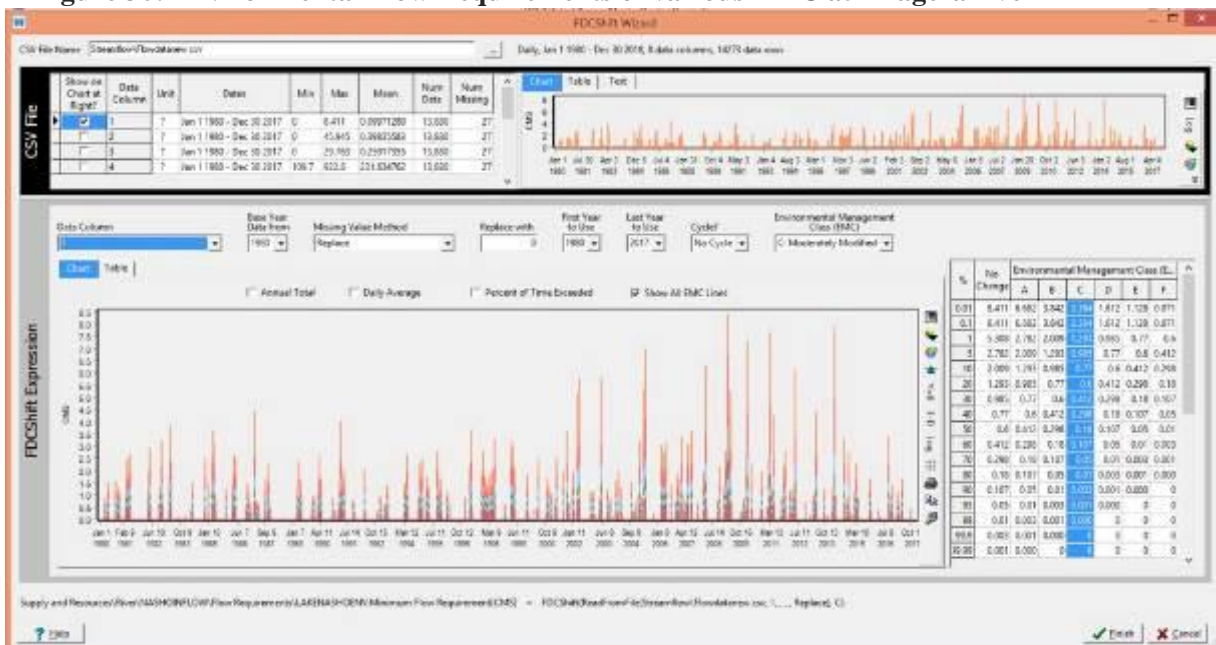


Figure 31: Environmental Flow Requirements of various EMC at Lake Kibare Outlet

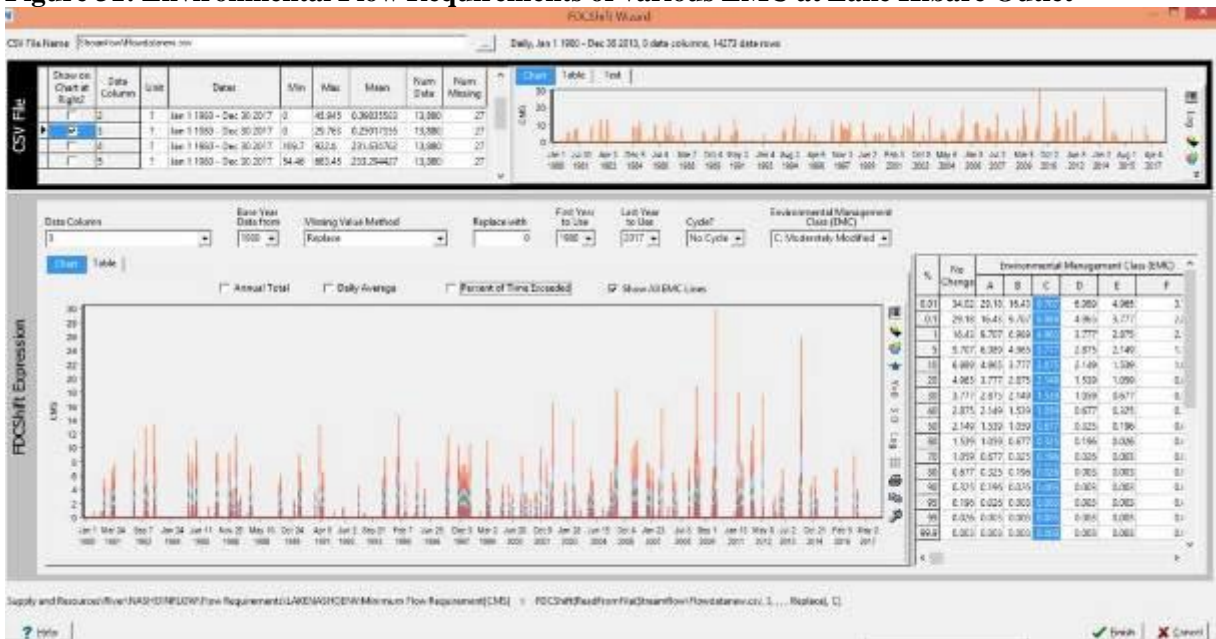


Figure 32: Environmental Flow Requirements of various EMC at Lake Nasho Outlet

- **Conclusion and recommendations**

Akagera River is considered as the main watercourse that dominates the project activities in terms of water recharge. The results of the bathymetry survey conducted in the project area show that the River contributes to water recharge of both lakes Kibare and Nasho. Other water sources in the project area include smaller wetlands located on both sides of the lakes and the rainfall recharge of the basin. The connection of both lakes and River water bodies is a critical factor for water recharge of the lakes especially during the dry season when the water level in the river is the lowest. The average rainfall of the project area is estimated at 835 mm per year with an annual evaporation of 624 mm per year (75%) and 4820 Million Cubic Meter of the ground water recharge. This amount provide enough water for domestic use, irrigation, farming and other uses and will replenish the average monthly and annual discharge of the lakes. The project area also appears to be strongly influenced by the rainfall conditions and by the river Akagera. Almost no lake level variations are observed in case of Lake Kibare as the lake receives substantially highly inflow compared to the demands. Irrigation abstractions do not affect Lake Kibare levelthe lakes significantly. In case of Lake Nasho which receives small amount of diversion from lake Cyambwe, abstraction of water for irrigation hugely affects the lake level variation.

The general observation show that both blocks Kibare and Ihema will be requiring the total amount of 100,228 m³/ha, 27,224, m³/ha and 51,596 m³/ha for Season A, B and C respectively to be abstracted from Kibare lake. Block Nasho will be requiring only 50,614 m³/ha, 28,612 m³/ha and 25,798 m³/ha for season A, B and C respectively. Considering available water, interconnection between Lake Kibare and Akagera River which in return is replenished by other upstream water sources such lake Rweru, lake Mugesera, Rusumo, Burera, lake Muhazi and Cyohoha as well as the rainfall inputs of the project area and the ground water recharge, there will be no major variation related to water abstraction for the project.

As the reliability of water supply is more that 98% at all blocks, it can be easily concluded that there is will be no water shortages for the project activities and no major or destructive impacts are expected on ecological sustainability. The total abstraction calculated for all blocks are 72% for block Kibare for season A, 7% for season B and 70% for season C, for block Ihema it remains 54% , 4% and 9.3% for season A, B and C respectively and for Nasho block 12%, 6% and 6% for season A, B and C respectively. Given that, lakes water will be used by other users, the regular monitoring will ensure that abstracted water for all users should not exceed the required amount and the Lake Kibare level should not be dropped 1283.79 m.a.s.l and the lake Nasho level should not be allowed to drop below 1285.9 m.a.s.l.. Further, 1/3 of available water is recommended for ecological demand as stipulated in the Water resources master Plan. The balance between water demand and available water ressources in targeted lakes provide more than 1/3 required for Envirolmental flow at laest for next 30years.

It is worth to note that there will be no water abstraction in Ihema lake. Irrigation water for Ihema and Kibare blocks will be abstracted from Kibare lake while water for nasho bloks will be abstracted from Nasho lake.

4.4.5. Other water users and Water use

Both Lake Nasho and Kibare lakes targeted for water abstraction are currently used for local community as source of water for different users.

- **Small scale irrigation**

BRAMIN, a joint venture between Bralirwa and Minimex, is situated along Lake Ihema to produce maize and soybeans. The farm is located on 650 hectares, with 337 hectares currently irrigated using five center pivots (300 ha) and sprinklers (37 ha). Maize and soybeans are rotated on a 6-month/3-month cycle respectively. The farm owns the land and employs 53 permanent staff and between 150-300 seasonal labourers per year. The farm operates a pumping station inside of Akagera National Park to irrigate 337 hectares with water from Lake Ihema. Lake Ihema will not be used for Ndego project and therefore water users on this lake will not be affected. Further, Lake Nasho and Kibare, local farmers were supported under REMA and Hingaweze project and are pump water from lakes and use it for irrigating banana Moringa plantation and vegetables which are the main economic crops on area estimated at 25ha.



Small-scale irrigation in the project area

- **Cattle feeding and domestic use**

Other water users include cattle owners who bring cows to ponds within the wetland for watering them. There are over 3,200 cattle across 199 dairy farmers in the Ndego sector and all of them depend on water from lakes.



Fish Cattle taking water from Kibare lake



Photo: *Protopterus aethiopicus* (Imamba).



Water for domestic use



Photo: *Labeo victorianus*

Table 28: Households sources of water for agriculture

Sources of water for agriculture	Kibare Block	Ihema block	Nasho Block	Tot. %
Rainwater harvesting	32%	32%	26%	29%
Irrigation from lakes	2%	1%	2%	2%
Purchase water from water suppliers	0%	0%	1%	0%
Others	1%	0%	0%	0%
Do nothing	65%	67%	70%	68%
Total	100%	100%	100%	100%

4.5. Ecological baseline data

4.5.1. Methodology and material for Ecological survey

Following the proposed delimitations of the study area, the whole project area was surveyed, with a focus on the three irrigation blocks (Kibare, Ihema and Nasho) spread across four cells: Isangano, Karambi, Kiyovu and Byimana (with an extension to Kabare Sector in the South). The assessment was carried out by block and different habitat types were determined by the major land use/cover (e.g. agricultural field, natural vegetation, built-up areas, etc.) and by major sensitive habitats (forest, lake, and wetland). For each site, habitat types were determined by the major land use/cover (agricultural field, natural vegetation, planted forest etc.) and by topography (valley, hill etc.). Key characteristic plant species were identified through a rapid taxonomic survey using a stratified-random sampling technique. Due to the limited time available for the survey and the extent of the area to be covered, different strata were pre-established using aerial maps and a timed-meander search method for ground truthing. A checklist of key plant species encountered during the field survey was established for each site by recording:

Species' scientific and vernacular names;

- Morphological forms;
- Origin;
- Conservation status (threatened and/or rare species);

The wildlife survey (mammals, birds and herpetofauna) was carried out through opportunistic observations combined with unstructured interviews with the local people. Recorded data included species names and their habitat preference

Biodiversity of vascular plants, amphibians, reptiles and birds was recorded along transects in four key areas including Command area, Catchment Command area, and Akagera wetland complexes including lakes. The ecological survey followed three main steps. The first step consisted of desktop work. During this phase, a literature review was undertaken. Species lists, species databases, existing documents, and previous studies and assessments for Rwanda were consulted to get information on species occurrence especially in the study area and wetlands of Akagera. As output, a list of species that occur, or could occur, in the study area based upon their habitat affinities and ranges was established. The second step consisted of field survey where data on species occurrence and diversity were collected based on standards survey methods as per animal taxa and recorded on pre-designed datasheets. The last step consisted of data entry, processing, analysis and report writing. The status of species were assessed using IUCN red list. The inventory of these organisms is presented iconography with photographs of as many species as possible is included.

- **Flora and vegetation:** For flora and vegetation transects were established in the most representative sites within the four area mentioned above. Plants were identified directly in the field and the main source for identification is the 'Flore du Rwanda' in 4 volumes (TROUPIN 1978, 1983, 1985, 1988). The circumscription of plant families follows APG (2009). The nomenclature of plant communities is used according SCHMITZ (1988).
- **Amphibian and reptile :** Field methods for recording amphibian diversity followed standard methods for amphibian inventories (HEYER et al. 1994, RÖDEL & ERNST 2004, VEITH et al. 2004). The main field method was a combination of visual and acoustic transect sampling and visual (VES) and acoustic (AES) encounter surveys (cf. RÖDEL & ERNST 2004). The combination of visual and acoustic sampling techniques is especially efficient because not only species that are easily detected by sight can be found but also those that call from hideouts. In each of the investigated areas we have established between 3 and 5 linear transects (length 300-500 m) in which we sampled on 22 non-consecutive days in the Morning and in the afternoon.
- **Birds :** For recording data on birds, two methods were used. The first method consisted of point count; where observation points were established at an interval of 200 meters along the reconnaissance route. At each point observers waited for 3 minutes to allow birds to settle down and then record all sightings and calls of birds for a period of 10 minutes (Sutherland, W. 2000). The observers then moved on to the next point and repeated this same process. In order to maximize species recording, this methodology was complemented by the opportunistic sampling, where all bird species seen or heard at different times of the

day were recorded. For bird species identification, we used the identification keys provided by Stevenson & Fanshawe (2002).

- **Mammals:** For mammals, species were recorded based on direct observation and information from community members. Species were recorded in vernacular name and then cross-checked to find their equivalent in English and their species names on species lists in Rwanda.
- **Lake biodiversity:** It was not practical to assess all species so a number of priority taxonomic groups were selected to represent a range of trophic levels within the food webs that underlie and support lake and wetland ecosystems. Priority groups were selected to include those taxa for which there was thought to be a reasonable level of pre-existing information such as fish. Other information biodiversity aquatic fauna, were identified through direct observation and consultation with fishermen as well as literature review. Local community members and fishermen provided vernacular name of species and these were cross-checked to find their equivalent in English and their species names.

Information collected on field was crosschecked and complemented with data from Rwanda Environment Authority (REMA-Research Department) Rwanda Development Board (RDB-Conservation department) and Center of excellence in biodiversity and Natural Resources.

- **Assessing the conservation status of species**

For assessing the conservation status of each species, we used the IUCN Red List of Threatened Species, version 2020-2 (IUCN, 2020). In addition, the ministerial order No 007/2008 of 15/08/2008 establishing the list of protected animal and plant species was consulted to identify plant and animal species protected in Rwanda. Any endangered or listed species on IUCN red list or any species protected in Rwanda were highlighted and brought to the client's attention.

4.5.2. Genera presentation of three blocks in terms of ecological status

- **Kibare block**

The Eastern edge of the Kibare irrigation block borders Lake Kibare and its associated wetland in the South-West. The lake is used for fishing activities, where the most commonly found fish species include Nile Tilapia, (*Oreochromis niloticus*), African Catfish (*Clarias gariepinus*) and *Haplochromis* sp. The invasive Mamba fish (*Pteripteris aethiopicus*) is also common in the area. The area is very dry, with low rainfall and high temperatures compared to other parts of the country. As a result of the water scarcity, people use the lake water for domestic purposes, including drinking, cooking, etc. Lake Kibare is also important for watering livestock as cattle farming is common in the region.

Apart from the various crops being grown in the fields, there are a range of savanna tree species growing in the area, mainly in cattle ranches to the North of Lake Kibare lake. Both Kibare and Ihema blocks border the southern end of the protected ANP forest, along Ihema Lake. Dominant plant species in the small forest patches and in this part of ANP include *Euclea racemosa* subsp. *schimperi*, *Combretum molle*, *Boscia angustifolia* var. *corymbosa*, *Scutia myrtina*, *Ozoroa insignis*, *Dichrostachys cinerea*, *Vepris nobilis*, *Rhus natalensis*, *Olea europea* subsp. *cuspidata*, *Grewia bicolor*, *Zanthoxylum chalybeum*, *Grewia similis*, *Albizia petersiana*, *Haplocoelum foliolosum*, *Acacia gerrardii*, *Lannea humilis*, *Afrocanthium lactescens*, *Lannea schimperi*, *Aloe* sp, etc. All around the four lakes found in Isangano (Lake Ihema, Lake Kibare, Lake Kagese and Lake Cyambwe), *Cyperus papyrus* is the dominant species. Some other key species along lake shores include *Phoenix reclinata*, *Aeschynomene elaphroxylon* and *Acacia polyacantha*.

- **Ihema Block**

The land in this area is predominantly used for agriculture with a built-up area between the two irrigation blocks. The area includes three lakes: Ihema in the North-West, Nasho and Cyambwe both in the South. Two main forests include a small area of the protected ANP forest which borders Ihema Block in the North (covering an area of 19 ha), and the Nasho Military Domain in the South-East which borders Kibare block (covering an area of 306 ha). A variety of agroforestry tree species were found throughout the area, comprising mainly *Eucalyptus* and *Grevillea* species. In the South-West of Karambi, some private farms host different native woodland species such as *Grewia similis*, *Combretum molle*, *Lannea schimperi*, *Albizia*

petersiana, *Markhamia obtusifolia*, *Euclea schimperi*, *Haplocoelum foliolosum*, *Acacia senegal*, *Acacia hockii*, *Searsia pyroides*, *Ozoroa insignis*, and *Erythrina abyssinica*. The wetland vegetation around the lakes is dominated by *Cyperus papyrus*. From the western part of Ihema Block, rain waters flow from the surrounding hills to flood the flat valley areas between the hills. The main crops grown around the irrigation blocks comprise soybean, groundnuts, maize, beans and cassava

- **Nasho Block**

Nasho Irrigation Block extends from the South-Eastern part of Byimana Cell (Ndego Sector) to the North of Kirehe Cell of Kabare Sector. Byimana is bordered by an elevated rocky hill to the West and Lake Nasho in the South-eastern part. Nasho Irrigation Block and its surrounding area are predominately used for the cultivation of maize, sorghum, beans and banana plantations. There are also scattered trees including *Grevillea robusta*, *Senna spectabilis*, *Moringa oleifera*, and *Lannea schimperi* mostly used for beekeeping but which also have medicinal properties and other uses. Extensive banana plantations border the surrounding of Lake Nasho, where a very narrow buffer zone is preserved.

Various fruit trees including mangoes, avocados and lemon can be found throughout the area, and some remnant native species are scattered in the agricultural fields or along the roads. They include mainly *Combretum molle*, *Acacia senegal*, *Markhamia obtusifolia*, *Albizia* sp, etc. which have a variety of uses and medicinal properties. The eastern-centre of the area comprises a seasonally flooded valley, dominated by *Hygrophila auriculata* species, an annual herb which can grow to 1.5m tall. The remaining area is covered by agricultural land where the dominant crops comprise beans, maize and banana plantations.

4.5.3. Ecological baseline in Command area

Command Area is defined as the planned irrigation is about 2000ha is where most of irrigation system infrastructure will be installed.

Table 29: Size of command area under different option

BLOCKS	B-1 (KIBARE)	B-2 (IHEMA)	B-3 (NASHO)	TOTAL AREA, HA
Option 1	481.7	683.6	858.6	2023.9
Option 2	497.5	654.75	864.95	2017.2
Option 3	482.8	636.5	898.2	2017.5

Source: Feasibility study.

Apart from intake Works/Pumping stations as well as water abstraction which will be installed on lakes/buffer zone, other irrigation system infrastructure will be installed in the command area (CA) and these include:

- ✓ Pipeline and related structures;
- ✓ Irrigation canals, drain channels and related structures;
- ✓ Sprinkler system;
- ✓ Centre pivot;
- ✓ Different hydraulic structures;
- ✓ Water storage facilities (Balancing storage reservoirs)
- ✓ Land husbandry technologies;
- ✓ Road networks.

The command area was delineated in agriculture land where natural vegetation has been removed and hence poor in terms of biodiversity. These structures and works are likely to affect biodiversity in the command area. As shown on the next figure. The Command area has been transformed into agriculture land and the natural vegetation has disappeared. Only Ihema blocs has included a wetlands which is also transformed into agriculture land.

During the field survey, data were collected along three (3) established reconnaissance trails one in each block. This included one reconnaissance trail per irrigation block. Species taxa recorded included bird, reptile amphibian, fish and plants.



Figure 33: Current status of the command Area

4.5.3.1. Fauna Species

- Birds

Twenty (11) species have been recorded during the field survey. Seven (7) species were common to all three blocks, and eight (8) species were common to two blocks, while five (5) species were found unique to one block. Ihema Block (B2) had more bird species than the other blocks (16 species), while Kibare Block (B1) had less bird species (11 species). Lastly, twelve (12) bird species were seen or heard during the fieldwork, while eight (8) bird species were identified through interviews with community members about known species occurrence.

Table 30: Bird species recorded in all irrigation blocks command area

Block	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status
B3	Coliiformes	Coliidae	<i>Colius striatus</i>	Spickled Mousebird	Umusure	Least Concern
B1, B2, B3	Passeriformes	Motacillidae	<i>Motacilla aguimp</i>	African-Pied Wagtail	Inyamanza	Least Concern
B1, B2, B3	Passeriformes	Sturnidae	<i>Lamprotornis purpuroptera</i>	Rueppell's glossy-starling		Least concern
B1, B3	Passeriformes	Corvidae	<i>Corvus albus</i>	Pied Crow	Icyiyoni	Least Concern
B1, B2, B3	Passeriformes	Passeridae	<i>Passer griseus</i>	Common Grey-Headed Sparrow++	Igishwi	Least Concern
B1, B2, B3	Passeriformes	Estrildidae	<i>Lagonosticta rubricata</i>	African Firefinch	Ifundi	Least Concern
B1, B2	Passeriformes	Ploceidae	<i>Ploceus pelzelni</i>	Slender-Billed weaver	Isandi	Not assessed
B1, B2	Accipitriformes	Accipitridae	<i>Polyboroides typus</i>	African Harrier Hawk	Ikizu	Least Concern
B3	Columbiformes	Columbidae	<i>Columba guinea</i>	Speckled Pigeon	Inuma	Least Concern
B1, B2	Accipitriformes	Accipitridae	<i>Milvus migrans</i>	Black kite	Sakabaka	Least Concern
B2, B3	Passeriformes	Leiotherichidae	<i>Turdoides jardineii</i>	Arrow-Marked Babbler	Ikijwangajwanga	Least Concern

Status | EN = Endangered (IUCN Red list); * = Protected species in Rwanda; ++ = most dominant species

- Reptiles

No reptile species was encountered during the field data collection. Species recorded are those mentioned by community members during interviews. According to them, seven (4) species are found in all three blocks. It is important to note that most of these species lay eggs in the wetland close to the water hence, the importance of avoiding destroying their eggs during construction works.

Table 31: Reptile species recorded in all irrigation blocks Command area

Block	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status
B1, B2, B3	Squamata	Colubridae	<i>Philothamnus heterolepidotus</i>	African Green Snake++	Incarwatsi	Not Evaluated
B1, B2, B3	Squamata	Viperidae	<i>Bitis arietans</i>	Puff Adder*	Impiri	Not Evaluated
B1, B2, B3	Squamata	Elapidae	<i>Naja nigricollis</i>	Spitting Cobra	Incira	Not Evaluated
B1, B2, B3	Squamata	Lamprophiidae	<i>Psammophis sibilans</i>	Striped Sand Snake	Imbarabara	Least Concern

Status | * = Protected species in Rwanda; ++ = most dominant species

- Amphibians

During the field data collection, no amphibian species was encountered. This may be because of the bad timing since most of amphibians move from the swamp to the land during the night. However, community members were shown pictures along with a clear description of species found in similar area and they confirmed the presence of six species to occur in the area (next table).

Table 32: Amphibian species recorded in all irrigation blocks command area

Block	Order	Family	Scientific Name	Common Name	IUCN Status	Conservation
B1, B2, B3	Anura	Ranidae	<i>Ptychadena mascareniensis</i>	Northern Leopard Frog	Least Concerned	
B1, B2, B3	Anura	Hyperoliidae	<i>Afrixanus quadrivittatus</i>	-	Least Concerned	
B1, B2, B3	Anura	Bufonidae	<i>Amietophrynus kisoensis</i>	-	Least Concerned	
B1, B2, B3	Anura	Hyperoliidae	<i>Afrixanus quadrivittatus</i>	-	Least Concerned	
B1, B2, B3	Anura	Bufonidae	<i>Amietophrynus kisoensis</i>	-	Least Concerned	
B1, B2, B3	Anura	Ptychadenidae	<i>Ptychadena porosissima</i>	-	Least Concerned	



• Mammals

Only domesticated mammals were identified in Command area including cattle, goats, sheep, Chicken etc

4.5.3.2. Flora

Project targeted area has been modified by mainly agriculture and only include crops and scattered woodlots. Around the project area, the vegetation is generally made of a mosaic of grassland, broadleaved and/or deciduous shrub land and scattered woodlots. Plant species recorded during the survey are presented based on irrigation blocks and command area versus catchment area .

- Nasho Block (B3)

Command Area: The command area is made of large area of agriculture farms and the dominant crop is banana plantation. Many of these private agriculture farms practice improved intensive agriculture with irrigation. There are also farms of Moringa plantation (*Moringa oleifera*). Most of these private farms are located near Nasho Lake and are separated from the lake a small stretch of a lake ripaline wetland. The upper part (far from the lake) is made of agriculture fields of a mix of cassava and maize.

• Ihema Block (B2)

The command area is made of large agriculture fields with scattered banana plantation and other perennial crops mainly cassava; as you move away from the wetland. The area close to the wetland are humid and comprise of crops such as maize, sweet potatoes, cabbages, tomatoes, etc. In addition, there is a large area in the southeast that is mainly used for cattle grazing. It was noted that the agriculture has been encroaching on the wetland in the recent years.



Eichornia crassipes



Aeschynomene elaphroxylon

- **Kibare Block (B1)**

Command Area: Most of the agriculture land located away of lake and wetland was abandoned due to droughts. As you move towards the lake and wetland, the land is dominated by banana plantation with scattered perennial crops such as cassava.

Table 33: List of plant species recorded and their location

No.	Block	Order	Family	Scientific name	Vernacular	IUCN Conservation Status
1	B2, B3	Fagales	Myricaceae	<i>Myrica kandtiana</i>		-
2	B1, B2, B3	Malpighiales	Euphorbiaceae	<i>Euphorbia tirucalli</i>	Umuyenzi	Least Concern
3	B3	Brassicales	Moringaceae	<i>Moringa oleifera</i>	Moringa	-
4	B1, B2	Poales	Poaceae	<i>Sporobolus pyramidalis</i>		-
5	B1, B2, B3	Fabales	Fabaceae	<i>Acacia Sieberiana</i>	Umunyinya	Least Concern
6	B1, B2, B3	Fabales	Fabaceae	<i>Acacia polyacantha</i>	Umunyinya	-
7	B1, B3	Sapindales	Anacardiaceae	<i>Lannea schimperi</i>	Umumuna	-
8	B1, B3	Mavales	Malvaceae	<i>Grewia similis</i>	Umukoma	-
9	B1, B3	Ericales	Primulaceae	<i>Maesa lanceolata</i>	Umuhanga	Least Concern
10	B1, B2, B3	Zingibinales	Musaceae	<i>Musa spp.</i>	Insina	Not assessed
11	B1, B2, B3	Sapindales	Anacardiaceae	<i>Mangifera indica</i>	Umwembe	Not assessed
12	B1, B2, B3	Malpighiales	Euphorbiaceae	<i>Manihot esculenta</i>	Umwumbati	-
13	B1, B2, B3	Poales	Poaceae	<i>Zea mays</i>	Ikigoli	Least Concern
14	B3	Solanales	Solanaceae	<i>Solanum lycopersicum</i>	Inyanya	
15	B2	Brassicales	Brassicaceae	<i>Brassica oleracea</i>	Ishu	-
16	B3	Solanales	Solanaceae	<i>Nicotiana tabacum</i>	Itabi	-

Source: Field observation, 2020

4.5.4. Ecological Baseline in the Command Area Catchment (CCA)

The total command area catchment of Ndego project site is 2,491.75 ha accounting for 55.25 % of the total project site. The major portion, 86.17 % of the command area catchment is situated in 0-6% slope class while 6-16% slope category cover only 13.8% of the total agricultural area of the catchment. The dominant land terrain 0-6%, the almost flat area will be treated with appropriate physical and biological measures while the land on 6-16% of the slope will be treated with the anti- erosive trenches supported with appropriate biological technologies. Like in the case of Command area, the Cathment Command Area (CCA) is maainely made of agriculture zone, transformed wetalnds around Lakes buffer zone as well as woodlots. The ecology of the command area Catchment is not much different from the one in Command area but is more important due to the proximity with wetlands, lakes and Savanna areas.



Figure 34: Overview of Command area Catchment

4.5.4.1. Fauna Species

- Birds

Twenty (20) species have been recorded during the field survey. These are grouped in nine (9) orders and seventeen (17) families. Seven (7) species were common to all three blocks, and eight (8) species were common to two blocks, while five (5) species were found unique to one block. Ihema Block (B2) had more bird species than the other blocks (16 species), while Kibare Block (B1) had less bird species (11 species). Lastly, twelve (12) bird species were seen or heard during the fieldwork, while eight (8) bird species were identified through interviews with community members about known species occurrence. Among recorded birds, one (1) species is categorized as Endangered on the IUCN Red List (IUCN, 2020). This species is commonly known as Grey Crowned Crane (locally known as Umusambi). In addition, 4 wetland birds are on the list of protected species in Rwanda (see next table)

Table 34: Bird species recorded in all irrigation blocks command Area catchment

Block	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status
B1, B2, B3	Gruiformes	Gruidae	<i>Balearica regulorum</i>	Grey Crowned Crane* (EN)	Umusambi	Endangered
B1, B2, B3	Pelecaniformes	Ardeidae	<i>Bubulcus ibis</i>	Cattle Egret++*	Inyange	Least Concern
B1, B2	Charadriiformes	Charadriidae	<i>Ardea melanocephala</i>	Black-Headed Heron*	Ururyongoyongo	Least Concern
B2, B3	Pelecaniformes	Scopidae	<i>Scopus umbretta</i>	Hamerkop*	Sarupfuna	Not assessed
B3	Ciconiiformes	Ciconiidae	<i>Anastomus lamelligerus</i>	African Open-Billed Stork		Least Concern
B1, B2, B3	Coraciiformes	Alcedinidae	<i>Corythornis cristatus</i>	Malachite Kingfisher	Murobyi	Least Concern
B2	Ciconiiformes	Ciconiidae	<i>Mycteria ibis</i>	Yellow-Billed Stork		Least Concern
B2	Charadriiformes	Charadriidae	<i>Venellus senegallus</i>	African Wattled Lapwing	Inkurakura	Not assessed
B2, B3	Pelecaniformes	Threskiornithidae	<i>Bostrychia Hagedash</i>	Hadada Ibis	Nyirabarazana y'inkara	Least Concern
B3	Coliiformes	Coliidae	<i>Colius striatus</i>	Spickled Mousebird	Umusure	Least Concern
B1, B2, B3	Passeriformes	Motacillidae	<i>Motacilla aguimp</i>	African-Pied Wagtail	Inyamanza	Least Concern
B1, B2, B3	Passeriformes	Sturnidae	<i>Lamprotornis purpuroptera</i>	Rueppell's glossy-starling		Least concern
B1, B3	Passeriformes	Corvidae	<i>Corvus albus</i>	Pied Crow	Icyiyoni	Least Concern
B1, B2, B3	Passeriformes	Passeridae	<i>Passer griseus</i>	Common Grey-Headed Sparrow++	Igishwi	Least Concern
B1, B2, B3	Passeriformes	Estrildidae	<i>Lagonosticta rubricata</i>	African Firefinch	Ifundi	Least Concern
B1, B2	Passeriformes	Ploceidae	<i>Ploceus pelzelni</i>	Slender-Billed weaver	Isandi	Not assessed
B1, B2	Accipitriformes	Accipitridae	<i>Polyboroides typus</i>	African Harrier Hawk	Ikizu	Least Concern
B3	Columbiformes	Columbidae	<i>Columba guinea</i>	Speckled Pigeon	Inuma	Least Concern
B1, B2	Accipitriformes	Accipitridae	<i>Milvus migrans</i>	Black kite	Sakabaka	Least Concern
B2, B3	Passeriformes	Leiothrichidae	<i>Turdoides jardineii</i>	Arrow-Marked Babbler	Ikijwangajwanga	Least Concern

Status|EN = Endangered (IUCN Red list); * = Protected species in Rwanda; ++ = most dominant species



Grey-Crowned Crane



Yellow-Billed Stork



Rueppell's glossy-starling

- Reptiles

No reptile species was encountered during the field data collection. Species recorded are those mentioned by community members during interviews. According to them, seven (7) species are found in all three blocks. These include five (5) species of snake, one (1) species of crocodile and one (1) species of tortoise. Other reptile species could be found in all 3 irrigation blocks. It is important to note that most of these species lay eggs in the wetland close to the water hence, the importance of avoiding destroying their eggs during construction works.

Table 35: Reptile species recorded in Command area Catchment area)

Block	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status
B1, B2, B3	Squamata	Colubridae	<i>Philothamnus heterolepidotus</i>	African Green Snake++	Incarwatsi	Not Evaluated
B1, B2, B3	Squamata	Viperidae	<i>Bitis arietans</i>	Puff Adder*	Impiri	Not Evaluated
B1, B2, B3	Squamata	Elapidae	<i>Naja nigricollis</i>	Spitting Cobra	Incira	Not Evaluated
B1, B2, B3	Squamata	Lamprophiidae	<i>Psammophis sibilans</i>	Striped Sand Snake	Imbarabara	Least Concern

Status|* = Protected species in Rwanda; ++ = most dominant species

- Amphibians

During the field data collection, no amphibian species was encountered. This may be because of the bad timing since most of amphibians move from the swamp to the land during the night. However, community members were shown pictures along with a clear description of species found in similar area and they confirmed the presence of six species to occur in the area (next table).

Table 36: Amphibian species recorded icommand area and catchment Command area)

Block	Order	Family	Scientific Name	Common Name	IUCN Conservation Status
B1, B2, B3	Anura	Ranidae	<i>Ptychadena mascareniensis</i>	Northern Leopard Frog	Least Concerned
B1, B2, B3	Anura	Hyperoliidae	<i>Afrixanus quadrivittatus</i>	-	Least Concerned
B1, B2, B3	Anura	Bufonidae	<i>Amietophrynus kisolensis</i>	-	Least Concerned
B1, B2, B3	Anura	Hyperoliidae	<i>Afrixanus quadrivittatus</i>	-	Least Concerned
B1, B2, B3	Anura	Bufonidae	<i>Amietophrynus kisolensis</i>	-	Least Concerned
B1, B2, B3	Anura	Ptychadenidae	<i>Ptychadena porosissima</i>	-	Least Concerned



Afrixanus quadrivittatus



Ptychadena mascareniensis

- Mammals

- **Mammals**

Only domesticated mammals were identified in Command area Catchment including cattle, goats, sheep, Chicken etc

4.5.4.2. Flora

Project targeted area has been modified by mainly agriculture and only include crops and scattered woodlots. Around the project area, the vegetation is generally made of a mosaic of grassland, broadleaved and/or deciduous shrubland and scattered woodlots. Plant species recorded during the survey are presented based on irrigation blocks and command area versus catchment area .

- **Nasho Block (B3)**

The command area is made of large area of agriculture farms and the dominant crop is banana plantation. Many of these private agriculture farms practice improved intensive agriculture with irrigation. There are also farms of Moringa plantation (*Moringa oleifera*). Most of these private farms are located near Nasho Lake and are separated from the lake a small stretch of a lake ripaline wetland. The upper part (far from the lake) is made of agriculture fields of a mix of cassava and maize.



Lannea schimperi



Euphorbia tirucalli



Mimosa pigra



Phragmites mauritanicus

Ihema Block (B2)

The command area is made of large agriculture fields with scattered banana plantation and other perennial crops mainly cassava; as you move away from the wetland. The area close to the wetland are humid and comprise of crops such as maize, sweet potatoes, cabbages, tomatoes, etc. In addition, there is a large area in the southeast that is mainly used for cattle grazing. It was noted that the agriculture has been encroaching on the wetland in the recent years.



Wetland converted into agriculture



Banana Plantation



Moringa plantation (*Moringa*



Maesa lanceolata

- **Kibare Block (B1)**

Most of the agriculture land located away of lake and wetland was abandoned due to droughts. As you move towards the lake and wetland, the land is dominated by banana plantation with scattered perennial crops such as cassava. Same areas are wetlands transformed ether into cattle keeping area or agriculture land. Similar to other blocks, in the catchment area the palnt species are is dominated by Papyrus reed in wetland (*Cyperus papyrus*) and some scattered *Phoenix reclinata* at its boundaries.



Wetland with natural vegetation around Kibare Lake



Agriculture land almost abandoned due to droughts around Kibare



Acacia sieberiana



Pennisetum clandestinum

Table 37: List of plant species recorded in Command area Catchment

No.	Block	Order	Family	Scientific name	Vernacular	IUCN Conservation Status
1	B1, B2, B3	Commelinales	Pontederiaceae	<i>Eichornia crassipes</i>	Amarebe	Not assessed
2	B2, B3	Fagales	Myricaceae	<i>Myrica kandtiana</i>		-
3	B1,B2	Fabales	Fabaceae	<i>Sesbania sesban</i>		Least Concern
4	B1, B2, B3	Fabales	Fabaceae	<i>Aeschynomene elaphroxylon</i>		-
5	B1, B2, B3	Fabales	Fabaceae	<i>Mimosa pigra</i>	Umuguha	Least Concern
6	B1, B2, B3	Poales	Cyperaceae	<i>Cyperus papyrus</i>	Urufunzo	Least Concern
7	B1, B2, B3	Arecales	Arecaeae	<i>Phoenix reclinata</i>	Umukindo	Least Concern
8	B1, B2, B3	Poales	Poaceae	<i>Phragmites mauritianus</i>		Least Concern
9	B1, B3	Myrtales	Myritaceae	<i>Syzygium cordatum</i>		Least Concern

No.	Block	Order	Family	Scientific name	Vernacular	IUCN Conservation Status
10	B2	Poales	Poaceae	<i>Pennisetum clandestinum</i>	Umucaca	Least Concern
11	B1, B2, B3	Proteales	Proteaceae	<i>Grevillea robusta</i>	Gereveriya	Not assessed
13	B1	Lamiales	Verbenaceae	<i>Lantana camara</i>	Umuhengeri	Not assessed
14	B1, B2, B3	Malpighiales	Euphorbiaceae	<i>Euphorbia tirucalli</i>	Umuyenzi	Least Concern
15	B3	Brassicales	Moringaceae	<i>Moringa oleifera</i>	Moringa	-
16	B1, B2	Poales	Poaceae	<i>Sporobolus pyramidalis</i>		-
17	B1, B2, B3	Fabales	Fabaceae	<i>Acacia Sieberiana</i>	Umunyinya	Least Concern
18	B1, B2, B3	Fabales	Fabaceae	<i>Acacia polyacantha</i>	Umunyinya	-
19	B1, B3	Sapindales	Anacardiaceae	<i>Lannea schimperi</i>	Umumuna	-
20	B1, B3	Mavales	Malvaceae	<i>Grewia similis</i>	Umukoma	-
21	B1, B3	Ericales	Primulaceae	<i>Maesa lanceolata</i>	Umuhanga	Least Concern
23	B1, B2, B3	Zingiberales	Musaceae	<i>Musa spp.</i>	Insina	Not assessed
24	B1, B2, B3	Sapindales	Anacardiaceae	<i>Mangifera indica</i>	Umwembe	Not assessed
25	B1, B2, B3	Malpighiales	Euphorbiaceae	<i>Manihot esculenta</i>	Umwumbati	-
26	B1, B2, B3	Poales	Poaceae	<i>Zea mays</i>	Ikigoli	Least Concern
27	B3	Solanales	Solanaceae	<i>Solanum lycopersicum</i>	Inyanya	
28	B2	Brassicales	Brassicaceae	<i>Brassica oleracea</i>	Ishu	-
29	B3	Solanales	Solanaceae	<i>Nicotiana tabacum</i>	Itabi	-

Source: Field observation, 2020

4.5.5. Ecological baseline in Akagera Wetlands Complex

The Akagera Wetland Complex (AWC) is situated south of the Akagera National Park in the Akagera valley at about 1,300 m in elevation, and consists of several lakes (Nasho, Ihema, Kibare Cyambwe, Mpanga) and part of the Akagera River. The water supply for these lakes is derived from the Nyabarongo/Akagera River, which then continues towards Lake Victoria. This area is an important contributor to hydrological area of the Akagera/Nile system, and provides an important marshland area for local communities to fish, farm, and collect other marshland products (Rwanda NBSAP, 2016). The geological base consists mainly of Precambrian granitic and quartzitic rocks. (Wetlands Biodiversity Inventory, 2011).

The project area specifically includes the administrative sectors Ndego and Kabare Sectors of the Kayonza District. Communities in this sector are directly reliant on the wetland's resources for their livelihoods. The study area is part of the broader Lower Akagera Catchment area, which commences at the overflow of Rusumo falls and follows the Akagera River north along the Rwanda and Tanzania border. It is an area that has been proposed by the government of Rwanda to become a Ramsar site (Prime Minister's Order No 006/03 of 30/01).

Prior to the 1980s, this area remained largely untouched, and was home to large swamps and dry forests with high species diversity. Following the genocide against the Tutsi in 1994, however, returning refugees settling in the area have resulted in heavy pressure on the ecosystem, causing a near complete deforestation in the area. Agriculture, cattle grazing, aquaculture, and the collection of building materials have depleted the landscape, leading to a reduction in the benefits derived by the neighbouring communities.

In 2010, REMA listed and mapped all wetlands in the country and assigned them various protection levels: i) total protection where no activities are allowed to take place; ii) conditional exploitation which requires a basic environmental and social impact assessment to be carried out, and for which the EIA licence issued by the Rwanda Development Board stipulates the conditions and types of activities that are permitted to be conducted in those wetlands; and iii) unconditional exploitation which allows use under given conditions.

Proposed irrigation schemes will draw water from lakes Kibare and Nasho surrounded by conditional use wetlands. Only Ihema block is bordering Ihema lake and its wetland which is under total protection.

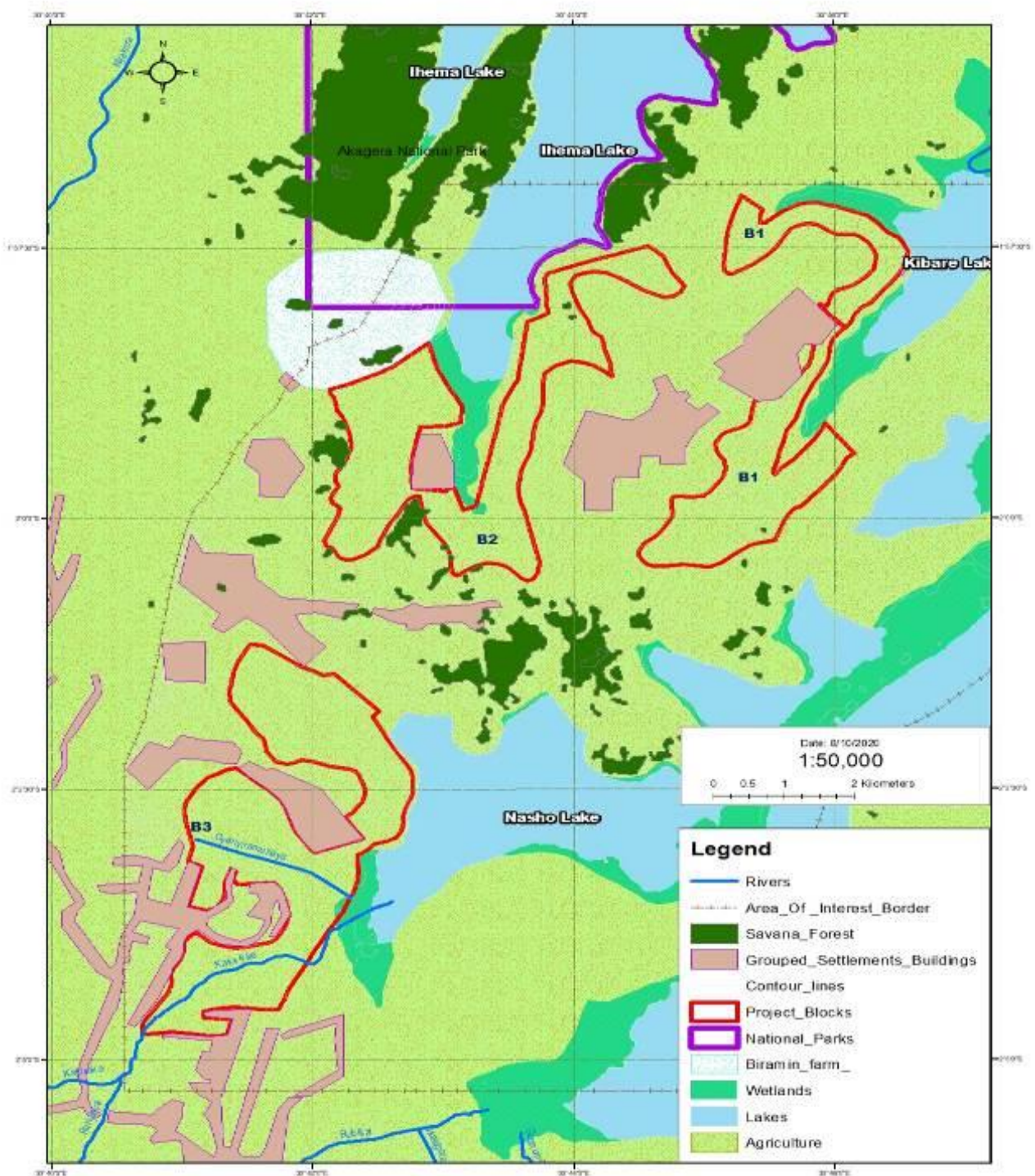


Figure 35: Wetlands identified in targeted area

From the above map, it is clear that command area is delineated on the edge of wetlands. Ihema block is bordering the Ihema wetland which is under full protection and it is recommended to avoid any encroachment and a buffer zone of at least 50m should be provided during detailed study. Nasho and Kibare blocks touch also on wetlands under conditional use. It is also recommended to provide a buffer zone of at least 50m as required by national regulations.

It is also important to indicate that the project is near the, Akagera National Park (ANP). The ANP lies between the northern border of the project area (Ihema block being the closest with less than 0.5km) and the western border of Tanzania with Rwanda, which is demarcated by the Akagera River. The park has a rich biodiversity due to its varied ecosystems including six forest fringed lakes, the largest protected wetland in Central Africa, savannah plains, the Akagera River and the Mutumba Hills reaching an altitude of nearly 2,000 m asl. The ANP originally covered an area of more than 2,500 sq km. However, following the civil strife, a number of refugees settled around the park, and as a result, the wildlife populations were severely

affected by poaching for meat, and due to clearing for cultivation. In 1997 the park area was reduced by about 50% of its total area (1,200 sq. km remaining) to provide land to returning refugees.

4.5.5.1. Flora and vegetation

The savannah vegetation in the area comprises a mosaic of grassland, broadleaved and/or deciduous shrub land and forest. The grass savannah is dominated by *Themeda triandra*, *Hyparrhenia* sp., with *Sporobolus pyramidalis* and *Botriochloa insculpta*. *Acacia* species are the most common trees found in the forest savannah; these include *Acacia senegal*, *Acacia Sieberiana*, *Acacia polyacantha*, *Acacia campylacantha*, *Acacia gerardii* and *Acacia brevispica*. There are also some rare or threatened species that can also be found, such as *Acacia kirkii*, *Impatiens irvingii*, *Markhamia lutea*, *Eulophia guineensis*, *Erythrina abyssinica* and *Pterygota mildbraedii*.

The wetland vegetation is dominated by Papyrus reed (*Cyperus papyrus*) and Phragmites (*Phragmites mauritanus*), and reeds such as *Echinochloetum pyramidalis* and *Cyperetum latifolii*. Shrubs along the swamp edges are characterised by *Syzygium cordatum* and *Myrica kandtiana*, while along the lake and river edges, *Sesbania sesban* and *Phoenix reclinata*, *Aeschynomene elaphroxylon* and *Mimosa pigra* are dominant. Aquatic plants occurring in the open water surfaces are *Nymphaea* spp, *Ceratophylletum demersi*, *Azolla nilotica* and *Eichhornia crassipes* (Water Hyacinth). Fischer (2011) prepared a biodiversity inventory for various important wetlands in Rwanda. He notes that within the Akagera wetland complex south of the Akagera National Park, there are a total of 77 vascular plants of which two are endangered orchid species (*Eulophia angolensis* and *Eulophia guineensis*).

- Plant communities

In Akagera wetland, the swamp is covered by Papyrus reed classified as *Cypero papyri-Dryopteridetum gongylodis* which forms a species-poor plant community with dominating *Cyperus papyrus*. Other reed communities are the *Phragmitetum mauritiani* with dominating *Phragmites mauritanus*, the *Echinochloetum pyramidalis* and the *Cyperetum latifolii*. Another community dominated by small shrubs is characterized by *Syzygium cordatum* and *Myrica kandtiana*. Along the lakes, a community with *Sesbania sesban* and *Phoenix reclinata* is developed (*Sesbanio-Phoenixetum reclinatae*). Also stands of *Aeschynomene elaphroxylon* and *Mimosa pigra* occur. The open water surfaces are colonized by communities of aquatic plants, e.g. the *Nymphaetum calliantho-mildbraedii* with *Nymphaea lotus* and *Nymphaea nouchalii*, and the *Ceratophylletum demersi*. Free floating species are *Azolla nilotica* and the neophytic *Eichhornia crassipes*.

- Flora of vascular plants

A total of 77 vascular plant species has been recorded in the Akagera Complex. Also no Albertine Rift Endemic could be observed.

- Endemic and/or remarkable species

Two remarkable and endangered orchid species, *Eulophia angolensis* and *Eulophia guineensis*, occur in the Akagera Complex. Especially *Eulophia angolensis* is restricted to swamps and reed habitats. The species was formerly widespread in Rwanda, but is rapidly declining actually due to swamp draining and conversion into agricultural landscape.

4.5.5.2. Fauna

Akagera Wetland Complex wetlands provide unique habitats for a number of faunal species. Fischer (2011) recorded 16 amphibian species, of which two species of frogs (*Phrynomantis bifasciatus* and *Hylarana albolabris*) do not occur elsewhere in Rwanda, and a newly identified frog species (*Phrynobatrachus* spp) is possibly endemic to the Albertine Rift. In addition, 13 reptiles species; 54 bird species of which the Papyrus Yellow Warbler (*Chloropeta gracilirostris*) is vulnerable and the Papyrus Gonolek (*Laniarius mufumbiri*) is near threatened; 11 mammal species, of which the Hippo (*Hippopotamus amphibious*) is vulnerable.

Akagera National Park is home to 23 mammal species including 12 species of antelope, 3 species of carnivores including lion, leopard both vulnerable on IUCN red list and hyena, and 3 species of primate. In addition, 4 species are of the high conservation importance including the recent introduced Eastern Black Rhinoceros (*Diceros bicornis ssp. Michaeli*) which is Critically Endangered on the IUCN red list; African Elephant (*Loxodonta Africana*), Giraffe (*Giraffa camelopardalis*) and Hippopotamus (*Hippopotamus amphibious*) all Vulnerable on the IUCN red list.

Concerning fish biodiversity, it was found that 21 species inhabit akagera Complex . Among these fish species reported in the upper Akagera sub-basin: 2 species are endemic to upper Akagera system (*Barbus acuticeps*

and *Synodontis ruandae*); 6 species are native to the sub-basin (*Barbus kerstenii*, *Barbus acuticeps*, *Haplochromis* Sp, *Synodontis ruandae*, *Clarias liocephalus* and *Mastacembelus frenatus*; 9 species were introduced in the sub-basin (*Astatoreochromis alluaudi*, *Haplochromis burtoni*, *Oreochromis leucostictus*, *Oreochromis macrochir*, *Oreochromis niloticus*, *Tilapia rendalli*, *Clarias gariepinus*, *Cyprinus carpio* and *Protopterus aethiopicus*); 2 species are probably going to be extinct in the lake (*Oreochromis macrochir* and *Barbus kerstenii*); 1 species is currently not seen in the lake although still in the neighboring Akanyaru River (*Synodontis ruandae*).

- **Amphibian species recorded**

16 Species have been recorded in the Akagera Complex, one taxon is a possible Albertine Rift Endemic.

- **Endemic and/or remarkable species *Africalusquadrivittatus***

The small tree frog is easily recognized by its dorsal pattern which consists of four dark longitudinal lines – hence the scientific name. The species is commonly encountered in the lower elevations (< 1800 m a.s.l.) of Eastern Rwanda and is widespread in Central Africa. Individuals are found along the edges of ponds and other lentic water bodies. The eggs are laid on a leaf and then the leaf is folded around the eggs and its edges are glued together. *Amietophrynus regularis* One of the most commonly encountered toads of the lower elevations (<1800 m a.s.l.) of Rwanda, *A. regularis* can be found all over the country in natural as well as in cultivated areas. At higher elevations, it appears to be replaced by *A. kisoensis*. There are a few localities in Rwanda where both species occur syntopically. *A. regularis* is a large toad, with males reaching a body length of up to 90 mm, females to 120 mm. It can be distinguished from *A. kisoensis* by the more rounded snout, less extensively webbed toes, larger size, and colouration. Eggs are deposited in lentic water bodies.



Figure 36: *Hyperolius acuticeps* (above left), *Hyperolius kivuensis* (above right)

- ***Hylarana albolabris***

A comparatively large frog, reaching a body length of 57 mm in males, 74 mm in females. The back is brown with small dark spots. The edges of the mouth are white, hence the name. In Rwanda, it is known only from the Akagera region. Otherwise it is widespread in western and Central Africa.

- ***Hylarana galamensis***

This species is larger than *H. albolabris*, reaching a body length of 78 mm in males and 86 in females. The basic colouration of the back is black but there is a broad golden band on each side of the body and many more irregularly shaped blotches of the same colour between the bands. This is distributed in the savannah belt from Senegal to Ethiopia and then southwards to Mozambique. In Rwanda it is only known from the Akagera region.

- ***Hyperolius acuticeps***

A very small species of the genus with a green back and a fine white to yellowish dorsolateral line running along each side of the body. The snout is long and sharp. The species belongs to a complex of several cryptic species, the systematics of which is currently under investigation. The form occurring in Rwanda is found in the lower parts of Eastern Rwanda and is otherwise known from several locations in the Great Lakes region.

- ***Hyperolius kivuensis***

A medium sized tree frog (males up to 30 mm, females 38 mm). Two colour morphs exist, a greyish-brown one and a more common green one. This species is commonly found in swamps in natural as well as cultivated areas. The swamp at the Rugezi site is the highest known distribution locality of this species in Rwanda. *Hyperolius kivuensis* is found in Eastern and Southeastern Africa from Ethiopia to Mozambique and Angola

- ***Hyperolius lateralis***

This species is a small tree frog, reaching a body length of about 25 mm. The back is either green or brown and a broad light line runs along each side of the body from the nostril to the groin. The species is distributed in the Great Lakes region, in swamps at elevations of up to 2000 m a.s.l. *Hyperolius lateralis* is ecologically very similar to *H. castaneus* and is replaced by this species at higher altitudes.

4.5.5.3. Reptiles

- **Reptile species recorded**

A total of 13 reptile species has been recorded, among them no Albertine Rift Endemic. Endemic and/or remarkable species include *Bitis arietans* – Puff Adder, *Chamaeleo anchietae* – Angolan Chameleon, *Crocodylus niloticus*, *Crocodylus niloticus*, *Dasypeltis scabra*, *Grayia tholloni* – Thollon's Water Snake, *Naja melanoleuca* – Forest Cobra, Black-necked Spitting Cobra, *Psammophis mossambicus* – Olive Sand Snake, *Python sebae* – Central African Rock Python, *Trioceros ellioti* – Montane Side-striped Chameleon, *Varanus niloticus* – Nile Monitor



Figure 37: *Chamaeleo anchietae* (above), *Varanus niloticus* (middle), *Crocodylus niloticus* (below).

4.5.5.4. Avifauna

The avifauna is very rich and includes 530 species, two thirds of them inhabiting the wetland complex within the park (Kanyambwa quoted by EXPERCO, 2003). Among bird species identified in Akagera Complex only two species are listed as threatened. *Laniarius mufumbiri* (papyrus gonolek) is classified as near threatened worldwide while *Balearica regulorum* (umusambi/Grey Crowned Crane) is classified as endangered (EN A2acd+4acd). It is well documented that their habitat is dramatically decreasing in Rwanda, likely due to agricultural pressure. The Akagera Wetland Complex, however, is ideal habitat for the species should be wisely managed for its protection. Although the Shoebill (*Balaeniceps rex*) has not yet been recorded in the previous inventories, anecdotal evidence collected from the local population revealed their

presence in the project area. The species is listed vulnerable by IUCN as the size of its population has declined from 5,300 to 3,300 individuals remaining globally. List of bird species identified in the project area is presented in annex1

Endemic and/or remarkable species: Beside *Laniarius mufumbiri*, the Papyrus Yellow Warbler *Chloropeta gracilirostris* has been recorded. It is olive green with a yellow underside and up to 14 cm long. It occurs in dense *Papyrus* thickets and has a local distribution from Eastern Congo, Rwanda, Burundi to South-western Uganda and South-western Kenya and North-western Tanzania. The species is listed as vulnerable due to habitat destruction.



The best way to avoid disturbing birds is to schedule activities outside the nesting season. The nesting season is not the same for all species, and not all sites will have nesting birds present during the entire nesting season.

- **Non-nesting Season: August 1 – January 31** is the best time to plan for tree removal, invasive plant species management, and grubbing and clearing. The nesting season can be divided into two major time-frames:

- **Early Nesting Season: February 1 – April 15** is the early nesting season. Disturbance to vegetation, especially trees, should be avoided during this time. Raptors (owls, eagles, falcons and hawks), herons, geese, and hummingbirds are early nesters. Great-horned owls are exceptionally early nesters and may lay eggs in January. Many early nesters have longer breeding cycles and most will not complete breeding until June or July.
- **Primary Nesting Season: April 15 – July 31** is the primary nesting season. Disturbance to vegetation should be avoided during this time. This includes songbirds and the majority of species. Willow flycatchers are late nesters, often extending to the end of August. As they leave the nest, young birds go

through the fledgling phase. They are often seen on the ground, flightless and unable to fend for themselves, however the adults are nearby and tending to them. June and July are peak months for fledgling activity. They often take shelter in low vegetation and are highly vulnerable to a variety of human disturbances at this critical time.

- **Nesting Habitats**

- **Trees:** Stick nests of hawks, crows, and jays placed in tree canopies are among the most conspicuous and familiar signs of nesting birds. These are the easiest to detect and the easiest to avoid.
- **Shrubs:** The majority of nesting birds build a cup nest in dense vegetation in the shrub layer, often close to the ground. These species – sometimes called “tangle nesters” – complicate reasonable efforts to avoid taking protected birds. Willow flycatcher, a species in decline.
- **Ground:** Many species place a well concealed nest on the ground in either open areas or forested habitats. Examples include meadowlarks, harriers, killdeer and Wilson’s warblers.
- **Cavity:** Rather than concealing a nest in vegetation, dozens of local species use cavities. These are often in dead or dying trees, but can also be in the ground or in a variety of structures in the urban environment. Tree swallows, Bewick’s wrens and downy woodpeckers are common cavity nesters.
- **Stream banks:** The northern rough-winged swallow and the belted kingfisher are “cut bank” nesters, meaning they use holes excavated in stream banks for nesting. Sometimes they even use holes on steep slopes of dirt stock piles.
- **Structures:** Many birds use human-made structures for nesting. In addition to using bird boxes that are intended for such use, birds will nest on bridges, under house eaves and on building ledges



Figure 38: Birds nests observed during Filed survey in June 2020

4.5.5.5. Mammals

A total of 11 mammal species has been recorded from the Akagera Complex . No Albertine Rift Endemic has been recorded and no species is IUCN listed. As these swamps are situated outside Akagera National Park, the density of large mammals is low. However, there are still considerable populations of Hippopotamus.

4.5.6. Lake Biodiversity

- **Flora**

Lake Kibare and Nasho like other lakes in Akagera Complex are quite rich in biodiversity: the phytoplankton consists mainly of chlorophyceae, cynophyceae and diatomophyceae. The flora is dominated mainly by Cyperus, Phragmites, Phoenix, Potamogeton, Aeschynomene, Thelypteris, etc. Water hyacinth (Eichhornia crassipes) is present and has started covering big areas of the lakes, representing a threat to their biological diversity.

The flora is dominated by the papyrus (Cyperus papyrus) mixed with Miscandium violaceum and Nymphaea nouchallii. The dominating species are those of the genus of Phoenix, Bridelia, Ficus, Aeschynomene and Echinochloa. The fish fauna consists of several aboriginal and fluvial species. Lake Rwampanga is distinctly richer in fish species than the other two. There is also the presence of hippopotamuses and crocodiles given their direct connection with the river Akagera. The ornithologic fauna found in the Akagera National Park is also found in the lakes that in fact constitute its continuity

- **Fauna**

Both lakes are among the richest in fish species in the whole country, and considerable populations of haplochromis and other fluvial species are dominant (Plisner, 1990; Micha and Frank, 1991). The ornithologic fauna represents 2/3 of the birds species found in the park (more than 300 species) and there are also species of migratory birds from Europe and other African countries. Some lakes, such as lakes Cyambwe, Rwampanga and Rweru are particularly rich in hippopotamuses and crocodiles. The lakes of Nasho basin have a very rich phytoplankton in biodiversity.

Based on field observation, consultation with Fishermen and local it is clear that the project area is home to species of international importance such as the *Labeo victorianus* (Ningu), ranked in the IUCN category of critically endangered (CR) fish species. In addition, *Synodontis ruandae*, a fish species endemic to the Akagera River System, is classified as vulnerable. In addition, many other fish species in the AWC are predicted to be locally threatened, although a complete assessment has not yet been conducted. For instance, the species such as *Oreochromis niloticus* are threatened by the predation from *Protopterus aethiopicus*. The same applies for smaller fish such as *Schilbe intermedius* whose production is dramatically decreasing in the area. All three lakes have same ecosystem and almost same species composition. Three main fish species are found in all three lakes.

a) *Oreochromis niloticus*

Also called “Miracle fish”, the Nile Tilapia *Oreochromis niloticus* is the most cultured and consumed fish worldwide. In fact, every 100 grams of Tilapia raw meat contains 19.2 g protein, 2 g fat, 100 calories, huge amount of calcium and 400g Omega-3 fatty acids²³. *O. niloticus* constitutes a species of economic importance and appreciated by consumers. Two decades ago, the species dominated in all fisheries’ catches. Fishermen interviewed have declared that fish stocks of larger planktivorous such as *O. niloticus* have seriously declined, principally due to overfishing and predation pressures. The productivity of Tilapia is continuously decreasing due to a number of factors predation by *Protopterus aethiopicus* (Imamba). Flooding has also been a serious problem to Tilapia productivity in Akagera wetlands complex. The most critical fall of productivity occurred in 2018 after the flooding that has even taken human lives in Nasho sector. Not only Tilapia fish have been killed but also the flooding has jeopardized their reproduction ability.

In lakes, adults forage in semi littoral and pelagic zones, but the species inhabits mostly littoral zones within habitats covered by shallow water and vegetation. In rivers, *O. niloticus* forages in vegetation zones, open water of ponds and channels. *Oreochromis niloticus* is a micro-phytoplankton feeder. The species filters suspended phytoplankton, its principal food item, especially at adult stage.

b) *Labeo niloticus*

Labeo niloticus is common in the rivers and lakes of East Africa down to Egypt in the Whole Nile Basin. It contributes to about 2% of the total fish catch from Nile River in Egypt. The species is predominantly herbivorous eating primarily diatoms and algae and secondarily some invertebrates associated to plankton. The species spawns in running water inside Akagera river.

c) *Protopterus aethiopicus*

Protopterus aethiopicus, locally known as Imamba is a lungfish in the family Protopteridae. It is found in the several African countries including East Africa. This species was introduced in Rwanda in Lake Muhazi in 1979 from Lake Edward. Fishermen confirmed a high presence of this species in all Eastern lakes and rivers (Akagera rivers). Literature and experienced fishermen confirm that this species prefer the littoral zones of lakes and rivers shores dominated by papyrus in most of the lakes. Adults of *Protopterus aethiopicus* live mainly in swamps, riverbeds and floodplains. The juvenile members of the species often live in between roots of papyrus plants. Despite being aquatic, adult *Protopterus aethiopicus* can live in riverbeds and other areas that have no rain for portions of the year due to their ability to estivate or burrow in the ground to form an air bubble and breathe out of a hole in the cocoon thus formed. *P. aethiopicus* is an invasive species, status confirmed by IUCN and needs more attention as it has already destroyed number of fish species in the eastern Province of Rwanda though it is a good source of proteins. However, local people do not prefer the species due to its snake-like.

d) *Schilbe intermedius*: Silver catfish/Sola/Ndera

Schilbe intermedius or silver catfish is a small (10-12 cm) fish species of the family of Schilbeidae.



It is naturally distributed in middle Akagera, but actually widespread in the whole Akagera wetland complex. The species is economically important as it is commercialized in the whole Akagera wetland complex. The species has potentially economic importance in the region, because the population greatly appreciates the good taste of the meat, but the quantity of fish usually caught remains unsatisfactory for market demand. Outside Rwanda, the species has a wide distribution, with no major threats for its conservation. Based on the fishermen's assertions, the population of *Schilbe intermedius* has declined since a two or three decades probably due to predation and habitat loss.

S. intermedius has been introduced in Lake Mugesera from Jinja / Lake Victoria in 1962 (De Vos, 1995). Nowadays, the species has colonized all aquatic ecosystems in the eastern part of Rwanda including Kibare, Ihema and Nasho. In lakes, *Schilbe intermedius* usually forages in pelagic zones, and during rainy season the species migrates in rivers and floodplain areas for reproduction. At juvenile and sub-adult stages, the species feeds on crabs and aquatic insects' larvae, while adult individuals consume principally small fishes, crustaceans and insects.

• ***Gnathonemus longibarbis*- ong snout Bulldog-Imbaraga-Inyamunywa**



Gnathonemus longibarbis is an indigenous species belonging to the family of Mormyridae with very little economic importance. It is widely distributed inside East African lakes including the Akagera complex wetlands. It is not much consumed by local people but it is present in some catches especially in Kibare. In lakes, the species inhabits benthic zones of littoral area or near the mouth of tributary to lake. It is a migratory species, swimming upstream in rivers for reproduction in floodplains. The species is essentially insectivorous at adult stage.

• ***Labeo victorianus*- Victoria Labeo-Iningu**



Labeo victorianus or *iningu* is a very small fish belonging to the Cyprinidae family with no economic importance in the neighbourhood of Akagera wetland complex. Usually, the species inhabits shallow inshore waters and the mouth of influent rivers. During rainy season, it spawns within floodplains covered by short vegetation. The species is principally a benthic algal feeder. Its food items comprise also macrophytes and detritus.

Table 38: List of fish species identified in Akagera Complex

No	Species	Vulnerable	Endangered	Critically Endangered	Least Concern
1	Bagrusdocmak				LC 3.1.
2	Mastacembelusfrenatus				LC 3.1.
3	Clariasliocephalus				LC 3.1.
4	Marcuseniusvictoriae				LC 3.1.
5	Pollimyrus nigricans				LC 3.1.
6	Brycinusjacksonii				LC 3.1.
7	Labeovictorianus			CR A2acde ver 3.1	
8	Synodontisafrofischeri				LC 3.1.
9	Petrocephaluscatostoma				LC 3.1.
10	Oreochromis niloticus				LC 3.1.
11	Clariasgariepinus				LC 3.1.
12	Barbuspaludinosus				LC 3.1.
13	Synodontisrwandae	VU D2 ver 3.1			
14	Gnathonemuslongibarbis				LC 3.1.
15	Protopterusathiopticus				LC 3.1.
16	Schilbe intermedius				LC 3.1.

Source: Field survey 2020

- **Commercial and domestic fishing**

Tilapia, Lungfish, African catfish species constitute the major fish catches and constitute major income source to the community in the area as mentioned by the President of the Cooperative (COVIPE). On Lake Kibare and Nasho, there is one fishing cooperative (COVIPE) operating there. Other community member are also fishing on individual basis but illegally. For example, the total fish catch for the period of July 2018 – June 2019 was around 52 tones, all fish species included. COVIPE has 68 members including 17 women and 51 men.

Table 39: Fish catch per fish type in all three lakes

Common Name	Vernacular Name	Scientific Name	Fish Catch July 2019 - June 2020 (in Kgs)
Tilapia	Ingege	<i>Oreochromis niloticus</i>	1,643
Lungfish	Imamba	<i>Protopterus aethiopicus</i>	40,724
African Catfish	Inkuba	<i>Clarias gariepinus</i>	5,230
Other small fishes			4,310
Total fish catch			51,907

Data Source: COVIPE (2020)

4.6. Socio-economic profile of project area

This section provides a description of population's demographic characteristics with respect to population size, household dependency ratios and area population structure. It also provide socio-economic status including source of income, access to social infrastructure and occupation.

4.6.1. Demography of Population in the project area

- **Population in Kayonza District**

Kayonza District is one of 7 Districts making the Eastern Province of Rwanda. As per the 4th population and households' census (2012), the population of Kayonza district totals up 344,157 including 166,720 males (48.4%) and 177,437 females (51.6%). It covers 1,937 km². The population density averages 178 persons/km² and the total number of households is 80,517. The population of Kayonza district is dominated by rural residents (90%) and about 10% of the population lives in urban areas. The Kayonza population is dominated by young residents where 53.7% represent residents under 20 years, 43% of residents lie between 20 and 64 years and 3% of residents are 65 years and above. The average size of the population of Kayonza district is 4.3 persons per household, similar to National and Eastern province figures. Kayonza district also hosted 880 foreigners (0.3% of the district population). The residents of Kayonza district are mostly Protestants (50%), followed by Catholic adherents (32%), Seventh Day Adventists (10.8%), Muslims (3%) and irreligious residents (2.7%).

- **Population in Ndego Sector**

Ndego Sector is one of the 12 administrative Sectors, which form Kayonza District. It extends over an area of 177 km². In reference to the 4th population and households census (2012), the total number of households

(HH) in Ndego sector is 4,542 with corresponding population of 18,918 residents of which 9,241 are male residents (about 49%) and 9,677 are female (51%). It should be noted that Ndego residents are purely rural (100%). The average size of the households is 4.5 persons per household. The population density of Ndego sector is 107 residents/km². The census counted 19 foreigners in 2012 (0.1% of its residents). Among the total residents of Ndego sector, 9,727 were children aged less than 17 years. The Sector is composed of 4 Cells namely Byimana, Isangano, Karambo and Kiyovu and the total number of households per cell is 826; 1,118; 1,205 and 1,393 respectively. The households' survey, through a structured questionnaire, was used to collect information related to respondents' identification (age structure of respondents, education levels, marital status, family size of households, housing conditions. A sample size of 5% of the total household number (i.e 227 households) was used to gather the needed data. The information gathered is presented below:

- **Age structure of respondents**

The survey results on the age structure of respondents in the project area are presented in the following table.

Table 40: Age of respondents

Age of Household Head	Frequency	Percentage
Below 30 years old	11	4.8
Between 31 and 40 years old	52	22.9
Between 41 and 50 years old	89	39.2
Between 51 and 65 years old	53	23.3
Above 65 years old	22	9.7
Total	227	100

Source: Socio-Economic survey, 2020

From the table above, it comes out that the majority of respondents (39.2%) are between 41 and 50 years old, followed by land owners with 51 and 65 years old (23.3%) and 31 and 40 years old category (22.9%). The elders (above 65 years) and youth (below 30 years old) occupy 9.7 and 4.8% respectively.

- **Marital status and gender**

The marital status in the project area is illustrated in the Table below.

Table 41: Marital status of farmers in the project area

Marital status of Household Head	Frequency	Percentage
Single	4	1.8
Married	172	75.7
Widowed	47	20.7
Divorced	4	1.8
Total	227	100

Source: Socio-Economic survey 2020

The good portion of respondents in the project area (75.7%) was married. The single, widowed and divorced respondents occupy 1.8, 20.7 and 1.8% respectively. Out of the interviewed groups, 78% were men and 22% women.

- **Family size of households**

The next table summarizes the family size of the households' respondents. The survey' results indicated that 46.2% of the respondents' families are of medium size (4-6 people) while families with large size (ie above 6 per household) represents 20.6% of the studied population. The average size of the household of respondents in Ndego site is between 4-6.

Table 42 Family size of respondents in the project area

Family size	Frequency (No)	Percentage (%)
Small (2-4)	74	33.2
Medium (4-6)	103	46.2
Large (above 6)	46	20.6
Total	223	100

Source: Socio-Economic survey 2020

Data from the Cells of Ndego Sector indicate that the size of household of Ndego sector was 4.7 people in March 2019 which is 0.2 higher than the one reported in 2012, Census.

4.6.2. Gender and ages of household heads

Although the 52% of the households in all targeted areas are male headed, females head a substantial proportion of households. Notably, the percentage of female-headed households (58%) is higher than the male headed (42%) in Kiyovu cell (Ihema block). The main reason provided for the low number of male headed households in the affected area is attributed to many of the male spouses in the area not residing in their homes but spending most of their time outside the district or across the border in search of better economic

opportunities. Unfortunately, many households report how such spouses rarely return to fend for their households, hence the predominance of female-headed homes.

Table 43: Gender and ages of household heads

Household head's gender	Kibare Block	Ihema block	Nasho Block	Tot. %	Household Head's Age	Years
Male headed households	52.6	42.0	54.3	51.7	Min	18
Female headed households	47.4	58.0	45.7	48.3	Max	90
Total	100.0	100.0	100.0	100.0	Mean	45

Source: Socio-Economic survey 2020

The 607 households surveyed have a total of 2,2763 people residing in the homes with an average household size of 4.5 members per household. The household data from the district indicates the affected areas have 6,974 households with a total population of 29,418 people, resulting in an estimated household density of 4.2 members per household. The highest household density is observed in Byimana cell (Nasho Block) with an average household size of 4.4 members.

Regarding the population structure, there are more females (52%) than males (48%) in the affected areas. The targeted area population is generally young with 69% of the population below the age of 30 years and 55% below 20 years. There are no considerable differences in age or gender structure across the three sites. Because of this high population of young people and high number of elderly people, the burden on the working age population is high with the dependency ratio¹⁰ of the affected areas estimated at 77%. Observations and discussions indicate that the inhabitants in the affected area are characterised as a relatively mobile population. For instance, much as the district population records for 2018/19 suggested Ndego sector is inhabited by 5,623 households, sector records at the time of the fieldwork indicated 4,638 households inhabit the area. Many respondents describe the affected areas in Ndego as inhabited by many citizens that were resettled by the GoR after returning to Rwanda from mainly the neighbouring countries of Uganda and Tanzania. As such, the population in the area varies all year round with many migrating in and out of the country, especially to Tanzania or across district boundaries, usually depending on the prevailing economic situation in the district associated with the weather and agricultural productivity.

4.6.3. Socio-economic categories and vulnerable people

All households in Rwanda are classified under four socio-economic “Ubudehe” categories to enable national programming and as a mechanism of identifying the social and economic wellbeing of citizens in order to inform national programmes such as the social protection support programme “VUP”. Ubudehe category one is the most vulnerable and four is the most well-off category. These categories are being revised and new grouping will be established. The national socio-economic categorisation of citizens and households was used to benchmark levels of vulnerability within the affected households. In addition, the numbers of households receiving social protection support packages as well as presence of people living with disabilities (PWDs) are used to identify and estimate the vulnerability levels within the targeted households.

Table 44: Socio-economic categories of households in the affected area

Ubudehe categories	Kibare Block	Ihema block	Nasho Block	Tot. %
One ¹⁴	13.7	6.0	10.6	10.9
Two ¹⁵	38.3	29.0	23.8	29.3
Three ¹⁶	48.0	65.0	65.6	59.8
Four ¹⁷	0.0	0.0	0.0	0.0
Do not know	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0

Source: Socio-Economic survey, 2020

¹⁴ Families who do not own a house or cannot pay a rent, have a poor diet and can hardly afford basic household tools and clothes

¹⁵ Have a dwelling of their own or are able to rent one, mostly get food and wages from working for others but rarely get full time jobs

¹⁶ Those who have a job and farmers who go beyond subsistence farming to produce a surplus that can be sold;

¹⁷ Includes people who earn high incomes; people who own houses; people who can afford a luxurious lifestyle, (not targeted by KIIWP)

Table 45: Social Protection Support

Support received	Kibare Block	Ihema block	Nasho Block	Tot. %
Receive VUP Support	10.2	6.0	7.70	8.2
Registered in FARG	1.5	0.0	1.60	1.3
Have health insurance	84.7	84.0	83.90	84.2
People living with disabilities				
Households with PWDs (%)	21.4	21.0	19.9	20.1
Adults with disabilities in households (#)	40	16	50	106
Children with disabilities in households (#)	12	9	18	39

Source: Socio-Economic survey, 2020

From the above tables, 40% of the households in the affected area are in the two poorest Ubudehe categories, while 60% are in the Ubudehe category three. Although the majority of the households are in category three and it was observed that many of them still live in noticeably vulnerable conditions. The main reason the category three households are classified under this grouping is because many of them own farmland, personal houses and have household members of working age. The household survey findings are consistent with the Ndego sector office records that indicate that 1,976 (8%) people are in category one, 5,924 (25%) in category two and 15,497 (66%) are in category three.

Furthermore, at least 8.2% of the households in the affected area confirm having received VUP support, specifically direct financial support, in the last one year while 1.3% of the affected households report being registered under the Fund for Neediest Survivors of Genocide in Rwanda “FARG” and receive various kinds of financial and material support. Records from the “Ibuka” Association of survivors in the areas indicate FARG has 54 registered members, with 11 who have no certificates. The affected area has a considerable number of cases of people with disabilities (PWDs), both physical and mental disabilities are present. 20% of the households in the affected area report having at least one household member living with a disability. A total of 145 individuals were identified of which 106 are adults and 39 are children. Most of the PWDs, especially among the younger population are cases of birth deformities such as the blind and deaf cases observed. Although there is indication of high levels of poverty among the affected households, there is high uptake of health insurance with 84% of the households having health insurance. This is mostly attributed to support received by the poorest categories to access health insurance and the relative affordability of the national Community Based Health Insurance Scheme “Mutuel” (CBHI).

Using the simple Poverty Probability Index (PPI) Scorecard (poverty assessment tool) based on the 2010/11 national integrated household living standards survey (EICV 3), the SEB estimates the proportions of households with the likelihood of having consumption below Rwanda’s national poverty line¹². As shown in Table 10 above, 100% of the households in the affected area have between 90.3% and 0% likelihood of being below the national poverty line. Therefore, the affected area’s group average poverty rate¹³ is estimated at 27.0%. The poverty rate is highest within Kibare site (Isangano and Karambi) at 29.5% and lowest in ihema

The national poverty line (sometimes called here “100% of the national line”) is the average total consumption for households whose actual food consumption is within ± 10 percent of the food line. For Rwanda on average during the 2010/11 EICV, this is RWF 402 per adult equivalent per day. no PPI scorecard has yet been developed or published for use based in the EICV5 data/prices, so all local poverty analysis (PPI) to date is based on the EICV3¹⁸. Poverty rate of a group = $\text{Sum (corresponding \% Probability} \times \# \text{ of Households with PPI Score corresponding to \% Probability)} \div \# \text{ of households with \% probability between 90.3\% and 0.9\% site (Kiyovu) at 21.8\%}$. The poverty rate estimates of the affected communities reached are consistent with the national reported Kayonza poverty rates of 26.7% and 8.5% for extreme poverty¹⁴. This high level of extreme poverty can be attributed to extreme weather patterns that have affected their agricultural productivity and household incomes that remain markedly lower than most national statistics such as the current annual GDP per capita currently estimated at 748.39 USD per annum.

4.6.4. Education status

As shown in the next Table below, the household heads’ levels of education in almost all the areas is very low with 92% of the heads having either only primary education levels or no education at all. Less than 2% of the household heads have either completed secondary education or have any tertiary education certification. However a considerable proportion (44%) of the household heads in Kibare (Isangano and Karambi) report

¹⁸ http://www.simplepovertyscorecard.com/RWA_2010_ENG.pdf

having completed at least primary education. Overall the level of education among the affected communities is very low.

Table 46: Household heads' levels of education

Level of education	Kibare	Ihema	Nasho	Tot. %
No education	31.0	28.0	35.7	32.9
Primary education	43.5	30.0	37.7	38.2
Primary Education drop out	21.4	30.0	18.3	21.3
Partial secondary	3.1	9.0	6.1	5.6
Completed secondary	0.5	1.0	1.6	1.2
Tertiary (college/ University)	0.5	2.0	0.6	0.8
Others	0.0	0.0	0.00	0.0
Total	100.0	100.0	100.0	100.0

Source: Socio-Economic survey, 2020

4.6.5. Occupation Patterns

56% of the households in all sites consider crop production and livestock with some cropping (28%) as their main economic activity. The highest proportion of crop producers are identified in Humure (59%) and Byimana (58%) sites (Table 12). Many of these are small-scale cereal and legume growers. There are only a few (1.3%) sole-livestock farmers mainly located in Humure (3%). Off-farm employment is observed mainly among households in the Kibare site (6%) located close to trading centres in Isangano and Karambi. Other significant observations include in all sites where despite most households mentioning cropping only as their main occupation, there is a considerable proportion of casual labourers and land squatters occupying land that belongs to individuals that do not reside in the affected areas who are taking advantage of the fertile land to cultivate seasonal crops to sustain their livelihoods. The presence of households residing temporarily on land within the target areas could complicate project implementation as they in some instances will not have the rights to plant for example long term trees as most of their agreements with landowners may only permit growing annual crops.

Also, although very few households report having no off-farm employment, during the FGDs it is observed that a considerable number of households engage in off-farm activities, such as public bicycle transport, retail trade, sand mining and fishing from the lakes and others but they do not acknowledge these occupations during the survey focusing instead on crop production.

Table 47: Main occupation of household heads

Occupations %	Kibare	Ihema	Nasho	Tot. %
Cropping only	52.0	59.0	58.2	56.3
Livestock only	2.0	3.0	0.3	1.3
Cropping with some livestock	3.1	1.0	0.6	1.5
Livestock with some cropping	28.6	24.0	29.3	28.2
Off-farm employment	6.1	4.0	3.2	4.3
Other	8.2	9.0	8.4	8.4
Total	100.0	100.0	100.0	100.0

Source: Socio-Economic survey, 2020

4.6.6. Housing Conditions

The nature of housing, determined by types of building materials, is a reliable measure of poverty, deprivation, social exclusion and standard of living. The collected information on the types of building material used for housing in particular with regard to roofing material, walls, floors and nature of sanitary facilities. The next table indicates that at least 11% of the houses use clay tiles as roofing material, which is a cheaply available building material usually obtained from swamps and moulded by household members. Clay roofs are also characteristic of lower economic categories in the general population. 89% of the households in the affected area live in houses with iron sheet roofs. Many of the houses' walls (43%) are constructed out of wood and mud, which are the most cheaply available construction materials in the affected area, and rural Rwanda generally. Most of the houses are either constructed out of concrete blocks (57%) or mud bricks and wood (45%). 43% of the houses have floors with no paving or detailed finishing and only made of clay covering suggesting that the majority of households belong to the lower economic categories. However, a considerable proportion of 18% of the houses have floors paved with cement. 78% of the households in the

affected area have unprotected pit latrine toilet facilities. Only 21% have improved protected pit latrines. Only a few, 1%, of the households report having no toilets. The majority of these are located in Kibare site.

Table 48: Status of housing structures

Roofing material	Kibare	Ihema	Nasho	Tot. %
Thatching/clay tiles	10.2	9.0	11.6	10.7
Iron Sheets	89.8	91.0	88.4	89.3
Total	100.0	100.0	100.0	100.0
Exterior walls				
Mud bricks and wood	44.4	34.0	45.0	43.0
Cement / clay burnt bricks	55.6	66.0	55.0	57.0
Total	100.0	100.0	100.0	100.0
Floor material				
Clay	48.0	38.0	41.2	42.8
Wood	3.6	2.0	3.2	3.1
Cement	18.9	24.0	16.1	18.3
Tiles	0.0	0.0	0.0	0.0
Stone	0.5	1.0	0.3	0.5
Bare earth	29.1	35.0	39.2	35.3
Total	100.0	100.0	100.0	100.0
Toilet facilities				
No toilet	1.5	1.0	0.6	1.0
Protected pit latrine	21.9	22.0	20.3	21.1
Unprotected pit latrine	76.5	77.0	79.1	77.9
Flush toilet with septic tank	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0

Source: Socio-Economic survey, 2020

4.6.7. Occupation and Source of income

• Occupation

Survey results indicates that 56% of the households in all sites consider crop production and livestock with some cropping (28%) as their main economic activity. The highest proportion of crop producers are identified in Ihema (59%) and Nasho (58%) sites (Table 12). Many of these are small-scale cereal and legume growers. There are only a few (1.3%) sole-livestock farmers mainly located in Humure (3%). Off-farm employment is observed mainly among households in the Kibare site (6%) located close to trading centres in Isangano and Karambi.

Other significant observations include in all sites where despite most households mentioning cropping only as their main occupation, there is a considerable proportion of casual labourers and land squatters occupying land that belongs to individuals that do not reside in the affected areas who are taking advantage of the fertile land to cultivate seasonal crops to sustain their livelihoods. The presence of households residing temporarily on land within the target areas could complicate project implementation, as they in some instances will not have the rights to plant for example long term trees as most of their agreements with landowners may only permit growing annual crops. Also, although very few households report having no off-farm employment, during the consultation it was observed that a considerable number of households engage in off-farm activities, such as public bicycle transport, retail trade, sand mining and fishing from the lakes and others but they do not acknowledge these occupations during the survey focusing instead on crop production.

Table 49: Main occupation of household heads

Occupations %	KIBARE	Ihema	Nasho	Tot. %
Cropping only	52.0	59.0	58.2	56.3
Livestock only	2.0	3.0	0.3	1.3
Cropping with some livestock	3.1	1.0	0.6	1.5
Livestock with some cropping	28.6	24.0	29.3	28.2
Off-farm employment	6.1	4.0	3.2	4.3
Other	8.2	9.0	8.4	8.4
Total	100.0	100.0	100.0	100.0

Source: Socio-Economic survey, 2020

• Income source

41% of the households in the affected area report earning income from different agricultural activities over the last 12 months. The commonest source of income is from paid farm labour (reported by 24% of households), followed by selling crop produce (16%) and selling livestock (14%). Even though the majority of households earn income from paid farm labour, the median annual earnings from crops and livestock sales are both higher (100,000 Rwf) than from paid farm labour (70,000 Rwf). Overall households earn an average of 189,327 Rwf per annum from all sources of on-farm income though there is a considerable variation in average farm incomes between the sites ranging from 124,032 Rwf in Ihema to 269,608 Rwf in Kibare. Total farm earnings across the three sites were 47,521,000 Rwf with 56% from crop sales, 27% from paid farm labour, 15% from sales of livestock and livestock products and the less than 1% from other agro-products. Crop sales are highest in Kibare (followed by Nasho and Ihema) and account for 65% of total farm earnings while in Ihema, income from the sale of livestock and livestock products is most significant accounting for 37% of total on-farm income generating 301,667 Rwf compared to crop sales which account for 23% of total on-farm income (generating 191,429 Rwf). In Nasho, total sales of livestock and livestock products were 207,727 Rwf (accounting for 35% of on-farm sales) compared to 235,833 Rwf from crop sales (equivalent to 39% of on-farm sales).

4.6.8. Expenditures

Table next table below shows that the biggest household expense was from buying food; 80% of households classify this as their highest or major expenditure. The second and third highest household expenditure were on health (63%) and clothing (34%) respectively. These expenses are mainly attributed to the existing community-based health insurance scheme's inability to cover the cost of more specialised drugs and treatments. Education (28%) is also identified among the most costly expenditure for households, especially for secondary education. Other expenses, including agriculture, hiring labour, transport and others, are only classified by 1–21% of the households as major expenses.

Only 21% of respondents report spending on agricultural inputs. The limited use of modern farming inputs and small-scale agriculture is contributing to low productivity realised in most of these areas. FGD participants explain how prolonged dry seasons discourage most households from spending on inputs such as organic manure and improved seeds as these inputs are lost during extreme weather conditions. The annual median expenditure of a household in the affected areas ranges from 80,000 Rwf in Nasho to 108,500 Rwf in Kibare, with the highest median expenses incurred on food (60,000 Rwf) and hiring labour (45,000 Rwf) especially for cultivating farmland. The wedding expenses are not considered in this measurement as this is only reported by 2% of the respondents, which is not a substantial proportion of the population. Overall, the majority of the households in the affected areas have very limited disposable income and therefore endeavour to practice self-sustaining subsistence agriculture and prioritise expenditure on basic needs such as food, health and clothing.

Table 50: Households' expenditure levels

Expenses	# of respondents	Kibare	Ihema	Nasho	Total for all areas	Average in FRW ¹⁹	Medium in FRW
Education	170	38,383	38,737	36,853	4,824,900	37,695	14,000
Health	383	15,723	13,207	17,790	4,746,340	16,480	12,000
Transport	67	26,850	14,143	22,300	1,358,700	23,029	14,000
Funeral	7	29,250	0	33,933	235,000	33,571	20,000
Wedding expenses	10	55,000	0	118,571	940,000	104,444	50,000
Clothing	208	27,697	23,674	23,613	4,328,300	25,165	20,000
Hiring Labour	20	389,286	42,500	57,556	3,328,000	184,889	45,000
Farm inputs	126	19,263	11,556	17,631	1,945,400	17,848	10,000
Firewood	83	87,775	15,000	12,561	3,702,100	47,463	12,000
Others	21	64,571	0	51,818	1,022,000	56,778	30,000
Average total annual expenditure		260,353	116,186	155,023	78,981,090	182,827	95,000
Median Annual Expenditure		108,500	80,000	82,000			

Source: Socio-Economic survey, 2020

¹⁹ 1\$=975 frw

4.6.9. Financial Inclusion

39% of household heads in the target areas confirm that they are members of Village Savings and Loan Associations (VSLAs) and an additional 13% of other members in their households are in VSLAs (Table 19). It is only in Kibare that a considerably higher percentage of 42% of the household heads confirm that they are in VSLAs, compared to all the other sites. This is explained by the presence of trading centres in Karambi and Isangano that contribute to more financial transactions, hence more financial inclusion. The proportion of household heads (28%) and household members (1.8%) with accounts in formal financial institutions, including commercial banks and savings and credit cooperatives (SACCOs), is much lower than those using informal financial services. Most of these households report having accounts in the local area SACCO. Only one financial institution was identified in Ndego sector, SACCO Dukire Ndego. Also one Bank of Kigali (BK) agent was found to provide financial services in the targeted areas.

In-depth discussions with participants indicate that most of the population prefer to use informal financial services and products mainly because of the ease with which they access services such as credit. The credit is accessible to them at low interest rates and at the end of the year, they are able to benefit from the interest accrued as a group. Contrarily, formal financial institutions obligate several requirements before accessing credit, with the risk of losing their collateral in case of defaulting and have high interest rates and bank charges on transactions, hence the majority of the rural population prefer not to use their services. But overall there is limited access to formal financial institutions in the area. Despite preferring VSLAs for credit, only 14% of respondents confirm having a loan at the time of the survey while 38% have cash savings. Use of mobile money services is the most popular financial services product (FSP) used by 59% of households in the targeted area and 44% accept keeping money in a safe place at home.

Table 51: Uptake of financial services and products

Use of Financial Services and products	Kibare	Ihema	Nasho	Tot. %
HH Head in VSLA	41.8	36.0	37.3	38.6
HH Member in VSLA	11.7	11.0	14.5	13.0
HH Head in Formal Financial Institutions	26.5	27.0	28.9	27.8
HH Member in Formal Financial Institutions	1	3.0	1.9	1.8
Household with cash savings	38.3	31.0	40.2	38.1
Household with a loan	15.3	7.0	15.8	14.2
HH using mobile money	57.9	62.0	56.9	58.6
HH using individual money lenders	28.6	14.0	18.3	20.9
HH keeping money in secret place at home	39.8	45.0	45.3	43.5
HH keeping money with individual in HH	21.4	12.0	17.4	17.8
Other financial services	1.0	0.0	0.0	0.3

Source: Socio-Economic survey, 2020

4.6.10. Crop production

As shown in the next table below, 28% of the households' homesteads are located 1 km from their fields while the majority (66%) travel no more than 5 km to access their arable land. At least 5% travel more than 5km to access their arable land, with most of these (11%) located in Karambi and Isangano cells in the Kibare site. 80% of the households surveyed in the affected areas confirm that they are currently involved in crop production. Consultation indicate that although a considerable number of households mention that they have sold part of the staple crop (18%) they produced over 12 months, for many of the smallholder farmers, most of their crop produce is primarily for home consumption (82%) and most of what they sell only occurs when harvests are higher than average which is a rare occurrence in most parts of Ndego sector because of the frequency of the prolonged dry seasons.

Only 1.6% describe crop productivity as having increased over the past 2 years. More commonly (78%), the respondents explained how crop productivity has reduced over the same time frame. This reported reduction in crop yields is mostly attributed to mainly increased incidence of drought and reduced rainfall over the years. The few who acknowledge increased production attribute it to mainly the Government's crop intensification program (CIP) that included subsidies such as improved seed and inorganic fertilisers availed through the national agriculture extension system, specifically "Twigire Muhinzi", as well as the land consolidation policy increased land cultivation as cooperatives and associations. Also, more specifically,

farmers in the consultation mention that the notable increase in crop production has been mainly in maize, which has been the main focus of the CIP in the affected areas.

Access to arable land (Km)	Kibare	Ihema	Nasho	Tot. %
0-1	15.8	26.0	36.7	28.2
1-5	71.9	71.0	61.1	66.2
5-10	11.2	3.0	3.2	5.3
More than 10	1.0	0	0	0.3
Crop production				
Hh growing crops	81.6	77.0	78.8	79.5
Hh selling portion of crop produce	22.4	12.0	17.4	18.1
Hh confirming increase in crop production	2.6	0.0	1.6	1.6

Source: Socio-Economic survey, 2020

Although data were gathered for 7 cereal crops and at least 15 cash crops, the detailed analysis presented in Table below is for the three main crops reported to have been produced in the last two seasons by majority of the farmers in the areas targeted by the KIIWP. Overall, beans are grown by at least 18% of the farmers in the target areas as their main staple crop and the average production is 171 Kgs per household. The highest household yields are observed in Kibare (254 Kgs per household). The second most commonly grown crop is cassava that is reported by 17% of the farming households as their main staple crop. The average yield from all the households is 541Kgs per household with the highest yield reported in Nasho site (889 Kg per household).

Maize is the third most common crop reported by 11% of the farming households as their main staple crop. The average yield from all the households is 355Kgs per household with the highest yield reported in Kibare site (664 Kg per household).

Regarding crop productivity, the yields per hectare for all the crops are rather lower than the Kayonza district productivity reported for season A (September 2018 – February 2019)¹⁵. Reported yields in the affected areas indicate that the average yield for beans was 344Kgs/ha in the target areas compared to 854Kgs/ha for the whole district. Meanwhile the average yield for cassava was 1,321Kg/ha compared to 12,617 Kg/ha and for maize the average area yield was 656Kg/ha compared to 2,217Kg/ha. These results indicated generally low crop productivity in the affected areas which most farmers and local leaders attributed to short rains and prolonged dry seasons that destroys crops after planting. Other common crops in the areas included banana (6%), Sorghum (5%) and sweet potatoes (2%).

Table 52: Production area and yield for main crops in targeted area

Crops	Beans					Cassava					Maize				
	#	Prod. Area (M2)	Total Pdn (Kgs)	Average Hh Pdn (Kg/hh)	Yield (Kg/ha)	#	Prod. Area (M2)	Total Pdn (Kgs)	Average Hh Pdn (Kg/hh)	Yield (Kg/ha)	#	Prod. Area (M2)	Total Pdn (Kgs)	Average Hh Pdn (Kg/hh)	Yield (Kg/ha)
Kibare	53	224,225	10,569	264.2	471.4	36	128,194	15,226	447.8	1,187.7	20	96,874	13,288	664.4	1,371.7
Ihema	11	62,150	1,455	76.6	234.1	29	110,644	4,305	159.4	389.1	7	31,400	1,739	289.8	553.8
Nasho	46	157,366	3,227	78.7	205.1	40	137,742	30,227	889.0	2,194.5	37	207,615	6,997	194.4	337.0
All areas	110	443,741	15,251	171.4	343.7	105	376,580	49,758	540.8	1,321.3	64	335,889	22,024	355.2	655.7

Source: Socio-Economic survey, 2020

4.6.11. Livestock production

37% of the households in the targeted areas confirm that they own one or more different types of livestock. Goats are the most commonly owned livestock with 28% of the households owning at least one goat. This is followed by ownership of cattle (13%) and chickens (10%). Among the cattle owners, local dairy (5%) and mixed dairy (5%) cows are the most commonly types of cows in the area. Pigs (6%) and other short-legged livestock such as rabbits and Guinea fowl are a common site in the affected areas. Altogether, the surveyed households in the affected area own a total of 149 heads of cattle, which are owned unevenly among 80 households. This is low compared to 531 goats owned by 168 households and 432 chickens owned by 60 households in the same area.

Among key factors contributing to the availability of cattle among many of the households is the Government's one cow per family "Girinka" programme that has contributed to increasing the total national

herd stock. The effects of the national programme are more evident in Kibare (60) and Nasho (59) that have almost twice the cattle numbers compared to the other areas such as Ihema (30).

21% of the livestock-farming households in the targeted areas consider their livestock productivity to have increased in the last two years, while 19% perceive it to have either reduced or have observed no change (10%) in livestock productivity. Farmers who consider livestock productivity to have improved attribute it to mainly improved access to veterinary services and increased availability of fodder. While those noting a decline attribute it to the prolonged drought, limited availability of fodder and commercial feeds and low access to water. Some respondents in the area also attribute the increase to mainly the increase in total number of cows, mainly distributed through the “one cow per family” national program, rather than the net production per cow.

Table 53: Households’ ownership of livestock

Ownership of livestock (%)	# Hh	Kibare	Ihema	Nasho	Tot. %
Yes, own livestock		18.9%	31.0%	37.9%	36.6%
Increased livestock production					
Type of livestock owned (#)					
Exotic Dairy Cattle	8	13	0	4	17
Local Dairy Cattle	28	18	11	18	47
Mixed Dairy Cattle	28	19	15	19	53
Exotic Beef Cattle	5	4	0	1	5
Local Beef Cattle	8	2	2	17	21
Mixed Beef Cattle	3	4	2	0	6
Chickens	60	118	139	175	432
Goats	168	216	69	246	531
Pigs	34	18	2	31	51
Sheep	9	4	2	11	17
Others	6	8	3	4	15

Source: NISR, Seasonal Agricultural Survey, Season A 2019 Report, March 2019

The next table below, presents the average annual earnings among households that report having earned income from their different livestock in the 12 months prior to this assessment. Overall, average annual earnings are highest among livestock owners with dairy cattle. Although not common in the area, the average annual earnings from exotic dairy cattle (600,000 Rwf) are the highest in comparison to all the other types of livestock. This is followed by mixed beef (224,000 Rwf) and Exotic beef (200,000 Rwf) cattle. The earnings from local dairy cows is also high but less than the other types of cattle. Other earnings from livestock are lower than 100,000 Rwf and are mostly earned from smallholder and more vulnerable households and are not a major economic activity among most of these households, as they mostly rely on crop production.

Table 54: Livestock productivity and income from sales of livestock and livestock products

Livestock Sales	Kibare		Ihema		Nasho		Total	
	Qnty	Ave. (Rwf)	Qnty	Ave. (Rwf)	Qnty	Ave. (Rwf)	Qnty	Ave. (Rwf)
Exotic Dairy Cattle	1	600,000	0	0		0	1	600,000
Local Dairy Cattle	3	131,667	3	116,667	6	145,167	12	134,687
Mixed Dairy Cattle	1	5,000	0	0	2	116,000	3	47,037
Exotic Beef Cattle	0	0	1	200,000	0	0	1	200,000
Local Beef Cattle	1	130,000	0	0	4	115,525	5	132,016
Mixed Beef Cattle	0	0	3	108,333	2	225,000	5	225,000
Chickens	8	22,238	9	37,222	16	9,594	33	24,311
Goats	30	43,469	0	0	42	29,357	72	36,531
Pigs	4	40,000	0	0	5	78,600	9	61,444
Sheep	1	7,000	0	0	2	25,000	3	19,000
Other	0	0	0	0	1	8,000	1	8,000

Source: NISR, Seasonal Agricultural Survey, Season A 2019 Report, March 2019

Most of the households with livestock confirm sourcing fodder for their livestock by grazing the livestock around the villages (43%) followed by grazing on their own land (32%) with the remaining practicing zero grazing (24%). Although national regulations require all livestock owners to practice zero grazing, less than 8.6% of the respondents gather fodder and feed their livestock in kraals. Only 9.1% of the households have

sufficient fodder in their farmlands where they are able to graze their livestock. Overall most of the livestock owners openly graze their livestock in and around the affected areas. The open grazing is attributed to most of the livestock owners not planting their own fodder and relying on wild shrubs for fodder and the surrounding lakes for water to feed livestock. Sourcing fodder has become more difficult in recent years. Only 17% and 18% of households with livestock report that fodder has become easier and/or cheaper to access in the last two to three years.

Consulted people identify open grazing of livestock as a potential source of conflict once the irrigation project commences and crop production increases. They explain that there will be need to increase the control of movement of livestock to avoid common losses incurred when livestock destroy farmers' fields, despite practices such as muzzling of goats to avoid crop destruction.

Table 55: Households' primary source of feed for livestock

Primary Fodder Source	Kibare	Ihema	Nasho	Tot. %
Grazing on your own farmland	13.3	8.0	6.8	9.1
Grazing around village	18.4	16.0	15.0	16.3
Grazing away from village	0.5	2.0	2.6	1.8
Purchasing fodder	0.5	2.0	0.6	0.8
Zero grazing – feed collected & brought to animals (kraal)	4.6	3.0	12.9	8.6
Own No Livestock	62.7	69.0	62.1	63.4

Source: Socio-Economic survey, 2020

4.6.12. Food security

Community members and local leaders in the targeted areas reported repeated food shortages in the target areas over the last 2 years resulting in some households migrating from Ndego Sector into neighbouring areas such as Mpamba sector around lake Nasho and Nasho sector in Kirehe district where the Buffett Foundation project is being implemented. As a result of the food shortages, Ndego sector records indicate that in the financial year 2018/19, the sector provided food relief in form of maize and beans to 1,500 households in Kiyovu and Byimana cells and during 2019/20, 3,000 households in Byimana, Kiyovu, Isangano and Karambi were provided with food relief.

82% of all households that responded to the survey confirmed that they had encountered food shortages in the last 12 months. Households in consultation describe food shortages as periods when they did not have enough food to meet their households' needs or when they had to eat less frequently than usual, no more than 2 meals a day. Households that experienced the food shortage did so for an average of 6 – 8 months in the last 12 months. Food shortages were experienced by 82% of households in Ihema, by 81% in Nasho and by 75% in Kibare. Although the majority of the households in the target area have experienced food shortages in the last 12 months not all households experience severe hunger. As shown in Table 30 below only 3% of all households are considered to have encountered severe hunger over the last year. The highest incidence of severe hunger was experienced in Kibare (3.1%) and Ihema (3%).

Table 56: Household's experience of food shortage and dietary diversity

Experience food shortage	Kibare	Ihema	Nasho	Total (%)
Food Shortage in last 12 months	75.0%	82.0%	80.7%	81.7%
Number of months of food shortages	6.7	8.1	8.1	7.7
Hunger scale categories ²⁰				
Little to no HH Hunger (0 - 1)	68.9%	71.0%	63.4%	68.5%
Moderate HH Hunger (2 - 3)	28.1%	26.0%	27.8%	28.5%
Severe HH Hunger (4 - 6)	3.1%	3.0%	2.7%	3.0%
Dietary Diversity ²¹				
HH dietary diversity	15.3%	21.0%	15.4%	16.8%

Source: Socio-Economic survey, 2020

Overall only 16.8% of households in the target area reported consuming four or more of the required food groups within the 24 hours before the survey (September 2019). There are not many differences between the

²⁰ Household hunger scale = Sum of Frequency of experiencing three types of food shortages (No food; Night hunger; Day and Night hunger) per household, where rarely=0, sometimes=1, and often=2

²¹ Adequate dietary diversity is achieved when household members conform consumption of four or more food groups from the listed 11 food types

sites, except in Ihema where a considerably higher proportion of the respondents (21%) confirm receiving above the minimum required dietary diversity.

4.6.13. Existing public infrastructure and Social Services

Availability and access to social and economic infrastructure and services are anticipated to be affected both directly and indirectly by design and implementation of proposed project. Existing social and economic infrastructure available in the affected areas and benchmarks the affected household's use and access to these services and infrastructure for future monitoring purposes.

- **Access to the Market**

There is generally very limited commercial market infrastructure within the affected areas. There is no modern market but there are at least three trading centres. The most vibrant market is the Kibare minimarket that area residents frequent to trade with individuals from mostly Tanzania. A visit to the market and interviews with most residents indicates that many of the residents sell retail goods purchased from mainly Kigali and use the cash obtained to purchase food items imported by the traders from Tanzania. The other two trading centres in the area are the Kiyovu and Isangano trading centres.

Out of all the households surveyed, only 18% confirm crop production with selling of produce as their main purpose, indicating the higher prevalence of subsistence agriculture. Subsequently, only 16% confirm selling crop produce and 14% selling livestock and their products in the last year. As shown in Table 33 below, of the households that sold produce 9.6% confirm selling their produce through the existing area markets with the majority (11.7%) selling their produce in Kibare market. 8.5% of the households sold their produce to middlemen. Most of the households that sell their produce are within 2 kms of the surrounding markets, with the maximum any household has to travel not exceeding 8 kms. Overall all households have easy access to existing markets, but the markets are not built up or necessarily vibrant points of sales.

Table 57: Household's access to markets

Access to markets	Kibare	Ihema	Nasho	Total (%)
Hh that sell farm produce	23.4	12.0	15.8	18.1
Selling points	Kibare	Ihema	Nasho	Total (%)
Village market	11.7	6.0	9.3	9.6
Traders (Middlemen)	11.7	6.0	6.3	8.5
On the roadside	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0
Do not sell produce	76.6	88.0	84.4	81.9
Total	100.0	100.0	100.0	100.0
Distance to selling point (Kms)	Kibare	Ihema	Nasho	Total (%)
Maximum	8.0	1.0	8.0	8.0
Minimum	1.0	1.0	1.0	1.0
Average	3.2	1.0	3.2	2.8
Median	2.0	1.0	2.0	2.0

- **Education services**

The household survey findings indicate that primary school enrolment rates range between 84% for boys and 89% for girls among households with children between the ages of 6 and 12 years. This is consistent with the findings in Table 34 below where households using primary schools is the highest at 53%. Primary school enrolment is followed by pre-primary (20%) and secondary (16%). Enrolment in secondary and tertiary (1.6%) is very low in the area. Most of the local authorities attribute the low enrolment to three factors including, the cost of attending secondary and tertiary education, limited access to tertiary education facilities and limited interest in further education as many parents and youth have not yet seen the creation of employment opportunities in the areas that require such academic qualifications. Also, enrolment in pre-primary education is rather low in the areas mainly because of the limited availability of Early Childhood Development (ECD) services in the sector. More than 90% of the households are within 5Kms of most of the primary and pre-primary education facilities while 62% are within 5kms of secondary schools.

Table 58: Households main sources of education services

HH using Education facilities (%)	Kibare	Ihema	Nasho	Total (%)
Pre-primary	20.4	20.0	20.3	20.3
Primary	48.5	57.0	54.3	52.9
Secondary	11.2	23.0	17.0	16.1
Tertiary	3.1	0.0	1.0	1.5

HH using Education facilities (%)	Kibare	Ihema	Nasho	Total (%)
Within 5 km of Schools	Kibare	Ihema	Nasho	Total (%)
Pre-primary	87.5	100.0	93.5	92.6
Primary	92.6	86.0	91.2	90.7
Secondary	68.3	65.2	58.6	62.4
Tertiary	65.8	0.0	96.5	76.2

Source: Socio-Economic survey, 2020

A review of Ndego sector records and field visits indicate that the sector has one secondary school, one nine-years basic education (YBE) school and three primary schools listed in the table below. The secondary school has 673 students enrolled while 5,448 children are enrolled in the primary schools. Interviews with local leaders indicated children from the three cells in Kabare Sector neighbouring Ndego Sector attend the listed schools in the sector, as the schools in Kabare sector are further than the ones in Ndego. The dropout rates from the schools in the last two academic years were high - at least 131 and 24 students have dropped out of primary and secondary schools respectively. Local leaders explain that most of the students that have dropped out of the schools have either been part of families that have moved out of the sector, most especially during the drought periods, or family members that have withdrawn their children from school to take part in family agricultural activities.

Table 59: Households main sources of education services

Schools	School Type	Number of pupils	Dropout rates	
			(2018/19)	2019/20
École secondaire Ndego	Secondary	673	13	11
Groupe Scolaire Ndego II	9-YBE	2888		
École primaire Amahoro	Primary	573	117	
École Primaire Ndego	Primary	1223		
École Primaire Byimana	Primary	764		14

Source: Socio-Economic survey, 2020

• Health services

The population in the affected area have fair access to health services through mainly one health centre, two health posts and one regional hospital, these include:

- Ndego Health Centre, Kiyovu Cell, Gasabo Village
- Post De Santé Karambi, Karambi Cell, Musenyi Village III. Post De Santé Isangano, Isangano Cell, Gashonga Village IV. Rwinkwavu Hospital, Rwinkwavu Sector, Kayonza District

Most of the respondents (66%) identify the Karambi health post as the most frequented health facility in the area. However, this is mostly used by the residents of Isangano and Karambi Cells (85%), most of the other respondents' households rely on the Ndego Health Centre (44%). The closest General Hospital to the affected area is the Rwinkwavu Hospital that is approximately 30 Kms from Ndego sector. Many respondents (7%) mention having used the hospital only after referral from the area health centre. Very few (0.5%) households confirm using private clinics and none was identified within the project area during this assessment, the only user of private clinic services is one household in Karambi Cell. 84% of the households in the affected areas confirm that they are within 5 kms of the nearest health post while 65% are within 5 kms of the Ndego health centre, which is the most reliable health facility in the sector.

Table 60: Households main sources of health services

HH using Health facilities (%)	Kibare	Ihema	Nasho	Total (%)
General hospital	6.1	6.0	7.4	6.8
Health centre	33.2	75.0	41.5	44.3
Health Post	85.2	24.0	67.2	65.9
Private clinic	1.0	0.0	0.0	0.5
Within 5 km of Health facilities				
General hospital	33.5	83.3	65.2	58.6
Health centre	67.6	69.3	61.2	65.0
Health Post	86.2	75.0	82.3	83.5
Private clinic	51.0	0.0	0.0	51.0

Source: Socio-Economic survey, 2020

Ndego sector records indicate that 67% of all households in the sector have paid up their annual health insurance subscription for the year 2019/20, hence have health insurance. The remaining 33% are mostly cases of households that have not reported their status as most of the vulnerable households (Ubudehe category one) are supported to acquire health insurance. The baseline also gathered benchmark information from the Ndego health centre for key health indicators that will be tracked over the duration of the project to monitor the health, nutrition and wellbeing of the targeted communities. As shown in Table 37 below, malaria is the most prevalent disease in the sector with 19,004 positive out of the 38,252 patients (49.7%) that used the health centre in the last financial year 2018/19. There is a low HIV/AIDS prevalence in the area with 15 new cases reported in the last year, along with 2 tuberculosis infections. Regarding maternal and child health, the health centre recorded zero maternal mortality in the last one year but 4 fatalities of children under 5 years. Also 2 severe and 22 moderate child-malnutrition cases were recorded at the health centre.

Table 61: Community health status for Ndego sector 2018/19

Health Status	Cases
Malaria	19,004
HIV/AIDS_ New Infections	15
Tuberculosis	2
Maternal mortality	0
Infant mortality_ Below 5 years	4
Moderate malnutrition	22
Severe malnutrition	2

Source: Socio-Economic survey, 2020

- **Water and Energy**

This section assesses the access and availability of water for household use (washing and drinking) and energy for cooking and lighting. As shown in Table 38 below, 53% of the households rely mostly on water accessed from the surrounding lakes and streams with a particularly high dependency on these water bodies among households interviewed in Kibare (89% using these open sources for a supply of household water). Also, a considerable number of households rely on water accessed through retailers (32%) and communal taps (28%). 33% of the households that use the lake water confirm that they are within less than 5km of the nearest water source, while 17% are within 5 to 10 kms. Among the local authorities interviewed and local community there is concern over the surrounding communities' level of access to water for household use if access to the lakes, dams and other low-lying areas are closed off or destroyed by proposed project irrigation infrastructure.

Table 62: Households main sources of water for household use

Hh water sources	Kibare	Ihema	Nasho	Total (%)
Borehole	0.5%	6.0%	9.3%	5.9%
Dam	9.2%	8.0%	4.5%	6.6%
Private tap at house	1.0%	1.0%	4.8%	3.0%
Rain collected at homestead	17.3%	21.0%	14.5%	16.5%
Communal standpipe	6.6%	38.0%	38.9%	28.3%
Well/spring	0.5%	2.0%	5.1%	3.1%
River/Stream/lakes	89.3%	44.0%	33.8%	53.4%
Water sold by other people	13.3%	45.0%	38.6%	31.5%
Other	0.0%	0.0%	0.0%	0.0%

Source: Socio-Economic survey, 2020

The national grid recently reached Ndego area but many people are not yet connected. Before those public facilities such as the health centre, sector and cell offices was relying on solar powered lighting and energy to run machines such as office equipment. Also, public lighting, mostly available around public facilities, is solar powered. At least 37% of the affected households confirm that they use solar energy for lighting. Regarding energy for cooking, 99% of the households rely on firewood as their main source of heat energy. Use of charcoal is very low (1%) and there is no reported use of any other forms of cooking energy. The connection to the electricity is at 0.3%

Table 63: Households main sources of energy

Main sources of energy	Kibare	Ihema	Nasho	Total (%)
Wood	98.5	99.0	99.0	98.8
Charcoal	1.5	1.0	1.0	1.2
Electricity	0.2	0.4	0.5	0.3
Gas	0.0	0.0	0.0	0.0

these have been able to obtain their legal personality, “ubuzima gatozi”. From the table below, the cooperatives have at least 541 members, with males (51%) making up most of the membership and women only representing 38%. The proportions for different gender do not balance because some cooperatives register households and not necessarily individuals while other groups do not keep proper records of their members. The 6 Cooperatives recorded in Kabare sector only account for those that operate within the two cells of Ruramba and Kirehe that are part of the 3 irrigation sites.

Most of the cooperatives and associations are involved in agricultural activities with a few of them involved in other social and economic activities such as supporting PWDs, sand mining, fishing, public transport services, cleaning services and making of handcrafts. The other social networks in the affected areas are the VSLAs or savings groups, “ibimina”, that the sector has no record of as all of these are informal networks or associations but are all organised in one Union of VSLAs, “CARE Union”. The sector office also reports two social groups, Utunyange and Abaharinara Amahoro. Utunyange is a youth cultural group that engages in mostly cultural performances for different events while Abaharinara Amahoro is a peace and unity network that focuses on fostering peace and unity within the different communities. Some of the cooperatives identified in Ndego Sector are presented below.

Table 64: Cooperatives identified in Ndego

Name	Total	M	F	Activity
Cooperative of Cassava Cultivators Ndego (COCACUN)	30	11	19	Cassava production, but has suffered from diseases that has affected production. Cooperative now has 3 ha of on which they are cultivating
Cooperative Tuzamurane Mubucuruzi Ndego (COOP KTBN)	31	29	4	Purchase and distribution of agriculture produce from Ndego Sector and other parts of the country. Currently have tenders to supply large customers such as MINAGRI, SOSOMA, and MINIMEX industries
Cooperative Vision des Pecheurs de Ndego (COVIPE)	68	52	16	Engage in fishing with the average production ranging from 5 - 8 tons during the high season and not more than 1 ton in the low season
Cooperative de Protection de Mieulles d’Akagera (COPROMA)	57	50	7	Beekeepers with 114 modern and 400vtraditional beehives, currently produce more than 1,500 kg of honey per season
Twigire Ndego (Terimberemuhizi)	27	20	7	Cassava production, but has suffered from diseases that has affected production. Cooperative now has 3 ha of on which they are cultivating. Engages in various agricultural production activities on land that has been provided freely from part of the sector owned land
Abakunda Ibidukikije	29	2	27	Handcraft making and Poultry farming with 120 chickens currently in one location.
IMPALA (cooperative yita ku ibidukikije)	25	17	8	Cassava production, but has suffered from diseases that has affected production. Cooperative now has 3 ha of on which they are cultivating Engages in various agricultural production activities on land that has been provided freely from part of the sector owned land cooperative currently owns 60 beehives and produces 120 kg of honey in the last season. They are also into tree production and tree nurseries development
Ubuzima Bwacu Ndego	91	30	61	Comprised of community health workers (CHWs) engaged in goat rearing and banana production
Cooperative de Tax Velo Ndego (CTVN)	35	25	10	Comprised of mostly youth engaged in bicycle transport services in and around the sector
Cooperative Aborozi ba Ndego (COABONDE)	62	50	12	Cattle owners cultivating fodder on a consolidated piece of land on which they feed their livestock
Abaharanira Iterambere Association	12	2	10	A village saving and loan association comprised of membered from Humure village

Source: Socio-Economic survey, 2020

CHAPTER FIVE: PUBLIC CONSULTATION AND PARTICIPATION

5.1. Overview

Public consultation and stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts. Stakeholder engagement is an on-going process that involves the following elements; stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism and on-going reporting to affected communities.

5.2. Purpose

- To prepare communities on potential emergency scenarios that could be caused by the project and can affect the community.
- To build a trusting relationship with the affected communities and other interested stakeholders based on a transparent and timely supply of information and open dialogue.
- To ensure effective engagement with local communities and other key stakeholders throughout all phases of the project.
- To actively build and maintain productive working relationships, based on principles of transparency, accountability, accuracy, trust, respect and mutual interests with affected communities and other stakeholders.

5.3. Public consultations and participation

As part of the project consultations, efforts were made to consult with the decision making official at central level as well as a number of local authorities, to determine their thoughts, opinions and feedback on the impact of proposed Ndego project. Information and comments collected from the public early in the study process were of use. Local communities especially farmers who are currently using command area and Command area catchment were also consulted to give them the opportunity to express their views and concerns. As part of the process, they were also provided with relevant and sufficient information on the project prior to its start - up.

5.3.1. Stakeholders

Discussions with decision making bodies, key stakeholders, sector institutions and specialist experts were made on the very concepts and nature of the proposed project, giving emphasis on levels of public participation, role of key stakeholders and joint contributions of these actors to the success of the project. In addition, the scope of the proposed project and possible means of maximizing local communities' social, economic and environmental benefits from the project implementation were underlined. Key stakeholders and authorities with whom consultations made at the project study areas were:

Table 65: Category of Consulted People

Category	Institution/desired person	Issue to discuss
RAB	Environmental Specialist	Environmental requirement
	Social safeguards specialist	Resettlement Requirement
	Project Engineer	Projects design
	Irrigation engineer	Water requirement and proposed irrigation option
	Project agronomist	Farmers organization, crop suitability and crop selection
	Feasibility and design team	Project design and options
Regulatory and standards authorities	Rwanda Environment Management Authority (REMA)	Environmental and social requirements
	Ministry of Environment	Environment and water quality requirements
	Rwanda Water Board	Water quality, water abstraction permitting
	Rwanda Land use and Management Authority	Land ownership and Resettlement
	Rwanda Development Board	EIA process
Kayonza	District agronomist	Crop selection, farming practices

Category	Institution/desired person	Issue to discuss
District		
	Land administration	Land registration, valuation and ownership transfer
	District environment officer	Environmental and social monitoring at local level
Ndego sector	Land manger	Land registration, valuation and ownership transfer
	Agronomist/ veterinary	Crop selection, farming practices
Community	Current users of targeted area including Hinga wize, Bramin, Musambi Project and other users	Project appreciation, crop selection, project, proposed mitigation measures, sustainability, crop selection etc.

5.3.2. Public participation – methods and process

Due to restrictions imposed by COVID-19, where by public gathering were not allowed one to one interview, conference call and phone calls were only consultation approaches used.

5.4. Consultative meeting held with stakeholders during ESIA preparation

Different meeting was organized by the study team from the earliest stage of project planning to present to all stakeholders the proposed project. In addition to public consultation meeting with project beneficiaries or project-affected persons, the study team held technical meeting and one to one meeting with stakeholders as well. Meetings and consultation continued throughout the study period.

5.4.1. Project Introductory meeting

The initial consultation meeting was held on May 13th, 2020) at the SPIU offices. The meeting was attended by lead consultant and project team involved in feasibility study and ESIA study including SPIU environment and Climate Change Socialist, SPIU Social Safeguards Specialist, project Manager and irrigation engineer. The purpose of the meeting was to introduce project team agree on project ESIA timeline and plan for scoping mission as well as implications of COVID-restrictions.

Table 66: Issues and answers recorded during initial consultation meeting

Item	Summary of discussion	Conclusion
Project Schedule	The meeting discussed the project schedule based on the contract signed by between RAB and BESST LTD. It was noted that, the contract was signed on March 28, 2020 and the duration was six month. Due to COVID-19 and restriction to travel between provinces the Consultant was not able to submit the inception report as it was not possible to visit the site	It was agreed that RA will request a special authorization for the consultant to visit the site and the consultant will prepare and submit an inception report on May 22 nd , 2020 Further, the inception report will include a revised study schedule
Project team	The Consultant confirmed the availability of ESIA team including Team Leader, Socio-economic Expert, Agronomist, Hydrologist, Ecologist and GIS expert.	It was agreed that the consultant will work closely with the designated project manager and study team from client side
Project documents	The meeting discussed available projects documents that will help the consultant to conduct the ESIA	It was agreed that the client will provide the consultant with the Feasibility study and project shape file and other relevant documents

Source: BESST Ltd, 2020

The meeting was attended by:

For the consultant

- Théogène Habakubaho, ESIA team Leader

For the client:

- Usabyimbabazi Madeleine, Environmental and Climate change Specialist and Client project manager
- Muligande Benjamin, Social safeguards Specialist;
- MUCYO PAPIAS, Senior Irrigation Engineer, Ag. Irrigation Program Leader
- Dr. SIRIKARE N. Sylvere (KIIWP Focal Person
- Ndagijimana Andre, Project Specialist

5.4.2. Presentation and Validation of inception report

After the submission of inception report, the consultant presented to stakeholders in order to get comments and views on the proposed methodology and study schedule. Due to COVID-19 restrictions, the validation was conducted via conference call and was attended by Consultancy team, client team, Specialist from Rwanda Environment Management Authority (REMA) and Rwanda Development Board (RDB)/EIA department. The next table present participant to the meeting

Table 67: Consultation at inception report

Names	Institutions	Position	Contact
Usabyimbabazi Madeleine	RAB/SPIU	Environmental and Climate change Specialist and Client project manager	madousa2020@yahoo.fr
Muligande Benjamin,	RAB/SPIU	Social safeguards Specialist;	muligandeben2007@gmail.com
Dr. SIRIKARE N. Sylvere	RAB/SPIU	KIWP Focal Person	sylvere.sirikare@rab.gov.rw
Ndagijimana Andre,	RAB/SPIU	Project Specialist	ndagabruce@gmail.com
Theogene Habakubaho	BESST LTD	ESIA team Leader	htheogene@yahoo.fr
Nshimiyimana Fabien	BESST LTD	Hydrologist	nshimiyefabien@gmail.com
Ruzibiza Marcel	BESST LTD	Agronomist and land Husbandry specialist	mrurizibiza1980@gmail.com
Nzamuambaho Etienne	BESST LTD	Survey and GIS Expert	etienne2020@gmail.com
Ngaboyamahina Théogène	REMA	Environment Inspection and regulation officer	tngabo@rema.gov.rw
Jacqueline Musoni	RDB	Environment Review Specialist	jacqueline.musoni@rdb.rw

Source: BESST LTD, 2020

After the presentation made by ESIA team leader, participants was given an opportunity to provide comments and ask questions. The inception report was validated and the consultant was requested to incorporate comments provided and submit a revised inception report and proceed with detailed ESIA study. Comments provided includes:

- To provide a detailed information on how the baseline data/information on biophysical & social economic condition of the project area will be collected;
- To expand the list of key stakeholders to be consulted and incorporate other development partners who have the activities within the scheme and or adjacent to the scheme (such as USAID Project_Hinga wize, Bramin, etc)
- It was recommended to provide a brief introduction to the key features of Ndego irrigation development project
- It was recommended to consider description of the aquatic life of the 2 lakes (which are targeted as key source of water for this project)
- It recommended that the ESMPs of the 3 irrigation scheme in Ndego should be separated and be site specific
- It was recommended to ensure a close consultation with the local communities in order to ensure sustainability (especially existing farmers organizations in that area)
- It was recommended that lake Ihema should be removed among the three sources of water under the final inception report given that the water permit was not granted
- It was recommended to provide additional information to the provided scoping matrix in order to provide justification to why some impacts are expected to be positive or negative or neutral vis a vis the features of the schemes as well as the location of the key irrigation infrastructures vis a vis the existing biophysical and socio-economic condition (information should be provided from the preliminary site visit)
 - ✓ Under RAP section: it was recommended to provide a list of all socio-economic activities that are likely to be affected by the project in addition to providing a list of all peoples who are likely to be affected by the project development.

5.4.3. Consultation with official at central and local level

In addition to the public consultation meeting, the consultant team conducted one to one interviews with different official to discuss the projects and collect their views, concern and recommendation. Consultation conducted also allowed the team to collect different data and information related to the projects like existing laws, standards and policies helped. Below are the key stakeholders consulted.

- Ministry of Agriculture and animal Resources: Environmental and Social safeguards Specialist for World Bank Funded Projects ;
- Ministry of Environment, Water Pollution Control Expert
- Rwanda Environment Management Authority(REMA): In charge of pollution control
- Rwanda Development Board RDB: Environmental Review Specialist.

- Rwanda agriculture Board: Project team involved in ESIA and feasibility study for Ndego Irrigation schemes
- Kayonza District agronomist
- Kayonza Land administration officer
- Kayonza District environment officer
- Ndego sector Land manager
- Ndego Sector Agronomist
- Hinga wize, Bramin, Musambi Project and other users; and
- BRAMIN management

Full list of Consulted people at technical level is provided in Annex 1

• **Key issues identified during consultations at central level include:**

- Pollution of water bodies during construction and from non-point sources during project implementation, soil erosion, sedimentation of river due to excavation around the river, Possibility of loss of property , crops and trees, disturbance of water table, loss of biodiversity.
- Likelihood of delays in compensation of PAPs, which could escalate into disputes, Execution period, employment for their citizen, cost and accessibility of potable water waste management and disposal, Source of construction material, health insurance; connectivity to the existing network, cost of land acquisition and eligibility criteria.;
- Possibility of low wages to local workers during construction works;
- Payment of water fees;
- Roles and responsibilities in implementation and monitoring of ESMP/RAP;

5.4.4. Consultation at community level

Public participation and community consultation has been taken up as an integral part of social and environmental assessment process of the project. Consultation was used as a tool to inform project affected people, beneficiaries and stakeholders about the proposed activities both before and after the development decisions are made. It assisted in identification of the problems associated with the project as well as the needs of the population likely to be impacted. This participatory process helped in reducing the public resistance to change and enabled the participation of the local people in the decision making process. Initial Public consultation has been carried out in the project areas with the objectives of minimizing probable adverse impacts of the project and to achieve speedy implementation of the project through bringing in awareness among the community on the benefits of the project.

As the consultation was held under restriction imposed by COVID-19, local community was conducted in form of interview and small group of 3-5 people. The full list of all consulted people at community level is presented in Annex 2.

Table 68:Key outcome of consultation at community level

No	Question/comments	Answers provided by consultant
Consultative meeting in Kibare		
1	How are we going to know the value of our properties?	RAB in collaboration with Kayonza district will hire an independent valuer who will agree with assets owner the compensation value.
2	When the project implementation will start so that we can plan for our agriculture activities?	As of now we are still at feasibility study that will be followed by detailed design. Once design are completed, the community will be informed about implementation schedules
3	Will the project gives us the jobs or it will use machines?	Though some activities will require the use of machines, other works will be performed by people and affected people will be given priority.
4	What are the mechanisms that are you putting in place to ensure that local are provided with jobs?	First of all, locals will be provided with information on time but also during the preparation of construction contract RAB shall emphasize the use of local resident in construction work where possible.

No	Question/comments	Answers provided by consultant
5	We are using Kibare for cattle water, what will happened once the lake is being used for irrigation	All water users are considered in feasibility and water allocation will be done in consideration of users.
6	Is there any impacts on fishing activities in the lac Kibare?	There can be impacts if water is over abstraction, however, the determination of amount of water abstracted will consider fish farming requirements.
7	What will happen for income loss during land husbandry works?	Farmers will be involved in works and will have get income from employment to cover losses.
8	We are having water shortage in the area and we are using lake water. Does project plan to support the local community in getting water for domestic use.	The project will work with other institution to addressed this issues by exploring possibility of having water points for cattle and for domestic use?
9	What are measures in place to avoid conflict over water use?	Water Users Association will be formed as well as Grievance redress mechanism
Consultative meeting Ihema		
1	Sometimes the fees paid as compensation is not enough to buy another land. What are you planning to address this issue?	There will be compensation for land owners and Special attention will be taken on these who are going to lose government land. RAB will hire and independent valuer to provide the replacement cost. For the person who disagrees with the value assignment to his/her property appealing measures are provided.
2	When are we going to get results of your data collection?	This exercise is the initial identification of assets and PAPs and results will be included in RAP report which will be made public. However a final asset valuation will be conducted and every PAP will sign on the valuation form after verification of his attest and its value
3	Can we know exactly where different infrastructure will be installed?	During detailed design, reference point will be established and people will be informed
5	Will farmers allowed to continue to use the land located after full water level?	Yes, but a buffer of 20 m will be required for dam protect. Farmers who have land in these meter will receive compensation
6	One PAPs wanted to know the size of his land that will be taken.	All affected land has been identified but once detailed design is completed an assets inventory will be made and everyone informed about results.
Consultative meeting in Nasho		
1	Will our land be taken without compensation?	Private land will be compensated
2.	What kind of compensation will you give us?	Compensation measures will be provided based on eligibility criteria and the nature of Impact and the compensation may include land for land compensation or monetary compensation. Especially for crops and trees.
3	When shall the construction start?	The final date for construction is not yet fixed but when fixed people will be communicated
4	We cannot be against public interest but, but what are the support are we going to receive from the government?	Compensation will be provided to the affected people and job opportunities will be provided during construction.
5	How many seasons are we going to miss during land husbandry works	The number of season to be missed will be known after final design study and construction schedules. However reference made to other similar number of missed season range between 2 and 4
6	Is there any compensation for the income loss during construction?	The income losses during construction have been estimated and means of compensation shall be proposed in the RAP including jobs during construction and other possible assistance to be agreed between RAB and farmers
7	People who are doing small irrigation now will be considered in the design.	All users are considered

CHAPTER SIX: PROJECT NEED AND ANALYSIS OF ALTERNATIVES

6.1. Project need and justification

Kayonza is a district with fertile soils in almost all its sectors. Its economy mostly depends on agriculture and livestock. Ndego Sector, formerly part of Akagera National Park till 1996, was converted into agricultural land mostly to accommodate newly repatriated Rwandans. This Sector, located at 37 km from Kabarondo Center is inhabited by 18,918 people and over 90% of them are farmers (NISR, 2012). The area is home to lakes like Ihema, Nasho, Kibare, Kagese, etc and natural savannah trees. It is environmentally affected due to overexploitation of natural savannah trees for charcoal.

Despite the good number of lakes, the project site has been characterized by prolonged droughts for the last 3-4 years and this resulted in crop failure, leading to decreases/ losses in agricultural production and livestock deaths and left most farmers desperate. Due to lack of adequate rains, over 15,000 residents of Ndego and Rwinkwavu Sectors in Kayonza District and Nyamugali, Kigina and Kigarama Sectors in Kirehe District started receiving food assistance since December 2017.

Along with its strategy to mitigate the drought-induced calamities through improved use of untapped water resources and in order to address agricultural issues in Ndego area and other sectors affected by drought, the Government requested IFAD to support a new integrated irrigation and watershed development project in most seriously droughts prone areas of Kayonza District. Those areas cover Gahini, Kabare, Kabarando, Murama, Murundi, Mwiri, Ndego and Rwinkwavu.

Ndego study site is composed of three (3) irrigation schemes chosen based on its good soil fertility, the incidence of prolonged droughts leading to persisting food insecurity, limited rainfall (averaging 900 mm per year and poorly distributed throughout the cropping seasons) and its high potential for irrigation. Financing the irrigation project for sustainable agricultural production in a drought prone area like Ndego is a good decision because of the availability of water resource and productivity potential of the area.

6.2. Presentation of Option considered

During the planning stage, RAB through the SPIU IFAD financed projects and District preselect sites in Kayonza District based on the district needs including drought incidence, irrigation potentialities, agricultural productivity, environmental protection and climate change mitigation, etc. During the feasibility stage, various options were explored and weighed from all considerations such as cost, environmental aspects and ease of implementation and maximum utilization of available resources. The aim of alternative analysis is to arrive at a development option, which maximizes the benefits while minimizing the adverse impacts. Various alternatives were considered and detailed below:

6.2.1. Option 1: Full Surface Irrigation

Under the first option, Balancing storages (BS) were proposed to regulate the flow towards the canal system and to compensate a minimum of 3hrs peak demand in case of pump operation interruption. For lowering investment and operation costs, BSs are situated at different levels, so that the pumping head is optimized. In this option, nine BSs were proposed including three in Kibare, two in Ihema and four in Nasho Block.

The canal system layouts were also designed. These include the main canals, secondary and tertiary canals. The main canal begins from the Balancing Storage (BS) towards the irrigation area for surface irrigation application. The main canals in Kibare, Ihema and Nasho Block have 19.8, 19.5 and 18.1km length respectively. Balancing storages situated at the peak level of the blocks (command area). These canals run along the contours with 1/3000 to 1/5000 slopes.

Secondary canals of Option 1 are aligned along the main canal and few secondary canals run perpendicular to the main canal with series of drops. They are also running along the contour. Secondary canal length is fixed not to exceed 1.0km, unless the terrain features and layout dictates to adopt more or less. The secondary canals commanded 105 secondary blocks. Summary of canal lengths of each Blocks secondary canals were determined as 12.9, 14.6 and 17.2km for Kibare, Ihema and Nasho Blocks respectively.

Tertiary canals /pipes were set with the following considerations: (i) some of the tertiary canals/ connected to quaternary canal; (ii) the shape of the unit is square or rectangular as far as topography permits; (iii) the unit has a provision of farm roads for the farmers to transport their crops and machines or cattle can move to and from the plots with ease and supply of inputs; (iv) it has clear boundaries, such as water courses, roads etc; (v) each unit to have its own drainage system to drain excess irrigation water or rainfall; (vi) directly borders to a secondary or main canal.

Tertiary canals /pipes are perpendicular to the secondary canals and run along the slopes. Most of them are pipes and the flow types are pressurized. In this tertiary canal alignment, the setting is such that the canal length is limited by the terrain shape. The preliminary layout for this option is provided with 495 tertiary blocks. For Ndedo site, three irrigation methods were proposed based on the command area slope and pressure requirements for tertiary canals/pipes. These comprise of (i) Furrow irrigation, (ii) sub-field pipes with boxes and field outlets (tertiary outlet pipes) and (iii) basin by flexible hose-reel. From the command area of 2,500 ha, a net irrigation area of 2,024ha is available in this option. The area coverages are presented in the following Table.

Table 69: Net irrigation area by irrigation type for option 1

SNo	Irrigation Area (Ha)	B-1 (Kibare)	B-2 (Ihema)	B-3 (Nasho)	Total (Ha)
1	Gross Command Area	600.0	830.0	1,070.0	2,500
2	Net Irrigation Area	481.7	683.6	858.6	2,024
3	Basin Irrigation	454.5	419.4	316.2	1,190
4	Furrow Irrigation Area	27.2	264.2	542.4	834

Source: SMEC (2020). Feasibility Study report

6.2.2. Option 2: Surface Irrigation mixed with Pressurized System

In option 2, Balancing storages (BS) are also considered. In total, five BS are proposed, including two in Kibare, two in Ihema and one in Nasho Block. The following main criteria are followed to prepare option2 layout. These are:

- The maximum pumping head considered ranges between 65 and 70m. Medium head sprinklers and CPT irrigation requires operating head of 25 to 30m (minimum) for operating the systems and sprinkling to the designed diameters. Therefore, areas with higher elevations (i.e greater than 1325.0 El) which encounter to exceed the specified pumping head are dropped from pressurized irrigation;
- Minimum available CPT size is 6.5Ha with a diameter of 288.0 m (Manufacturers Manual). For Ndedo Project, this size is excluded from the layout at this will cause to remove a lot of surveyed and suitable land from the proposed irrigation layout. The minimum CPT size considered in the layout preparation is 13Ha, with a diameter of 410m. Therefore, any potential command area with a width with less than 410m will not be developed with CPT alternative. Instead, sprinkler systems are proposed in these areas, provided that the head requirement mentioned above is satisfied.
- After analysing the experience in Rwanda with implemented irrigation projects, the drip system alternative is dropped. This method is not welcomed by the farmers and operation experts, due to complicated tasks during farm preparation, farming and harvesting. In addition, this system incurs a lot of expenses as a result of replacement costs for the laterals and re modification of the spacing from the proposed ones.

The main pipelines, distributions, branches and sprinkler laterals for the center pivot, sprinkler and surface irrigation were discussed. Three types of pipelines are aligned in the Centre Pivot Technology (CPT) layouts. Main pipelines (MP) convey flow from pumping station, branch pipelines (BP) branched from the main pipelines and a distribution pipe connected to the CPT inlet. Depending on the layouts, the main lines are also directly connected to the CPTs inlet. The systematic and clear understanding of the layouts, the pipeline and the CPT system are designated as discussed below:

- B1-CPT MP = Block 1 main pipeline to CPT's
- B1-CPT BP = Block 1 branch pipe to CPT's
- CPTs for each Block are designated by initial of the Block as KCPT, ICPT and NCPT for Kibare, Ihema and Nasho respectively.

In general, the slopes identified for CPT are between 1.4 to 5% and are directed towards the lake. These slopes are suitable for CPT irrigation. CPT irrigation is possible in all soil types with infiltration rate higher than water application rate (except clay loam). Moreover, the precipitation can be designed to suite the infiltration capacity. The number of centre pivots is nine, eight and 13 in Kibare, Ihema and Nasho Blocks respectively. The total area covered by the centre pivots in Kibare Block, Ihema and Nasho Blocks are 210, 175 and 398 ha respectively. The total pipe length for centre pivot irrigation for main pipeline, branch and distribution to the CPTs is 31.4 km and irrigation area of 783.0Ha (see Tables below). For inspection and maintenance purpose, the main and branch pipelines to the distribution pipes to CPT inlet are provided with 6.0m access road.

Table 70: Summary of pipelines lengths per block

Block	No of main pipelines	No of Branch lines	Pipe lengths (m)		
			Main pipeline	Branch pipe	Distribution to CPT
Kibare	1	1	3,353	1,808	4,821
Ihema	2	1	6,745	95	1,543
Nasho	2	-	9,200		3,801
Total			19,298	1,903	10,165

Table 71: Summary of CPT sizes and numbers per block

Block	13 Ha	CPTs sizes and numbers				Total	
		20 Ha	33 Ha	50 Ha	75 Ha	CPT (No)	Area (Ha)
Kibare		8		1		9	210
Ihema	4	2	1	1		8	175
Nasho	4	4	2	1	2	13	398
No of sprinklers	8	14	3	3	2	30	
Total area (Ha)							783

Two types of pipelines are aligned in the Sprinkler layouts. The main pipelines convey flow from pumping station and branch /secondary pipelines connected to the sprinkler laterals. Sprinkler systems are designated as discussed below:

- B1/1MP = Block 1 main pipeline 1
- B1/2MP = Block 1 main pipeline 2

Sprinkler irrigation types are categorized depending on the operating pressure for sprinkling. Ndego project sprinkler irrigation was categorized as Medium pressure (ie 35-50 Lh/in2 and 2.4-3.5 bar). The total main pipeline length is 10.9km and area of 137.1ha. The lengths of secondary and sprinkler laterals are determined as 6.8 and 29.7km.

Primary, secondary and tertiary canals were proposed under surface irrigation for Option 2. Like for option 1, surface irrigation is by open canal conveyance from balancing storages to secondary canals as well as to the field system. The irrigation methods adopted in this option is basin irrigation with hose-reel and tertiary outlet pipes at the upper part and most of furrow irrigation potentials are taken by CPT system.

In this option, the secondary canals commanded 71 secondary blocks. Summary secondary canals lengths were determined as 9.5, 13.2 and 7.8km for Kibare, Ihema and Nasho blocks respectively. About 344 tertiary blocks are plotted in this option with a length of 11.8km canal and 67.5 pipelines. With regard to irrigation coverage area by type, a net irrigation area of 2,017ha is available in this option from the command area of 2,500ha. The area coverages are presented in Table below.

Table 72: Net irrigation area by irrigation type for option 2

SNo	Irrigation Area (Ha)	B-1 (Kibare)	B-2 (Ihema)	B-3 (Nasho)	Total (Ha)
1	Gross Command Area	600.0	830.0	1,070.0	2,500
2	Surface Irrigation	150.1	479.75	416.5	1,046
3	Pressurized Irrigation	344.7	175	449.45	969
3.1	Sprinkler	137.4	-	50.45	188
3.2	CPT	210	175	398	783
4	Net Irrigation Area	497.5	654.75	864.95	2,017

Source: Project feasibility Study report

6.2.3. Option 3: Pressurized System

The balancing storages (BS), Centre Pivot (CPT) pipelines and Pipe networks are among the proposed irrigation infrastructures under option 3. The main pipelines, distributions, branches and sprinkler laterals for the Centre pivot and dragline sprinkler irrigation types were discussed. In this option, five BS are proposed at the same locations: two in Kibare, two in Ihema and one in Nasho Block. The main criteria followed to prepare option 3 layout are similar to those in Option 2. Three types of pipelines are aligned in the CPT layouts. The main pipelines (MP) convey flow from pumping station, branch pipelines (BP) branched from the main pipelines and a distribution pipe connected to the CPT inlet. Depending on the layouts, the main lines are also directly connected to the CPTs inlet. The systematic and clear understanding of the layouts, the pipeline and the CPT system are designated as discussed below:

- B1-CPT MP = Block 1 main pipeline to CPT's
- B1-CPT BP = Block 1 branch pipe to CPT's
- CPTs for each Block are designated by initial of the Block as KCPT, ICPT and NCPT for Kibare, Ihema and Nasho respectively.

In general, the slopes identified for CPT are between 1.4 to 5% and are directed towards the lake. These slopes are suitable for CPT irrigation. CPT irrigation is possible in all soil types with infiltration rate higher than water application rate (except clay loam). Moreover, the precipitation can be designed to suite the infiltration capacity. The total area covered by the centre pivots in Kibare Block, Ihema and Nasho Blocks are 210, 175 and 398 ha respectively. Concerning pipe networks, the total pipe length for centre pivot irrigation for main pipeline, branch and distribution to the CPTs is 31.4 km and irrigation area of 783.0Ha (see table 26 and 27 For inspection and maintenance purpose, the main and branch pipelines to the distribution pipes to CPT inlet are provided with 6.0m access road

Table 73: Summary of pipelines lengths per block

Block	No of main pipelines	No of Branch lines	Pipe lengths (m)		
			Main pipeline	Branch pipe	Distribution to CPT
Kibare	2	1	4,340	1,808	4,821
Ihema	4		11,826	95	1,543
Nasho	3		12,783		4,381
Total			28,949	1,903	10,682

Source: SMEC (2020). Feasibility study report

Table 74: Summary of CPT sizes and numbers per block

Block	13 Ha	CPTs sizes and numbers				Total	
		20 Ha	33 Ha	50 Ha	75 Ha	CPT (No)	Area (Ha)
Kibare	1	8		1		10	223
Ihema	5	7	1	1		14	288
Nasho	4	5	3	1	3	16	526
No of sprinklers	10	20	4	3	3	40	
Total area (Ha)	130	400	132	150	225		1037

Source: SMEC (2020). Feasibility study report

In relation to area coverage, studies showed that a net irrigation area of 2,018ha is available in option 3. The area coverages are presented in Table below.

Table 75: Net irrigation area by irrigation type for option 3

Block No	Irrigation area (Ha)				Total (Ha)	Net
	Sprinkler		CPT			
	Direct pumping	Booster pump	Direct pumping	Booster pump		
Kibare Block	105.6	154.2	223		482.8	
Ihema Block		348.5	215	73	636.5	
Nasho Block		372.9	398	128	898.9	
Total Net	105.6	875.6	836	201	2,018.2	

Source: Project Feasibility Study report

6.2.4. No-option Alternative

The No Project option in relation to the proposed project implies that the statusquo is maintained. This option will involve several losses on socioeconomic condition both to the local population and the nation as a whole. Crop failure in Ndego area will persist and the local farmers will continue facing with the constraints they are currently experiencing and food security and poverty reduction will not be attained. For an area facing with

drought and a country emerging from fighting for poverty alleviation and food security, this option is not desirable considering the need of the population to sustain their livelihood. The environmental effects of the proposed activities will be avoided, making the option desirable considering the state of the environment.

The proposed project will bring important benefits to Ndego residents that would not be accrued if the proposed interventions are not implemented. This project is expected to sustainably increase agricultural productivity in food crop value chains and strengthen market linkages between farmers and other value chain actors.

6.3. Evaluation Criteria

6.3.1. Socio-political and economic Criteria

The socio-political criteria were also used to select suitable project areas and criteria considered included:

- (a) Responsiveness/interest of beneficiaries,
- (b) Government will to strengthen irrigation agriculture in order to address water scarcity issues;
- (c) District leadership and ownership
- (d) Level of social impact:
 - ✓ The number of beneficiaries on the site, relative to site size;
 - ✓ Number of households to be displaced and land acquisition may occur but small size
 - ✓ Number of beneficiaries on the site, relative to site size;
 - ✓ Proportion of female-headed Households therein;
 - ✓ Presence in a drought zone (also to be used as a food security indicator);
- (e) Accessibility to markets (near Ngoma and Kabarondo markets and local markets accessed by people from outside the project area, including those from Tanzania).

Given that all three blocks are in the same location and the proposed technologies are the same, all options meet criteria at the same level.

6.3.2. Technical and Environmental Criteria

The following indicators were assessed:

1. Command area greater than 50 ha;
2. Sufficient water harvesting potential (water from lakes);
3. Persistence of drought in the area;
4. Level of environmental impact, i.e. option that would lead to high and significant adverse impacts were rejected;
5. Potential pollution downstream;
6. Ecological functions were also important criteria in selecting the water bodies. This means that water bodies that provided sensitive ecological functions and contained species of rare significance were regarded as critical and if selected the need for stringent mitigation measures would be adopted.

6.4. Comparison of alternatives

6.4.1. No-option alternative

The No Project option in relation to the proposed project implies that the statusquo is maintained. This option will involve several losses on socioeconomic condition both to the local population and the nation as a whole. Crop failure in Ndego area will persist and the local farmers will continue facing with the constraints they are currently experiencing and food security and poverty reduction will not be attained. For an area facing with drought and a country emerging from fighting for poverty alleviation and food security, this option is not desirable considering the need of the population to sustain their livelihood. The environmental effects of the proposed activities will be avoided, making the option desirable considering the state of the environment.

The proposed project will bring important benefits to Ndego residents that would not be accrued if the proposed interventions are not implemented. This project is expected to sustainably increase agricultural productivity in food crop value chains and strengthen market linkages between farmers and other value chain actors. Even from environmental perspective, No-option is not the best option given that various ecosystem in the area are undergoing different pressure leading to degradation, soil erosion, loss of biodiversity and water

pollution. For these reasons, No-option alternative is not recommended and project implementation option were compared.

6.4.2. Comparison of proposed options

The feasibility identified the following 5 alternatives: (i) Option 1 - All surface Irrigation; (ii) Option 2 – Mixed surface Irrigation and pressurised (CPT and Sprinkler); (iii) Option 2B - Same as Option 2 with water supply from Lake Kibare and Lake Nasho; (iv) Option 3B - Same as Option 3 with water supply from Lake Kibare and Lake Nasho and, (v) Option 3 - All pressurized irrigation system (Center Pivot Technology and Sprinkler);

Option 2 and option 3 are not analysed because water abstraction in lake ihema is no longer considered as the water abstraction permit was denied due to other interventions on the lake. Therefore, the study team compared four alternatives including No-option alternatives:

1. Option 1 - All surface Irrigation;
2. Option 2B - Mixed surface Irrigation and pressurised (CPT and Sprinkler)
3. Option 3B - Same as Option 3 with water supply from Lake Kibare and Lake Nasho.
4. No-option alternative

Table 76: The comparison and analysis

Option Criteria	Option 1 Full Surface Irrigation	Option 2: Surface Irrigation mixed with Pressurized System	Option 3: Fully pressurized irrigation
Economic analysis (from Feasibility study)			
E-NPV (RWF)	39,934,195,652	43,187,451,264	47,322,615,421
E-IRR:	32 %	35 %	42 %
E-BCR	3.32 : 1	3.81 : 1	4.81 : 1
Financial analysis (from Feasibility study)			
E-NPV (RWF)	35,649,574,389	39,413,911,166	44,318,430,196
E-IRR	27 %	31 %	37 %
E-BCR	2.77 : 1	3.18 : 1	4.01 : 1
Environmental impacts and technical consideration			
Advantages	<p>Under full surface irrigation option nine pumping stations, main canals, secondary and tertiary canals are proposed. Key advantages under this option from environmental and technical consideration include:</p> <ul style="list-style-type: none"> - The system operated without any high-tech applications - Reduce the effects of water shortage on crop yields since it appears easier to apply the depths required to refill the root zone - Control and regulation structures are simple, durable and easy to operate - Essential structural elements are located at the edges of the fields which facilitates operation and maintenance activities. - The topography of the sites is not too undulating which reduces the investment cost associated with land levelling - Less energy consumption as energy requirements for surface irrigation systems will be only for pumping station 	<p>Under Surface Irrigation mixed with Pressurized System include Piped conveyance for pressurized and open channel conveyance for surface irrigation. Under this alternative, Layout of the main conveyance system for surface irrigation is the same as the one in full surface irrigation system while it has the same number of balancing storages and pumping stations as in option 3.</p>	<p>The balancing storages (BS), Centre Pivot (CPT) pipelines and Pipe networks are among the proposed irrigation infrastructures under option 3. Advantages of this option include</p> <ul style="list-style-type: none"> - Expansive land levelling or terracing is not required; - No loss of cultivable area due to channel construction; - Suitable for almost all soil types; - Water saving irrigation intensity can be changed in accordance with the infiltration capacity of soil and crop water requirements; - High efficiency due to uniform water distribution, crop water management can be adapted to growth stage

	<ul style="list-style-type: none"> - Salinity is less of a problem under surface irrigation than either of these pressurized systems. - Surface systems are better able to utilize water supplies that are available less frequently, more uncertain, and more variable in rate and duration. 		<ul style="list-style-type: none"> - and conditions; - Possibility of adding fertilizers or pesticides to irrigation water in an economic way; - Possibility of irrigating for other purposes: sprouting, frost protection or cooling during hot periods; - Lower labor requirements as compared to traditional surface irrigation approaches. - Better when considering the soil properties in the area including High infiltration rate and Variable infiltration
Disadvantages	<p>Key disadvantages of this system are mainly</p> <ul style="list-style-type: none"> - Water loss is higher due to evaporation and infiltration. - Water-borne and water-related disease tend to be more affected by waterlogging and soil salinity if adequate drainage is not provided - less efficient and more water loss or inadequate supply to meet crop water requirement - Surface systems tend to be labour-intensive - requires level land to achieve high efficiencies (maximum land elevation fluctuation should not be greater than half the applied irrigation depth); - Balancing storages, pumping station and canals requires excavation and clearance hence loss of biodiversity - Ndego potential irrigation area is dominantly sandy. Soil infiltration rate of Ndego is greater than 3.0cm/hr which indicates a high and/or variable infiltration rate category. So surface irrigation system is not the preferred choice with such soil characteristics and another method or system should be considered - the loss of soil fertility as a result of land preparation is an important concern 	<ul style="list-style-type: none"> - Water loss is higher due to evaporation and infiltration. - Water-borne and water-related disease tend to be more affected by waterlogging and soil salinity if adequate drainage is not provided - Surface systems tend to be labour-intensive - requires level land to achieve high efficiencies (maximum land elevation fluctuation should not be greater than half the applied irrigation depth); - Balancing storages, pumping station and canals requires excavation and clearance hence loss of biodiversity - the loss of soil fertility as a result of land preparation is an important concern as in option one 	<ul style="list-style-type: none"> - High energy requirement - High initial capital costs (investment in equipment - sprinklers and pipes) and high operation costs due to energy requirements for pumping and labour costs. - Sensitivity to wind, causing evaporation losses (under high wind condition and high temperature distribution and application efficiency is poor); - Unavoidable wetting of foliage in field crops results in increased sensitivity to diseases; - Debris and sediments in irrigation water can cause clogging of sprinkler nozzles
Resettlement Implications	With nine balancing water storages, main canals, secondary, tertiary and 4 pumping stations Canals this option has more resettlement impacts	Resettlement implication are less important than in option one but more important than in option B	Resettlement implication is less important compared to other two options;

6.4.3. Rating of proposed options

Evaluation criteria	Option 1 Full Surface Irrigation	Option 2: Surface Irrigation mixed with Pressurized System	Option 3: Fully pressurized irrigation
Economic analysis	3	2	1
Financial analysis	3	2	1
Technical considerations	3	2	1
Environmental impacts	3	2	1
Resettlement	3	2	1
Overall	3	2	1

6.5. Conclusion and recommendation

The irrigation project in Ndego area will contribute to socioeconomic improvement and will have positive impacts on residents' life quality. Due to rainfall shortage and considering that the lakes will constitute the only source of water during the implementation of KIIWP project, the consultant recommends the

implementation of project activities with crops that do not require too much water. Particular attention should be paid to the level of lakes to avoid their deterioration. Therefore, a monitoring system should be established both lakes to monitor water levels. The current design does not show how and where used water or excess water will be discharged. The detailed design should consider this aspect and filtration structure should be established before any discharge into lakes.

Most construction works (installation of irrigation infrastructure, land husbandry works, etc) are highly labour-intensive in nature. The use of local labour force over imported labour is important to increase local employment opportunities and ownership of project activities as well as limit the dissemination of possible communicable diseases. The awareness campaigns on communicable diseases prevention for workers should be prioritized.

For the three options assessed, fully pressurized irrigation is the best option in terms of environmental and social consideration given the moderate impacts in terms land acquisition, computability with sandy soil in the area, high water use efficiency, less water loss and less labour intensive. Further, this option do not require more land levelling hence less soil disturbance. The major disadvantages of this option is high energy requirement which may increase the operational cost and have impacts on local community.

With regard to economic and financial analysis, the site must have an internal rate of return (IRR) greater than 12 percent ($IRR > 12\%$), the Net Present Value (NPV) positive and the benefit cost ratio (BCR) greater than unity for the project to be viable. In terms of economic analysis all option have a positive ENPVs, EIRRs are greater than 8 which is the shadow discount rate (cost of capital) and benefit cost ratio are greater than unity (1) meaning every RWF spent will be able to return more than 1 RWF as benefit. The results also indicate that Option 3 are better than Options 1, and 2B. Further, Results of financial analysis done indicates economic viability of the project even when subjected to shocks such as increase in investment costs by 20 % and reduction in revenues (either through decreases in price of produce or yield) by 20 %. The results of economic analysis are sufficiently robust to withstand such shocks.

CHAPTER SEVEN: IMPACTS PREDICTION AND MITIGATION MEASURES

7.1. General overview

Generally an environmental and social impact refers to the changes of existing conditions of any area or environment caused by human activities or any internal or external influence which may be positive or negative. The impacts may also be direct or indirect, long term or short term and may be local or extensive. During the process of identification of impacts of this project on the environment, it was discovered that during the project phases especially during construction and operation, a number of positive impacts on the human environment and some negatives impacts will occur. The objective of impacts assessment is to identify and assess all the significant impacts that may arise from the undertaking of an activity and findings used to inform the competent authority's decision as to whether the activity should be either authorized, authorized subject to conditions that will mitigate the impacts to within acceptable levels, or refused.

7.1.1. Impacts types

Different types of impacts may occur from the implementation of this type of project, which may be positive or negative, and can be categorized as being either direct (primary), indirect (secondary) or cumulative. Direct impacts are impacts that caused directly by the activity and generally occur at the same time and at the place of the activity (for example, dust generation excavation activities). These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable. Indirect impacts are induced changes that may occur as a result of the activity (for example the use of water from a natural source at the activity will reduce the capacity for supply to other users). These types of impacts include all the potential impacts that either do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity (REMA, 2007).

Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities (for example, removal of vegetation may cause soil erosion, leading to excessive sediments in receiving stream, leading to reduced sunlight penetrating the water and thus reducing dissolved oxygen in the water and adversely affecting aquatic life and water quality). Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

7.1.2. Identification of potential impacts

In order to identify the potential impacts of this project, matrix was designed and used for the assessment of impacts associated with almost any type of development project. Its main strength is a checklist that incorporates qualitative information on cause-and-effect relationships.

7.1.2. Impact analysis

Impact analysis was done by conducting risk assessment, risk evaluation and risk management (relating directly to applicable mitigation measures to be implemented. Impact analysis matrix is presented in the next table.

Table 77: Impact analysis matrix

Nature or Status of the Impact: The type of effect the activity would have on the environment		
Status	Description	
Positive:	a benefit to the holistic environment	
Negative:	a cost to the holistic environment	
Neutral:	no cost or benefit	
Duration of the Impact: The lifetime of the impact		
Score	Duration	Description
1	Short term	Less than 2 years
2	Short to medium term	2 – 5 years
3	Medium term	6 – 25 years
4	Long term	26 – 45 years
5	Permanent	46 years or more
Extent or Scale of the Impact: The distance from source that impacts may be experienced		
Score	Extent	Description
1	Site specific	Within the site boundary
2	Local	Affects immediate surrounding areas
3	Regional	Extends substantially beyond the site boundary

4	National	Affects country
5	International	Across international borders.
Reversibility of the Impact: To what degree its influence on the relevant environment can be negated.		
Score	Reversibility	Description
1	Completely reversible	Reverses with minimal rehabilitation & negligible residual affects
3	Reversible	Requires mitigation and rehabilitation to ensure reversibility
5	Irreversible	Cannot be rehabilitated completely/rehabilitation not viable
Intensity or Magnitude of the Impact: Severity of the negative and magnitude of positive impacts		
Score	Severe/beneficial effect	Description
1	Low	Little effect - negligible disturbance/benefit
2	Low to moderate	Effects observable - environmental impacts reversible with time
3	Moderate	Effects observable - impacts reversible with rehabilitation
4	Moderate to high	Extensive effects - irreversible alteration to the environment
5	High	Extensive permanent effects with irreversible alteration
The Probability of the Impact: Describes the likelihood of the impact actually occurring		
Score	Rating	Description
1	Unlikely	Less than 15% sure of an impact occurring
2	Possible	Between 15% and 40% sure of an impact occurring
3	Probable	Between 40% and 60% sure that the impact will occur
4	Highly Probable	Between 60% and 85% sure that the impact will occur
5	Definite	Over 85% sure that the impact will occur
The Consequence (C)		= Magnitude/Intensity (M/I) + Extent (E) + Duration (D) + Reversibility (R).
The Significance (S)		= Consequence (C) x Probability (P)

7.1.3. Determination of Significance

After assessment of an impact in accordance to the criteria described above, the significance of an impact can be determined. The various ratings as indicated above are accorded to these criteria. These ratings are then used to calculate a significance (S) rating and are formulated by adding the sum of ratings given to the extent (E), duration (D), Reversibility (R) and intensity (I) and then multiplying the sum with the probability (P) of an impact as follows:

Significance (S) = (E+D+R+I) X P. The score is group as follow

Score out of 100	Significance
1 to 20	Very low
21 to 40	Low
40 to 70	Medium
Over 70	High

Description of significance

Significance	Description
Positive impacts	- Positive impacts is positive changes to the receiving environment
Very low	- No impacts on biophysical and social environments / livelihood / health / gender - No public concerns - No legal issues
Low	- Low/minor impact on environment / livelihood / health / gender - Minor social impacts - No legal issues
Medium	- Some level of impact on environment / livelihood / health / gender - Social issues apparent - May have legal implications
Severe/high	- High level impacts on environment / livelihood / health / gender - High public concerns or perceptions - Legal non- compliance

7.2. Anticipated positive impacts during construction and operational phase

7.2.1. Social economic impacts

a) Employment creation

Land husbandry implementation and irrigation infrastructure construction are all labour intensive activities and for that reason, the labour needed in the project area will create much needed employment opportunity to the local population. An estimate of more than 1500 persons per day is expected to be employed in land husbandry works. More than 300 persons / day are also expected to be employed in civil works for irrigation infrastructure. Planned activities will not only benefit locals in Ndego Sector but will also attract skilled and unskilled labour from areas beyond. This impact will happen to all three schemes and the level of impacts depends on the size of block whereby Nasho block will have higher impacts

b) Capacity building of farmers

In the course of the implementation of the project, farmers will be sensitized and trained on land husbandry techniques and their maintenance, various constructions, irrigation techniques and production of different crops, appropriate application of fertilizer, IPM, cooperative management, etc., thus imparting skills to them for improved production as well as to access markets, which they will utilize even after the project's exit.

Considering that the highest level of education in the project area is mostly 12 year basic education, not much skilled labour can be found in this area. However, as the construction phase and the implementation of land husbandry technologies proceed, locals will be able to acquire skills in masonry works from skilled staff (foreign expatriates or locals) which they can in turn apply at the operation stage for maintenance works of the small irrigation infrastructure such as maintenance of sluice gates, stone masonry channels, water intakes, etc. All three blocks will benefit from these impacts as the proposed irrigation and land husbandry technologies are the same.

c) Affordability of education and increased access to medical Insurance

Increased crop yields, ability to bargain for profitable farm-gate price and incomes from employment at the construction works of the irrigation infrastructure and land husbandry works, all this will hand the locals of the area the ability to pay school fees for their children and increase their access to medical insurance "Mituelle de santé" moving from the current sector average of 80% access to closer to the 100 mark. This will improve literacy levels, give children the opportunity of education and improve health status in the area. All three blocks will benefit from this positive impact

d) Increased exploitable area and agricultural productivity by farming all year round

Crop failure is frequent in Ndego area and some areas remain uncropped due to drought. The implementation of land husbandry technologies in the command area of Ndego site will increase the exploitable land area and improve soil fertility. In addition, due to the installation of irrigation infrastructure, water supply in the hillside irrigation scheme will be sufficient and reliable to enable a triple crop growing season per year. The increase in exploitable area, improved soil fertility, reduced drought incidence as well as hillside irrigation will lead to increased productivity. This will also improve on rural livelihoods. This impacts applies to three blocks.

e) Increased farm incomes from crop output

An increase in farm incomes as a result of increased marketed crop output is anticipated. This would additionally be due to better and reliable market access of high-value crop produce that would fetch a good selling price as well as increased volumes of marketable output of different crops. Most of the farmers indicated that as a result of increased incomes, farmers will be able to access inputs which they will use to expand existing enterprises.

They also indicated that the proceeds could enable them to purchase more pieces of land elsewhere where they could grow food crops that do not require irrigation, in order to utilize the irrigable land for commercial farming only. This impacts applies to three blocks

f) Productive use of hillsides

Introduction of hillside irrigation changes cultivation from the normal rain-fed type of cultivation of only two wet seasons to an all year cultivation. This implies that there is likely to be an increased agricultural production on the hillside as opposed to the common marshland irrigation. This impacts applies to three blocks.

g) Market access for agricultural products

Based on data from public consultation during the field visits, farmers' organization from groups to zonal committees and eventually to cooperatives allows farmers to bargain fairly the farm gate prices with profits without the influence of middle-men as is the case currently where farmers possess individual low bargaining power. These cooperatives will hence empower farmers economically. Under such organizations, these cooperatives will also be able to find market for their products by ensuring production in large quantities, good quality and continuity of market supply of agricultural products. This impacts applies to three blocks

h) Collective harvest for large quantities and market continuity

The project in Ndego area will involve establishment of post-harvest infrastructure for storage of produce to promote large volumes of high value harvest, control market price of their produce and enhance continuity in supplying demanding markets for their produce, locally, regionally and internationally. This impacts applies to three blocks.

i) Increased Livestock fodder

Major constraints hampering the development of the livestock sector include inadequacy of animal feed both in quality and quantity, which arises due to poor and narrow pastures and water shortage among other issues (MINAGRI, 2008). The implementation of the project interventions will indirectly lead to the development of the livestock sub sector as a result of increased quality fodder production which will be harvested from fodder trees and perennial forage legumes intended for the water catchment protection through the project interventions, thus improving the low productivity of livestock on these farms.

This will complement the government's initiative on one-cow one-family thus improving the welfare of the farmers within the project site, through provision of required nutrients at household level and income that may be used to purchase essential goods and services.

Availability of fodder for livestock will be an incentive for farmers to diversify and expand their livestock enterprises and enhance adoption rates of improved breeds which are early maturing and high yielder. Livestock development is envisaged to have a potential to contribute to poverty reduction through increased farm incomes. Livestock development projects often act as catalysts that enable farm households to join the market economy and thus to achieve a decent standard of living (ILRI, 2007). In addition to contributing to household level welfare, the increased milk production will have a positive effect on the national dairy sector. This impacts applies to three blocks.

j) Food Security

Bean, Irish potato, maize, wheat, vegetables (onion, cabbage, tomato, etc.) and fruit species are crops targeted by the project in the area and crop productivity is set to increase significantly. Most of targeted crops are among the staple food in Ndego area. As staple food and other food crop are increasing in the area, the project will contribute to food security at local and national level. This would imply that if the production is improved, there will be more food, thus resulting in a decrease in prices hence making it affordable to all the members within the community to have access to food. This impacts applies to three blocks.

k) Poverty Alleviation

The Rwandan Poverty Reduction Strategy Paper (PRSP, Rwanda, 2002) identifies five potentially competitive crops that will be targeted for expansion in addition to the traditional cash crops of coffee and tea. These are rice, maize, Irish potato, cassava, banana and bean. The KIIWP project is in line with the objective of tackling poverty through promotion of agriculture.

At the local level, the irrigation infrastructure project will promote increased agricultural productivity, diversification of agricultural crops and commercialization of agriculture from subsistence. Improvement in crop productivity will raise the income for the rural poor above the poverty line of less than a dollar a day. This is an indirect impact that will take a long process that will be felt after many years. This impacts applies to three blocks.

l) Land Appreciation

Nominal land prices may increase due to development works made, thus making the high value irrigable land useful for cultivation and marketable which was otherwise less favoured due to drought and because of the improved potential of its productivity, and then it would increase the value. This impacts applies to three blocks.

m) Provision of fuel wood

Trees and shrubs will be integrated during the implementation of land husbandry works. Firewood will be produced to satisfy farmers' demand. This impact applies to three blocks.

7.2.2. Positive Physical environmental Impacts

a) Improved soil conservation

The development of land husbandry technologies in the command area and command area catchment will contribute to soil conservation as a result of reduced erosion, proper management of runoff and soil fertility amelioration. As a result from livestock diversification, there will be an increase in the volumes of manure used to replenish soil fertility. Continued use of this manure will improve the soil quality and sustainably enhance soil fertility thus improving the yields. Improved soil conservation through improved land husbandry practices in the command area will lead to improved crop production resulting in an increase in income to farmers. This impacts applies to both blocks and the impacts will differ based on size of blocks and Nasho block has more command area lands.

b) Water Resources Conservation

The KIIWP project will invest in the protection of hillside through water harvesting, reforestation and ditches construction, improved irrigation efficiency, etc. This will reduce soil erosion and protect the hydrological systems from sedimentation, flooding and contamination. This will curb the rate of irrigation in the area and the country. This is only possible if irrigation schemes are well designed and potential impacts are mitigated including observing environmental flow, water balance and water wastage is avoided, put in place soil erosion structure and resettlement affects minimised and compensated. This impacts applies to three blocks.

c) Adaptation to climate change and prolonged drought

The irrigation canals, balancing storages, pipelines as well as center pivots to be constructed will help to supply water in the whole drought prone zone and capitalize on water efficiencies. The drought issues will be addressed. The whole area will be diversified into irrigation and the drought will not reduce its irrigation production. This impacts applies to three blocks.

7.2.3. Biological Impacts

a) Environmental Protection

The residents of Ndego area are using fuelwood as the main source of energy and clearing trees in search of energy source. This project will intensify farm production through land husbandry and irrigation components. Trees will be planted in the project area and this will reduce pressure of farmers to trees in the area or other sensitive natural habitat, like Akagera National Park and buffer zones of lakes from agriculture and livelihood encroachment. This impact applies to three blocks.

b) Revegetation

The balancing storages (BS) and canals protection activities will improve the vegetation in the surroundings of those irrigation infrastructures. Through land husbandry works, trees and grasses will be planted both in the

command area and command area catchment. This will increase the vegetation cover in the silt trap zones of canals and BS, land husbandry drainage systems, along contours and on embankments, afforested area and therefore, create new habitats and ecosystems. This impacts applies to three blocks.

c) Increased habitat for fauna and flora

Biological measures including agro-forestry and grasses are favourable to biodiversity and increases habitat to living organism as well as tree cover in the area. The creation balancing storages may also provide opportunity to aquatic biodiversity. This is a beneficial impact on the biological environment of the project area. This impacts applies to three blocks.

7.3. Predicted adverse impacts

The negative impacts likely to happen during implementation of Ndego irrigation schemes project were assessed by considering different planned activities and presented in three main project phases: design and planning phase, construction phase and operation phase. For each negative impact identified, mitigation measures were proposed. The potential adverse impacts are discussed below.

7.3.1. Adverse impacts during the design and planning phase

The design phase of Ndego project involved identification of a suitable site for the infrastructure and undertaking of a prefeasibility and detailed feasibility studies. It also include Environmental and social Impact Assessment as well as detailed design. The Planning and design phase does not have direct impacts on receiving environment. However, this phase is critical in project cycle given that at this stage impacts are identified, avoided minimised and mitigation measures incorporated in designs. Poor design may increase environmental and social risks while proper design reduces impacts and risks. Potential impacts that may results from design and planning phase include:

a) Encroachment of protected areas

The project is surrounding by lakes, Akagera National Parks and wetlands. Akagera National Park and Ihema lake are designated as protected area whereas Ihema wetland is classified as full protected wetland. Further 50m²² from Lake Kibare and Lake Nasho shores are protected and no agriculture activities are allowed. In addition, Kibare and Nasho wetlands are classified under conditional use where environmental management and EIA certificate is required before any use.

➤ Significance of impact

If these areas are encroached, the impact can be of high significance as it presents high level impacts on environment / livelihood / health / gender high public concerns or perceptions and legal non- compliance.

✓ Mitigation measures

- The option 3 that was proposing to abstract water from lake Ihema is no longer considered and this should be kept during detailed design;
- The current delineation of Ihema and Nasho block has slightly encroached wetlands which under full protection. The detailed design study should map out these sections of wetland and a buffer zone of 50m should be observed
- A buffer zone of 50m should be kept from lake shores in detailed design.
- Further, buffer of 20²³m from swamps is recommended to comply with environmental law but also for the protection of fauna and flora

b) Ecological imbalances and loss of ecological services due to water abstraction

The project is planned to abstract water from Kibare and Nasho block, which are connected to surrounding wetlands. Any wrong estimation of available water and water requirements may cause ecological imbalance

²² As required by Law on environment N°48/2018 du 13/08/2018, Article 42: Prohibitions in wetlands and protected areas

²³ As required by Law on environment N°48/2018 du 13/08/2018, Article 42: Prohibitions in wetlands and protected areas

and loss of ecosystem services. It was noted that both lakes and wetlands offers important ecological services including:

- **provisioning services** in particular crop and livestock production (providing 56% and 15% of total on-farm income respectively) as well as fuelwood (99% of households rely on fuelwood for cooking) and water supply (54% of households use local water bodies for their water supply) which are critical for food and nutrition security due to the predominance of subsistence farming in the area, other provisioning services include the production of timber, natural medicines and honey;
- **Regulating services**, in particular water regulation and purification, erosion prevention and maintenance of soil fertility (from vegetative cover), pollination (due to the presence of flowering trees at all sites which contributes to crop pollination), predation, pest control (by predators and parasites), climate regulation (from carbon sequestration and storage) and protection from extreme weather and climatic events;
- **Supporting services**, in the area including genetic diversity, soil formation and retention, seed dispersal, nutrient cycling, habitat etc. which derive from the high biodiversity; and
- **Cultural services**, particularly in terms of tourism and recreation.

➤ **Significance of impacts**

If available water and water requirement are not well estimated, the impact significance can be high as it presents high level impacts on environment / livelihood / health / gender high public concerns or perceptions and legal non-compliance.

✓ **Mitigation measures**

- Both water availability, water requirement and environmental flow has been calculated during feasibility study and this should be confirmed during detailed design. Climate change scenarios and future development should be also considered.
- Detailed design should provide water management and monitoring tools such as irrigation calendar, water monitoring system and efficient irrigation system/technologies.

c) Water and soil pollution

The proposed irrigation projects included land levelling and soil management including use of chemical fertilizers and pesticides. Excessive use of chemical fertilizers and poor agriculture practices may cause soil pollution, ground water and surface water pollution.

➤ **Significance of impacts**

The impact can be of high significance as it presents high level impacts on environment / livelihood / health / and legal non-compliance.

✓ **Mitigation measures**

- 50m buffer zone from lakes shores should be maintained and well demarcated and restoration activities of lake shores should be included in watershed protection package during detailed design;
- Recommended application rate for fertilizers should be confirmed in detailed design and the project budget should consider organic manure;
- As part of project preparation, KIIWP management should hire a consultant to prepare an Integrated Pest Management Plan;
- Extensive farmers training should be planned and provided before the operational phase and extension services should be provided to farmers.
- At least a buffer zone of 20m²⁴ should be observed from swamp areas/wetlands not only to comply with environment law but also to enhance the protection of flora and fauna

²⁴ As required by Law on environment N°48/2018 du 13/08/2018, Article 42: Prohibitions in wetlands and protected areas

d) Noncompliance with environmental Flows.

One of the major consideration to the detailed design stage is the resolution of environmental flows in Lake Kibare and Nasho. Water demand was estimated in consideration of all users and ecological flow and the recommendation is that Lake Kibare level should not drop below 1283.79 m.a.s.l. and the lake Nasho level should not be allowed to drop below 1285.9 m.a.s.l.. This should be confirmed during detailed design study and implemented during operational phase.

➤ **Significance of impacts**

If the environmental flow is not maintained, the impact can be of high significance as it presents high level impacts on environment / livelihood / health / and legal non- compliance.

✓ **Mitigation measures**

- Water abstraction permit should be obtained from Rwanda Water Board (RWB) and environmental flow instructed by the authority should be complied with.
- Detailed design should provide water management and monitoring tools such as irrigation calendar, water monitoring system and efficient irrigation system/technologies to ensure that all users are served and ecological functions are maintained.

e) Uncontrolled sourcing of construction material and establishment of work camps

If Quarry sites / borrow pits and construction yard/work, stockpile areas, storage areas, and disposal areas are not identified in advance, it may cause uncontrolled sourcing material and environmental degradation associated with it.

➤ **Significance of impacts**

If the environmental flow is not maintained, the impact can be of high significance as it presents high level impacts on environment / livelihood / health / and legal non- compliance.

✓ **Mitigation measures**

- Detailed design should identify Quarry sites / borrow pits to prevent uncontrolled sourcing of construction material.
- Detailed design shall also identify suitable locations for construction work camps, stockpile areas, storage areas, and disposal areas and other facilities near to the project locations.
- Sites to be considered shall not promote social instability and result in destruction of property, vegetation, irrigation, and water bodies. None of these temporary facilities shall be located within 500 m of residential areas and 50m from lakes and wetlands .
- The contractor will be requested to prepare environmental Management and Rehabilitation plans

Table 78: Summary of key impacts during planning and design phase

Impacts	With No mitigation measures			With mitigation measures
Encroachment of protected areas			---	-
Water and soil pollution			---	-
Ecological imbalances and loss of ecological services due to water abstraction			---	-
Environmental flow			---	-
Uncontrolled sourcing of construction material and establishment of working areas		--		-

-	Low significance negative impact
--	Medium significance negative impact
---	High significance impacts

7.3.2. Adverse Impact during construction phase

Adverse impacts during construction phase will mainly come from excavation and clearing activities, including removal of vegetation during construction, Land levelling during land husbandry, occupational

health and safety due to the presence of workers both at site and in the community etc. Excavation and clearing activities along the edge of lakes/buffer zones especially for installation of pumping station. Other impacts will be associated with Sourcing of construction materials, excavation of borrow pits, quarries, sand etc.

7.3.2.1. Impacts on Socio-economic Environment

a) Labour influx and conflict with local community

Land husbandry works, construction of balancing storage and irrigation infrastructures and as well as construction of other associated structures will attract many people in search for employment and settlements. For examples, land husbandry works requires between 700-1000man/day/ha. If we consider 2000ha in command area and 2,500ha in Command area catchment, the total man day can go up to 4,500,000. This may require a considerable number of workers who may come from other neighbouring sector and district. The presence of these workers in the community may cause conflicts between workers and community residents. Such behavior are generally related to socially unacceptable behavior according to local social standards and can be seen, for example, cases of drunkenness, robbery, insecurity, Sexual exploitation and Gender based violence and pressure on existing social infrastructure

✓ Impact Significance

This impact is also of medium significance in terms of magnitude, since it directly affects the humans and the project will be implemented in area with people living in grouped settlement.

➤ Mitigation measures

- The contractor will be required to prepared and implement a code of conducts and each employee will sign it before commencing to work
- Grievance redress mechanism will be established and local communities sensitized to use them
- Effort Should be made to use local communities especially for works which do not requires high technical skills;
- The Contractor will be requested to prepare and implement labour management Plan before mobilizing workforce at the site.

b) Physical and Economic Displacement

There is no physical displacement expected during the implementation of Ndego irrigation project given that all settlement are in grouped villages(Imidugudu) which are outside of Command area. However, during the construction of irrigation infrastructures (BS and canals networks) and post-harvest facilities, permanent land will be acquired, crops and trees be affected and a resettlement action Plan will be prepared and implemented. Further, all compensation measures should be implemented before construction workrs Based on current design 122 households will be affected by losing lands, trees and perennial crops where pumping stations, water balance storage and pressure pipeline will be constructed.

At water, balancing storage 37 households will lose permanently their land and will need compensation.

- In pressure Pipe pipeline it is expected that small strips of land will be affected and 65 households were identified;
- At pumping station 8 private plots and two government plots were identified as affected
- About 38 grazing lands and 36 cattle shed were also identified in the command area and will be relocated

➤ Impact significance

Though there is no residential houses to be affected, no physical relocation, the impact remain of medium significance and can go higher once all affected areas such quarries, borrow pits, construction yard, post harvest infrastructures are identified.

✓ Mitigation Measure

- A RAP should be prepared, implemented and all compensation measures ptovided prior construction works or land take.

- Project implementing entity will inform the current users on the timing of proposed activities so as to avoid cultivation and construction on the areas that will be used for irrigation and post-harvest infrastructures.
- Proper compensation measures and livelihood restoration programmes should be discussed and agreed with affected community in compliance with existing regulations.

c) Income losses from missed farming season during construction period

Irrigation schemes were delineated on agriculture lands with both seasonal and perennial crops including woodlots. During the construction phase of this project, some landowners will be requested not to use their land for a given period to free the area reserved for land husbandry works and construction of irrigation and post-harvest facilities. This implies that some farmers lose the produce that they could have obtained in that particular missed season, hence a loss in home income and in most cases domestic food. It also affects targets of crop production set by local government officials for their respective district sectors.

➤ Impact significance

This impact can have high significance given that agriculture was report as main source of income for Ndego population and loss of this source of income in the duration of project affects their apparent livelihood. With big size of command area Nasho Block will be more affected.

✓ Mitigation Measure(s)

- A clear implementation program indicating areas to be levelled and partitioned, dates when they will occur and a monitoring exercise involving project staff, sector agronomists and established cooperative committees should establish. It should also be shared with the local farmers as an awareness campaign.
- Farmers who have been affected should be given an affirmative priority in employing them for jobs for casual labour required at that time. This will be an alternative income source to sustain their domestic requirements.

d) Workers Occupational health and safety/ Injuries or fatalities

During construction, workers will be subjected to situations that could be detrimental to their health and safety. A few examples include injuries caused by handling of construction equipment, injuries from stepping on or using sharp objects, fires, accidents, communicable disease hazards due to interactions among the workers or with service providers such as food vendors, emissions of dust from clearing and excavation works and fumes from vehicles and other machinery that might cause respiratory dysfunctions, noise and vibrations from construction equipment causing temporary or permanent deafness. Presence of wild animal such snakes, crocodile or hippos may also threaten life and safety of workers.

✓ Impact Significance

This impact is also of high significance in terms of magnitude, since it directly affects the humans life which can go up to death.

➤ Mitigation Measure(s)

To avoid or reduce the effects of some of these occupational health hazards, it is proposed that the following measures are implemented:

- Workers on the site should be provided with appropriate protective gears such as; safety boots, helmets, nose masks, eye goggles and overalls.
- The contractor together with local authorities is required to enforce acquiring medical insurance “mituelle de sante” for all workers as a means of affordability of treatment and
- Also code of conduct, toolbox talks on OHS, emergency response plans, labour management, traffic management, first aid training and response, etc... should be included in contractor obligations;
- A qualified ESHS officer will be included in contractor key staff
- First aid Kits and first aid helper will be provided at each working area and medical agreement will be established with nearest health Center in case of emergence or serious injuries.

- Occupational Health and Safety(OHS) and Emergency response plans should be developed and implemented by contractor and,
- The contractor will be required to have life insurance for all workers;

e) Traffic congestion and accidents

The project will be implemented in remote area where people are living in grouped settlement along access roads. During construction period there will be increase in traffic due to moving machineries and vehicle traffic for material supply. Therefore, people may struck or run over by moving vehicles (e.g. during reversing), causing minor to major injuries (fractures, wounds) or death, Falling from vehicles, causing injuries or death or vehicles may hit people especially children playing in roads.

✓ Impact Significance

This impact is also of high significance in terms of magnitude, given the project location in populated area but also the consequences that may come from accident including fatality.

➤ Proposed mitigation measures include:

- Provision of training to train drivers
- Preparation and traffic management plan including signage and speed limit

f) Possible increases of HIV/AIDS and communicable diseases

Risk of increase of HIV/AIDS and other Sexually Transmitted Diseases(STD) Due to the increase of people from outside of the project zone, there is a risk of increase of HIV/AIDS and other sexual transmitted diseases. Though there is no workers camps planned for this projects Communicable diseases are anticipated among workers.

✓ Impact Significance

This impact is has medium significance in terms of magnitude, given the project location in populated area but and people are leaving in grouped settlement and small trade centers.

➤ Mitigation measures

- Regular sensitization on ways of HIV/AIDS prevention, importance of proper hygiene is important during execution of this project.
- The contractor is requested to arrange a health and hygiene training for workers in cooperation with health centre near the construction site, in order to prevent infectious diseases.

g) Child labour, forced labour , discrimination and abusive dismissal

The implementation Ndego project pipeline should be done in compliance with national and international standards in terms of child labour forced labour and discrimination. Therefore, recruitment procedures and minimum working age should be included in Contractor Environmental and Social Management Plans.

➤ Impact Significance

This impact is has medium significance in terms of magnitude, given that it has same level of impact on environment / livelihood / health / gender, Social issues apparent and may have legal implications

➤ Proposed Mitigation Measures

- Protect workers' rights by provide contract to each employee or times heed in duplicate for casual labour and respect payment schedule
- Workers GRM will be established and will include representative of workers
- Protect the workforce from inequality, social exclusion, child labour, and forced labour;
- The contractor should pay social security and PAYE contributions for its workers
- Mitigation agiants child labour, forced labour , discrimination and abusive dismissal should be clearly included in contractor labour management Plan

7.3.2.2. Adverse impacts on Ecological/Biological Environment

Anticipated adverse impacts on ecological environment describes in section 4.4, will be mainly associated with clearance and excavation works, land husbandry works water and soil pollution from oil spillage and other hazardous waste.

a) Loss of flora and fauna during site clearance

Ecological baseline (4.4) indicates that both three blocks are located in area with important biodiversity. Fortunately, the command area which will be more disturbed is located on agriculture land with no any endangered or threatened biodiverse. However, during Construction phase it is anticipated that there might be ecological disturbance especially at water pumping station that will be installed at the edge of lakes in buffer zone. Clearance, Excavation and use off machine will affect both water, soil and both terrestrial and aquatic biodiversity. Further, the construction of balancing water storages, irrigation canals and land husbandry works will disturb soil and biodiversity in Command area and command area Catchment. Expected impacts include:

- Disturbance to birds given the high number of workers who will be present at the site;
- Destruction of the habitat of amphibians due to digging work
- In sites where Pumping station, amphibian's eggs will be destroyed; especially those located at the close to the shore of the lakes;
- Destruction of snake's burrow during the digging works; Species that will likely be affected include African Rock Python and African Green snake, which make inhabit areas around swamps.
- Loss some natural tree species which will be cut down including *Acacia sieberiana*, *Acacia polycantha* and *Phoenix reclinata* at which birds make nests

✓ **Impact Significance**

The significance of this impact to be high especially for pumping stations that will be installed in sensitive areas. The scope will be localized and felt in the area where infrastructures will be installed but can spread into lakes in case of pollutions associated with.

➤ **Mitigation Measure(s)**

- Whenever trees have to be cut down, precautions need to be taken in order to avoid destroying bird nests. One staff need to be trained and made responsible for handling and relocating nests to trees, which will not be affected, should be appointed.
- Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal.
- Careful supervision of clearing activities so that only areas required for infrastructure and agricultural infrastructure are cleared
- Compensation measures which will include planting of more trees to replace the ones affected;
- Location of pumping station should consider areas where there is no much natural vegetation and if there is no other alternative; the design team will consider reducing the number of them.
- The final design should consider exploring the pumping stations system that requires a few number but also requires reduced area to minimize clearance area.
- Respect 50m buffer zone for other project components which does not have to be near lakes

b) **Loss of flora and fauna in Command area and Command area catchment**

It is expected that during the construction of irrigation canals, land husbandry and water balancing reservoirs, there will be some disturbance or loss of some fauna and flora species and /or their habitat. However, considering the fact that there were no identified protected/endangered species, there will be no loss of such flora.

✓ **Significance**

This impact is of low significance in terms of magnitude since it is an area that has been under agriculture and no forests will be affected by the project.

➤ **Mitigation Measure(s)**

- Lost local species (such as *Ipomoea involucrata* and *Acanthus pubescens*) can be offset by applying them on water catchment protection and in protection of water balance reservoirs and irrigation canals and benches;
- Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal.

- Avoid cutting trees which are beyond the area designated for construction

C) Loss of nesting areas

The ESIA was conducted in nesting period and the consultant team noted that birds are mainly nesting in trees and shrubs such as (*Acacia sieberiana*, *Acacia polycantha* and *Phoenix reclinata*) near lakes and in command area Catchment. During clearance, if done during nesting period, birds nests may be affected during construction of water pumping stations, land husbandly or balancing water storages.

✓ Significance

This impact is of medium significance in terms of magnitude since it is an area that has been under agriculture and no forests will be affected by the project and none of the bird species identified in targeted area is on the IUCN red list

➤ Mitigation Measure(s)

Although almost bird species were not on the IUCN red list, Whenever trees have to be cut down, precautions need to be taken in order to avoid destroying bird nests. One staff need to be trained and made responsible for handling and relocating nests to trees which will not be affected should e appointed.

- During field survey, almost all nests were live and this may be the case if construction are scheduled in nesting period as provided in baseline data. Therefore, where possible, clearance works will be schedules during nesting-off period;
- Before clearance and tree cutting, a rapid survey will be done to identify live nests and relocate them or avoid them.

7.3.2.3. Impacts on lakes buffer zone and wetlands

a) Potential encroachment of lake buffer zone and wetlands

The three irrigation schemes are located in areas with three lakes (Ihema, Kibare and Nasho) as well as surrounding wetlands. National requirements stipulate the need to maintain buffer zones of 50m around lakes. Any encroachment to the wetlands or buffer zone will be not only non-compliance to the regulations but also may cause the destruction of biodiversity in the area. The government has already made an effort in relocation of all activities in lakes buffer zone and the feasibility study has mapped out buffer zone during delineation of Command area. Further, lake Ihema which is classified as totally protected is no longer considered for water abstraction. Only Kibare and Nasho are considered for water abstraction and an environmental flow has been calculated and should be respected to avoid adverse impacts on biodiversity in lakes and wetlands.

➤ Impact significance

The Impacts significance is high as activities in these areas may affect fragile ecosystem but also non-compliance to the regulations.

✓ Mitigation measures

Proposed mitigation measures include:

- During detailed design the national requirements for buffer zones must be accommodated.
- Excessive use of chemical fertilizers should be avoid;
- The Design should explorer the possibility of reducing the number of Pumping stations, which are likely to be located in buffer zone.

b) Soil and water pollution

Currently two water pumping station are located on lake Kibare and Nasho(see section 4.2.5). If these stations are not relocated outside of these sensitive areas it would cause not only water and soil pollution but also disturbance of ecology in these areas. Pollution may come from debris during site clearance and excavation but also fuel and other waste.

➤ Impact significance

The Impacts significance is high as activities in these areas may affect fragile ecosystem but also non-compliance to the regulations.

✓ Mitigation measures

- Identify other location of Pumping station PS N1 and PS K3 and preferably put them outside the buffer zone;
- Explorer the possibility of having only one pumping station for Kibare Block instead of pumping station

7.3.2.4. Physical Environment Impacts

a) Soil erosion

During the construction of the BS and other irrigation infrastructures as well as post-harvest infrastructures (PHIs) and access roads (which will involve clearing of vegetation, excavation works etc.), excavation earth from the BS in addition to canals, drainages and access roads will create a pile up of soil. These activities may result in the increased erosion in areas where vegetation has been stripped and stockpile. This could lead to increased sediments deposition downstream. The same trend will be observed in borrow areas. During the construction of ditches or soil bunds within the command area, unprotected embankments or waterways will be exposed to agents of erosion, mostly water and wind.

✓ Impact Significance

This impact is going to be low in significance in terms of magnitude because the area is a drought prone site with gentle slopes and the project in itself is aimed at improving soil conservation through reduction of erosion. The erosion that will occur during the construction will be minimal and localized in the areas where excavation will take place only. The impact duration is only expected to be felt during the construction phase. This impacts will be felt at all the three blocks given that proposed works are the same and there is no much different in land cover or slopes.

➤ Mitigation Measure(s)

Soil erosion occurring during the construction phase of the project can be avoided through:

- Only clear areas earmarked for construction;
- Create contour drains during construction; especially in borrow pits and PHIs areas. However, efforts should be made to contain earth movement activities to dry seasons so as to avoid sheet and rill erosion. This measure may delay the project implementation program, therefore the protection and use of the stock pile is the alternative choice to prevent this impact.
- Planting vegetation on the cleared sites immediately after construction of ditches and soil bunds' embankments and waterways, cut off drains/ gullies;
- Avoid earthworks during heavy rains (mid-March to mid-May), especially in access roads works;
- Disposal of unused roads stockpiled topsoil before rains.

b) Air and Noise Pollution

Through site clearing, foundation excavation and site levelling, large masses of soil are likely to be displaced. Heavy machines will be used for these works. The expected adverse impact is dust generation due to the heavy machines' activities such as excavators, graders, trucks and other machinery such as concrete mixers, dumpers, etc.

During construction, there will also be noise pollution from labour force in land husbandry works and irrigation and post-harvest infrastructures in addition to movement of construction equipment at the project site. However, it will not be significant issue, since residential area is not located in and around the construction site.

✓ Impact Significance

This impact can be considered of medium significance given that the project is in populated area but schemes are not close to residential areas. It occurs only during the construction phase and there is no heavy machinery expected. Also, the project area is not heavily populated and only workers will be affected.

➤ Mitigation Measure(s)

- Contractor will spray water regularly when clearing land to reduce the dust, especially under roads works;
- Works should be executed during daytime, ie from 7.00 am to 18.00 pm
- Generators for use at the site shall have silencers to reduce on the noise emitted and regularly maintained;
- Furthermore, workers will be provided with personal protective equipment.

- Avoiding burning of any kinds of waste or construction materials

c) Loss of soil fertility

During bench terraces construction, soil layers are disturbed and this lead to modification in physical, chemical and biological properties of the soil, thus reducing soil fertility.

✓ Impact Significance

This impact is going to be medium in significance in terms of magnitude because the area has gentle slopes and land husbandry works do not required much disturbance.

➤ Mitigation Measure(s)

Soil fertility deterioration occurring during the construction of bench terraces and soil bunds can be avoided through:

- Application of good quality organic materials including compost, green manure, mulch, etc. to improve soil properties.
- Biological measures including agroforestry and grasses plantation will be implemented to reduce erosion but also improved soil nutrient;
- Application of lime after construction to reduce soil acidity. However, given the sandy soil observed in the area but also potential impacts on soil and water, the minimum rate recommended are provided in 2.4.3 as recommended by FAO depending on the level of PH.
- Preparation and implementation of IPMP

d) Borrow Pit and quarry Impacts

Though borrow pits and quarries are not identified, It is anticipated that the project will need construction material such as sand and stones. Therefore, it is appropriate to give consideration to the environmental implications in selection of quarry and borrow pits since poorly run operations create dust problems, contribute noise pollution, Occupational health and safety of their employees, or environmental degradation in general. Borrow pit are generally associated with scarring of the general environment and landscape owing to the excavation related works. If not backfilled immediately and replanted, the borrow pits end up becoming a health hazard and a source of spread of water borne related diseases like bilharzias, malaria, etc. This is because the pits end up collecting water that stagnate and hence becoming a rich breeding ground for the disease vectors. Borrow pits are also known to be potential sources of hazards especially accidental drowning of livestock and human beings.

➤ Impact Significance

Though borrow pits and quarries are not yet identified, the impact significance expected to be of medium.

✓ Mitigation Measure(s)

- Once borrow pits are identified, borrow pits management Plan will be prepared and implemented and should include backfilling procedures, rehabilitation plan that proposes how pits should be accessed and egressed, excavated, top soil preserved, reinstatement methods, drainage methods etc;
- It's therefore the responsibility of contractor or borrow pits/quarry owner to develop and implement an ESMP including Borrow Pits Closure Plan (BPCP). If the contractor open new query or borrow pits will be required to prepare and implement the BPCP before the handover the project facilities.
- The borrow pits are immediately backfilled after excavation related works and replanted with vegetation. The contractor and the local population will be informed of the public safety measures related to open borrow pits.

e) Fire outbreak

The construction of irrigation infrastructures will require a fuel store for re-fuelling the heavy equipment used for earth works. Mistakes with handling fuels or electrical short circuits can easily result in fire outbreaks that could cause serious damage, like loss of equipment, property. Further, the project area either is located in Savannah area where bush fires are frequently due to vandalism or accidentally, or during the dry season if a nearby field is being burned.

✓ **Impact Significance**

This impact is of low in significance in terms of magnitude and spatial extent. It could occur only during construction phase and only in areas of refuelling or uninsulated areas, however, it is a pre-cautious and avoidable impact. It can also occur during burning agriculture residue in neighbour.

➤ **Mitigation Measure(s)**

Regular checks on electrical installations and proper insulation of cables, to prevent short circuits that could trigger fires:

- Specific area restricted to only authorize personnel, should be allocated for fuel storage.
- Such an area should have sufficient fire extinguishing equipment to stop fires escalating.
- Water tank automobiles with hose pipes need to be part of the equipment required at the sites, for purposes of extinguishing fires.
- Fire management drills for the workers should regularly be done.
- Fire breaks emergency response plan, fire fighting training, first aid training and firefighting equipment such as extinguisher should be provided.

f) High Community Expectations

Consultations with the communities revealed that the communities' expectations are high in regard to the propose irrigation interventions and some time are expecting much during compensation phase . local community are also expecting to use water free of charge while the water fees law under preparation requires farmers to pay water fees

✓ **Impact Significance**

This impacts is of medium significance and may affect the sustainability of project if expectation are not well managed.

➤ **Mitigation measures**

- Local administration – particularly at cell level – will need to manage these expectations through consultation with local community and other stakeholders;
- Stakeholders and consultation with local community should be integral part of project implementation.
- Stakeholder Communication Strategy detailing how community expectations can be managed, and the roles that the authorities and KIIWP Project Teams in implementing the Communication Strategy.

Table 79: Summary of impacts significance during construction phases

Impacts	Positive impact	With No mitigation measures			With mitigation measures
		Low	Medium	High	
Positive impacts					
Employment opportunity	+				
Capacity building of farmers	+				
Affordability of education and increased access to medical Insurance	+				
Ecosystems Protection and restoration	+				
Revegetation and increased tree cover	+				
Negative impacts					
Labour influx and conflict with local community			==		-
Physical and Economic Displacement			==		-
Income losses from missed farming season during construction period				===	-
Workers Occupational health and safety/ Injuries or fatalities				===	-
Traffic congestion and accidents				===	-

Possible increases of HIV/AIDS and communicable diseases			■ ■	■ ■ ■ ■	■
Child labour, forced labour , discrimination and abusive dismissal			■ ■	■ ■ ■ ■	■
Loss of flora and fauna during site clearance				■ ■ ■ ■	■
Loss of flora and fauna in Command area and Command area catchment		■		■ ■ ■ ■	■
Loss of nesting areas			■ ■	■ ■ ■ ■	■
Potential encroachment of lake buffer zone and wetlands				■ ■ ■ ■	■
Soil erosion		■		■ ■ ■ ■	■
Air and Noise Pollution			■ ■	■ ■ ■ ■	■
Loss of soil fertility			■ ■	■ ■ ■ ■	■
Borrow Pit and quarry Impacts			■ ■	■ ■ ■ ■	■
Fire outbreak		■		■ ■ ■ ■	■
High Community Expectations			■ ■	■ ■ ■ ■	■
+	Positive environmental and Social Impacts				
■	Low significance negative impact				
■ ■	Medium significance negative impact				
■ ■ ■ ■	High significance impacts				

7.3.3. Negative Impact during Operation Phase

During operational phase, key adverse impacts are expected to come from water abstraction and irrigation operation as well agriculture practices including poor cultivation practices, eg. tilling, excessive use of chemical inputs, mono-cropping for long periods of time, Poor application of, and/or excessive use of agrochemical inputs etc.

7.3.3.1. Socio-economic Impacts

a) Water conflicts arising from the creation of irrigation scheme

With the coming of the irrigation schemes that involves land consolidation program for collective growing and harvesting, distribution of water through irrigation, if the locals are not organized into institutional frameworks, might cause conflict over who gets water for irrigation and what amount is meant for each of the plots, zones, etc, who is wasting water by leakage or spillage. The water conflict may also arise between users of water for irrigation and those for other users (domestic use like livestock). This can escalate in conflicts, enmity or vandalism.

➤ Impact Significance

The impact could be medium significance in terms of magnitude and duration given that a number of users including cattle keepers, fishermen and local community are already using water for small scale irrigation or domestic use. This impact can be long-term impacts if mitigation measures are not implemented.

➤ Mitigation Measure(s)

- Create and operationalize Cooperative and WUA that include all users to manage water distribution, maintenance of the irrigation infrastructure and resolve arising conflicts over water distribution within Ndego site.
- Creation of grievance of water users association to help in the management of grievances and implement irrigation calendar ;

h) Limited access to Pasture, Grazing and water for cattle

Irrigation schemes may hinder access paths used by livestock to reach water sources or pasture, as observed at the pumped irrigation sites in Ndego and Kabare Sectors. It was noted that cattle are getting water from lakes and with the establishment of irrigation schemes the access maybe limited.

✓ Impact significance

This impact can have medium significance given that only few pastures and grazing area were observed in project area.

➤ **Mitigation Measure(s)**

Proposed mitigation measures included:

- The design should consider the possibility of providing alternative watering points (eg. troughs) for livestock at locations as agreed with the communities and livestock owners;
- Now the National Land Use Master Plan is available, local level land use plans need to be developed which demarcate land use for different purposes. All grazing areas inside the command area will be identified and related in consultation with local communities.

c) Human-wild life conflict due to the proximity of schemes with wild animals

As it was indicated in section 4.4.5. from pg 84, the project area is bordering both national During consultations with the communities, farmers reported that their farms are frequently raided by hippos which reside in the dams and valley tanks, and also by baboons. This has led to substantial loss of crops, and poses a danger to farmers as well. With enhanced crop yields this impacts may increase as proposed crops may attract these animals and cause losses to local communities who may hit back and kill wild animals. The Government has already established a fund to compensate crops and livestock affected by wild animal and park fencing is ongoing.

✓ **Impact Significance**

The impact could be of medium significance in terms of magnitude depending of damages and killed animals but the Command area and Command area catchment are not closure to the park which reduces the risk (0.14km from Ihema block, 1,3km Kibare blocks and 5.8m from Nasho block).

➤ **Mitigation measures**

The sustainable mitigation measures would be to fence command area and Command area Catchment but this mitigation is not feasible from financial perspective The consultant team was informed that Rwanda development Board is putting electrical fence on parks and once this is completed, it will reduce the risk. In meantime, it is recommended that:

- The 50 m buffer one from lakes and wetlands has to be observed as required by environment law;
- Local Community will be sensitised on the importance of protection of wild animals and report any case to local authorities and Park rangers
- The cases registered will be reported to GRCs and reported to the national insurance fund for compensation of losses.

d) Vandalism of irrigation infrastructure

With the coming of the project, a number of infrastructures will be made from metal, steel, concrete, sluice gates, valves. It also should be noted that not all locals will be pleased with the project initiatives, later on the existence of petty thieves in the area. From experience of previous irrigation projects, if farmers are not organized in such as to have community policing to guard the infrastructure, they will be vandalized and sold elsewhere.

➤ **Impact Significance**

The impact could be of medium significance in terms of magnitude. With community policing encouraged in Rwanda and organized cooperatives operating in the project area, such an impact might be of short term scattered periods of vandalism.

➤ **Mitigation Measure(s)**

- Early establishment of farm organization (i.e. into groups, cooperative and WUA) as the management structure at the project site, sensitization of farmers to ensure project ownership and effecting community policing as a means of ascertaining security, will collectively avoid vandalism.
- Regulations on penalties to perpetrators convicted of vandalism are necessary. Punitive actions towards perpetrators by the authorities will facilitate compliance by the locals thereby avoiding vandalism.

c) Increased Spread of Water Borne Diseases such as malaria

According to Health institutions, Malaria is responsible for 46.3% of morbidity cases in Kayonza District. The proposed irrigation schemes will result in pools of stagnant water(Canals, balancing water storages etc) which

provide breeding habitats for mosquitoes. Water borne diseases such as; dysentery, diarrhea, stomach-related disorders specifically infestation by worms, all resulting from using the canal water for domestic purposes (drinking and cooking) may also affect local community.

➤ **Impact Significance**

The impact of disease spread will be long term for as long as the reservoir is existing and drainage canals which are habitats for disease vectors and the scale and severity is also moderately high and can be severe especially for children under 5 years and pregnant mothers who are vulnerable to malaria.

The scope of the impact will initially be localized but transmission of the disease is likely to extend the scope beyond the project area.

➤ **Mitigation Measure(s)**

- KIIWP should develop a program in collaboration with the Ministry of Health (MINISANTE) and the local communities which undertakes bi-annual survey of health records in Health Care Facilities (HCFs) to ascertain the spread of malaria and other water borne diseases. This data should then be used to develop a disease prevention programme within Ndego project that could include use of Insecticide Treated Nets for malaria control, Indoor Residual Spraying among others.
- The project should also develop water points or, in collaboration with WASAC, supply water to PAPs for domestic uses. The formed cooperatives shall need to work with local authorities in restricting locals from using water from the drains/canals for domestic consumption. Awareness meetings on hygiene of potable water will be encouraged.
- Mosquito repelling plants/trees such as Artemisia, Geranium and Neem around homesteads and fields should be promoted.

d) Damages of developed infrastructures

Due to the supply of water throughout the targeted Ndego area, there is a likelihood of local farmers encroaching the canals in case of insufficient water supplied to the plantations or by cattle keepers who are searching for water. This will lead to damages of encroached infrastructures. There is also lack of or poor maintenance of access roads, land husbandry infrastructures (drainage systems, damaged embankments, etc) and post-harvest facilities.

➤ **Impact Significance**

The impact will be medium significance, considering locals are aware of the environmental law restricting a buffer zone of 2 and 5 m from all small and medium water courses respectively, 20m around marshlands and the zero grazing policy is being successfully implemented.

➤ **Mitigation Measure(s)**

- There should be provision of troughs for cattle;
- A buffer zone of at one meter(1) should be established along the main drainage canals and at least five meters in the surroundings of the balancing storages. This buffer would be made by grasses.
- Regular cleaning and repair/ maintenance of damaged infrastructures through community works, etc.
- Training of schemes users on maintenance of irrigation, land husbandry infrastructures, access roads and post-harvest infrastructures (PHIs).
- Prepare and implement operation and maintenance.

➤ **Climate Risks and impacts**

The project is classified by SECAP's climate risk classification guidelines, KIIWP as high risk because it promotes agricultural activity on areas subject to extreme climatic events, such especially prolonged drought. Climate change projections shows that Project area foresee changes in temperature, rainfall or extreme weather that will adversely affect the Project's impact, sustainability or cost over its lifetime.

➤ **Impact Significance**

Project interventions themselves are intended to reduce vulnerability to the effects of climate change and the project will not increase the risk or vulnerability. However, Climate changes may have high significant impacts on project and this risk is not well taken in design.

Some of the mitigation measures recommended include:

- The design team should consider irrigation system that use efficiently available water
- During operational phase farmers will be trained on efficient water use techniques and conservation during the irrigation
- Establishment of clear irrigation calendar and inform the local community about it.

e) Wastage of water due to poor irrigation practices

Ignorance and insufficient skills of farmers on the irrigation could result in poor management of water distribution to plantations. In-experienced people managing the water realized, from the central drain into the secondary canals, excessive amounts of water released into the plantations, water leakages in the open channels, could all result in wastage of water meant for efficient irrigation during dry seasons.

➤ Impact Significance

The impact will be medium significance, considering locals are training and operational and Maintenance manual is prepared and implemented.

➤ Mitigation Measure(s)

- Creation of Water User's Association (WUAs) to manage quantities of apportioned water for each crop, hence reducing on likely water misuse. WUAs are required to have trained technicians in water management, infrastructure control and repair. These will be of technical assistance to WUAs in managing water losses.
- Frequent inspection and repairs of leaking infrastructure is necessary to reduce on losses of water through leakages.
- Water allocation infrastructure such as; off take structures of metal floodgates, wooden beams should only be managed by trained technicians. This will avoid excessive distribution of water thereby preventing wastage of water from the central drain.

e) Lack of ownership and sustainability

Irrigation system requires ownership from landowners and if there is no ownership, sustainability can be jeopardized, as expected results may not be achieved.

➤ Impact Significance

The impact can be of high significance if people are not involved in planning and implementation of proposed project.

✓ Mitigation measures

Proposed mitigation measures include:

- To involve community in all stages of the development of project activities subprojects, including siting of infrastructure.
- Community should be consulted on their ability to contribute, and the modalities of how they can or are able to contribute, since not all members of the communities have access to cash or loans at any given time.
- The Project design needs to be more specific about the involvement of youth as well as the physically challenged members of the Project communities and where needed assistance should be provided to vulnerable people.

7.3.3.2. Impact on Physical Environment

a) Reduced level of the lake water

The construction of BS and irrigation pipelines for irrigation involves deviation of the water flow from the Kibare or Nasho lake to the irrigation channels. Due to this, the level of the lake might reduce, therefore

disrupting activities and sources of livelihood that depend on the water and interferes with water flow in Akagera river, connected with the lakes. This is a medium term impact that only happens when the water will be diverted to the BS and canals/ pipes during drought period.

➤ **Impact Significance**

The impact will be high magnitude, severity and scale. Water abstraction of lakes water to fill up the BS and irrigate the command area will reduce the lake level and connected Akagera river flow. This impact is medium term and only expected to occur during the BS fill up over drought period.

➤ **Mitigation Measure(s)**

- Regulate water abstraction for irrigation and other uses. Irrigation Water should be efficiently used, especially during dry or drought period to enable schemes users downstream to continue to receive water all time and in adequate quantity. To achieve this, measures to minimize water losses / wastage should be adopted. In this regard, the calendar for water irrigation should be established and adopted by competent authority (WUA/ Cooperative and Kayonza District), communicated to all schemes users and its implementation well monitored. Damaged canals and pipes should immediately be repaired.
- There is a need to install master meters as part of the infrastructure to be developed. The master meter will be used to control the amounts of water abstracted from the lakes (Kibare and Nasho), thus allowing for management of water abstraction and water flow downstream.
- Lake levels in Lake Kibare should not be dropped below 1283.79 m.a.s.l. while in Nasho lake, the lake level should not be allowed to drop below 1285 m.a.s.l. Setting the thresholds depends on the purpose of water abstraction (Annual Lakes level are presented under water availability- table17).

b) Water wastage due to evaporation and seepage

The retention of water in the BS and Canals would lead to increased evaporation leading to surface water loss, ground seepage and spills. Open canals will increase the surface area exposed to evaporation of water. Furthermore, there are possibilities of water losses from open channel cracks. Loss of water through evaporation in the balancing storages is anticipated during drought periods. The anticipated water loss might also be through leaks and ground seepage.

➤ **Impact Significance**

The water loss will be through percolation, spills and leaks, evaporation among other factors. As the temperature in the project sites are mild, loss of water through evaporation is not going to be of significant impact. The water loss by evaporation, percolation, spills and leaks will also be of limited impact since pipelines will be used in the irrigation system. Water losses are likely to occur in case of pipes damages or defects.

➤ **Mitigation**

The damages or defects in irrigation infrastructures should immediately be fixed to minimize water losses through leakage. The irrigation farmers can also adopt water saving irrigation approach. Regular BS, pipes and canals inspections are needed to detect possible leakages early enough so as to reduce on avoidable water losses. The design of the irrigation system must include proper drainage network allowing for collection of runoff to avoid siltation and damages.

c) Surface Water Resource Pollution

The use of fertilizers and pesticides in the command area is going to be a potential source of introducing nutrients into the water resource of the marshlands and lakes downstream.

These chemicals, if applied in large amounts and at inappropriate time, will pollute water resources in the lakes and marshland and have cumulative effects in the basin and groundwater. Pesticides applied will bio-accumulate in the soaked soils of the command area, upset the natural ecological balance and biodiversity of the wetlands downstream.

➤ **Impact Significance**

The impact can be high in terms of magnitude and depending on the quantities of agrochemicals used. The scope of the impact will be felt throughout the drainage system and beyond hence cumulative and will be long term for as long as the chemical runoff continue ending up in the drainage network causing nutrient load effect. However, taking into consideration the national consumption of fertilizers per hectare (less than 4 kg/ha/year) (MINAGRI, 2007) and pesticides (0.1 kg/ha/year), the impact of fertilizer and pesticide is not going to be severe.

➤ **Mitigation Measure(s)**

- The Implementing Entity (RAB/SPIU) has to prepare a Pest Management Plan for the entire project which will provide guidance on the judicious use of agrochemicals in the cultivation and production of crops. Farmers will also be trained in techniques of agrochemical applications (handling, labelling and application of agro-chemicals under field conditions). The training should be incorporated in a farmer's field school (FFS) curriculum or farming as business (FAB) approach.
- Extension workers should also be able to deliver awareness program on the amounts and conditions for applying fertilizers and pesticides to prevent water pollution.
- Putting in place techniques aiming at filtering pollutants introduced into the water system through farm runoff such as creation of buffer zones along drainage canals, stabilizing drainage canals with grasses, etc. should be encouraged.

d) Ground Water Contamination

Infiltration of irrigation water in excess of available root zone storage will penetrate beyond the reach of roots and eventually recharge groundwater. Nitrates, salts, and other chemicals used in crop cultivation that dissolves in the soil water will move with the water. Crops with high water and N requirements (rice and vegetables) will increase the potential risk of nitrate pollution to groundwater. Because they do not evaporate, nitrates/nitrites are likely to remain in water until consumed by plants or other organisms.

➤ **Impact significance**

This impact will have medium significance given that buffer zone of 50m has to be observed as required by environmental regulations. However, area closer to wetlands may be affected especially in areas with light-textured soils and intensive production of shallow-rooted crops that will contribute to considerable nitrate losses by leaching.

➤ **Mitigation**

- Mitigating ground water contamination will require similar measures as used in preventing surface water pollution. Preventive measures will include practicing IPM and rational application of fertilizer only as a last results while use of organic manure.
- Soil nutrient management plan should be prepared

e) Water logging and Salinization

Ndego area is located in semi-arid zone of Rwanda where precipitations do not exceed 700mm. During the implementation of this project, the use of lime, fertilizers and pesticides is anticipated. There are four main ways through which salinization can occur in irrigation practice. These ways include:

- Addition of lime in most of the soils during the cultivation to boost the soil fertility.
- Residues of solutes applied to the soil in the form of artificial and natural fertilizers as well as some pesticides that have not been taken up by crops;
- Salts carried in irrigation water are liable to build up in the soil profile, as water is removed by plants and the atmosphere at a much faster rate than salts.

Considering the weather of the site (low rainfall, high temperature, high evaporation, etc) and the fact that agricultural inputs will be applied for increased agricultural production, there is a probability of salt build up to occur in the intervention areas especially through the residue salts and salt build up in the soil profile. This is likely to lead to soil salinity and reduced crops yields in the long run.

➤ **Impact Significance**

The impact could be of high significance in terms of magnitude and considering the quantities of chemicals applied. The impact could have a long term deteriorating effect on the soil.

➤ **Mitigation measures**

- With a properly determined crop water requirement, micro-management of irrigation water to specifically satisfy this need and regular monitoring of Crop Water requirement to regulate the water quantity released to the catchments, the likelihood of water logging and salinization will be minimized.
- Training of farmers to regulate quantities of water used will be a long term investment in sustaining the chemical properties of the soil for continuous fertility.
- Regulated amounts of fertilizer applied based on actual nutrients required.

f) Canal Siltation

Canal siltation is an adverse impact that clogs the canals leading to less flow of water into the command area and farming fields and this can reduce the crop yields. Increased soil erosion and siltation is generally impacting the hydrology of the command area negatively. Furthermore, clogged canals could soon become possible breeding site for mosquitoes if not maintained and unclogged.

Mitigation Measure(s)

- Establishment of silt trap zones: Silt trap zones have been included in the general design of the project and the canals will be flushed as frequent as possible to minimize this impact.
- Farmers should proceed with regular removal of silt and sediments in canals;
- Training on maintenance of the water canals: The project team should provide training for the local farmers on how to operate and maintain the water intake points, CPT and canals to ensure that there is no blockage or flooding.
- Catchment protection through biological measures should be implemented.

g) Water losses from evaporation

The project design include around 19 water-balancing reservoirs and given the level of evaporation in the area, there might be water losses due to evaporation. For example considering an inundated reservoir area of about 5% of the irrigated area, and additional 2 mm/day for evaporation and seepage losses from the reservoir, further water demand is about 3 650 m³/ha/year. A very approximate estimation for overall irrigation water demand is about 18,000 m³/ha/year of which about 3,000 to 7,000 m³/ha/year is supplemental to the natural hydrological condition in the marshland, or on average 5,000 m³/ha/year (National Water Resources Master Plan, MINIRENA 2014).

➤ **Mitigation Measures**

- Regular reservoir and canal inspections to detect possible leakages early enough so as to reduce on avoidable water losses.
- Irrigation canals need to be lined in areas with pervious soils to prevent ground seepage of water into the soil.
- Use of conveyance pipe instead of Canal

h) Floods from balancing reservoir over flow or collapse

It is proposed to have water Circumstances when the reservoir overflows or when its collapses and bursts should be envisioned. Though the planned balancing storage are small and store a small amount of water overflow or collapse may occur; causing soil erosion, crop destruction, destruction of property.

✓ **Impact Significance**

The impact could be low significant given that what is proposed is only balancing reservoir and water will be directly used for irrigation.

✓ **Mitigation Measure(s)**

- A Spillway has been designed will act as a flood control structure. This means that should the water level exceed reservoir height above ground, water will be evacuated via the spillway thereby avoiding the dam from being damaged or destroyed by water flowing on, over or against it.
- A Cut-off trench shall be included in the design of the dam to reduce seepage and improve stability of the dam, preventing it from tipping to allow water from the reservoir to flood downstream.
- Regular inspection of likely areas of weakness along the dam (such as; cracks, fissures) by qualified and experienced expert personnel is crucial to avoiding such calamities. In case of fissures, it can be cleaned off and concreted. For larger indentations or cracks, slush grouting should be used, which is a thick slurry mix of cement and water poured and bloomed into the larger cracks and fissures before any concrete is laid to fill the remaining indentations.
- Regular monitoring is essential to detect seepage and prevent failure. Downstream from the reservoir, seepage may be measured by increased flow from ground water springs in existence prior to the reservoir as might be caused by the pool of water behind the dyke.
- Also regular reservoir water level measures might indicate seepage. Continuous and sudden drop in the normal reservoir level could be sign that there is actual seepage that requires treatment to avoid collapse of the reservoir .
- **Installation of monitoring instrument:** The objective of the instrumentation monitoring is to determine that the behaviour of the dam is in accordance with predictions or, if this is not the case, to assess the likely cause and impact of any untoward occurrence. As part of normal operating procedures, the instruments will be monitored regularly to observe changes that occur and to confirm that movements, foundation pressures and seepage values are within acceptable limits.

7.3.3.3. Adverse impacts on Biological environment during operation phase

Anticipated impacts on biological environment during operational phase will mainly come from water abstractions into lakes for irrigation, poor application or overuse of chemical fertilizers and pesticides.

a) Loss of biodiversity

Based on ecological survey in the project area including biodiversity of the wetlands south of the Akagera National Park (see section 4.4), the wetlands within the Project area are rich in biodiversity. Any disturbance to these wetlands, for example due to changes in water flow regimes because of water abstraction for the proposed irrigation schemes may affect fauna and flora species. Further, overuse of agrochemicals could affect macro-invertebrates and flora that thrive under particular water flow regimes. This may affect fringes natural vegetation and probably local community crops and agro-biodiversity in the immediate areas surrounding the marshlands.

➤ Impact significance

The Impact can be of high significance given that the water will abstracted from lakes with important biodiversity both in lakes and wetlands.

➤ Mitigation measures

- The use of compost/organic farming instead of inorganic fertilizers and the adoption of IPM practices should be encouraged to reduce the amount of chemicals that end up in the water.
- The avoidance of ecosystem destruction from the use of agrochemicals will be taken into account to minimize chemical usage as described in different above sections of this report.
- A buffer zone of 50m has to be observed when delineating command area;
- Minimum ecological flow estimated has to be respected and Lake levels in Lake Kibare should not be dropped below 1280 m.a.s.l. while in Nasho lake, the lake level should not be allowed to drop below 1283 m.a.s.l. Setting the thresholds depends on the purpose of water abstraction (Annual Lakes level are presented under water availability- table17).

b) Emergence of Pests and Crop Diseases

The increased acreage of irrigated hillside land will create a more humid environment that may result in an increase of agricultural pests and plant diseases. Change to a more uniform environment on the subproject

areas will favour vigorous species adapted to a wide variety of conditions. Diseases and weeds will spread quickly via the re-use of waste-water and drainage water.

➤ **Impact significance**

The Impact can be of high significance given that the water will be abstracted from lakes with important biodiversity both in lakes and wetlands. Increased pests and plant diseases will affect farm harvest and lead to food insecurity and malnutrition. Increased pests and crop diseases will trigger increased use of pesticides leading to water contamination.

➤ **Mitigation**

- To mitigate against emergence of pests and diseases an incorporation of IPM approaches are proposed. These measures should involve rotational cropping practices which preserve greater diversity in habitat thus reducing impact of pest and diseases. Maize or bean varieties used in this project should be selected from the ones already introduced in Rwanda in order to avoid new diseases and pests. Other diseases tolerant crops can also be used.

c) Water weeds and reduction of aquatic life

Many of Rwandan water bodies, including lakes in Eastern Province, are infested with weeds, like water hyacinth (*Eichornia crassipes*). There is a risk that those weeds will invade new irrigation infrastructures (BS and canals) and the downstream part where waste water, infected with weeds, will be disposed of due to increased use of fertilizers in irrigated command area. Improper application and increased application of fertilizers in these areas will lead to leaching of the nutrients into the marshland downstream providing a good environment for weeds to grow there. The existence of vegetation in BS and canals also contributes to the emissions of methane, a potential Greenhouse Gas, and it is preferable that weeds and vegetation be cleared, whenever they appear. The presence of water hyacinth or other weeds may lead to BS and canals eutrophication as well as marshland and loss of aquatic biodiversity.

✓ **Impact significance**

The Impact can be of medium significance given that the water will be abstracted from lakes with important biodiversity both in lakes and wetlands. Balancing water storages and Canals can also be affected.

➤ **Mitigation**

Water weeds survive in water bodies due to supply of nutrients. To prevent infestation of weeds in the BS, canals and downstream area of the CA, the following is proposed:

- Attention should be taken to avoid invasive species during re-vegetation of the area. The water hyacinth (*Eichornia crassipes*), responsible for much disruption of aquatic systems, must not be introduced in marshlands ecosystem. Wherever it appears, it should mechanically be controlled.
- Periodic manual removal of weeds from the BS and canals is proposed, to avoid the possibility of an uncontrollable invasion of the irrigation facilities by weeds.
- Nutrients should not be allowed to enter the BS and canals. This should be achieved through practicing protection of the catchments and rational application of fertilizer in farms.

d) Loss of ecosystem services

Degradation of lakes and wetlands due to pollution or over water abstraction could lead to the loss of some services in particular a loss of biodiversity and aquatic habitat, water regulation and purification, climate regulation, fishing etc. According to the socio-economic baseline survey, 53% of households in the project area rely on water accessed from the surrounding lakes and streams suggesting that the lakes and other low-lying areas provide an important source of water for local communities. 99% of the households in the proposed project area rely on firewood as their main source of cooking energy suggesting a high dependence on the local area for a supply of fuelwood.

➤ **Significance of impacts**

The significance of this impact can be high as it directly affecting livelihood of local community and ecological function.

✓ **Mitigation measures**

Mitigation measures recommended include:

- Maintain environmental flow requirements taking into account human, livestock and ecological needs;
- Monitor surface water levels in Lake Nasho and Kibare) and ensure measures are in place to prevent the withdrawal of water in excess of the recharge rate;
- Install water abstraction monitoring infrastructure (gauges);
- Construct alternative water access points for affected households;
- Construct community livestock water point;
- Install water-harvesting structures to capture surface water run-off.

Table 80: Summary of impact significance during operation phase

Impacts	Positive impact	With No mitigation measures			With mitigation measures
		Low	Medium	High	Low
Positive impacts					
Employment opportunity	+				
Capacity building of farmers	+				
Affordability of education and increased access to medical Insurance	+				
Increased exploitable area and agricultural productivity by farming all year round	+				
Increased farm incomes from crop output	+				
Productive use of hillsides	+				
Market access for agricultural products	+				
Collective harvest for large quantities and market continuity	+				
Increased Livestock fodder	+				
Food Security	+				
Poverty Alleviation	+				
Land Appreciation	+				
Provision of fuel wood	+				
Improved soil conservation	+				
Improved water source conservation	+				
Adaptation to climate change and prolonged drought	+				
Ecosystems Protection and restoration	+				
Increased tree cover	+				
Increased habitat for fauna and flora	+				
Negative impacts					
Water conflicts arising from the creation of irrigation scheme			++		-
Limited access to Pasture, Grazing and water for cattle			++		-
Human-wild life conflict due to the proximity of schemes with wild animals				+++	++
Vandalism of irrigation infrastructure			++		-
Increased Spread of Water Borne Diseases			++		-
Damages of developed infrastructures			++		-
Climate Risks and impacts				+++	++
Wastage of water due to poor irrigation practices			++		++
Reduced level of the lake water				+++	++
Lack of ownership and sustainability				+++	-
Water losses from evaporation and leakages			++		-

Surface Water Resource Pollution by fertilizers and pesticides			■ ■	■ ■ ■	■
Ground Water Contamination fertilizers and pesticides				■ ■ ■	■ ■
Water logging and Salinization		■		■ ■ ■	■
Canal Siltation			■ ■	■ ■ ■	■
Loss of aquatic biodiversity and wetlands biodiversity				■ ■ ■	■
Emergence of Pests and Crop Diseases				■ ■ ■	■
Water weeds and reduction of aquatic life		■		■ ■ ■	■
Floods from balancing storages due over flow or collapse			■ ■	■ ■ ■	■
+	Positive environmental and Social Impacts				
■	Low significance				
■ ■	Medium significance				
■ ■ ■	High significance impacts				

CHAPTER EIGHT: ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

The Environmental and Social Management and Monitoring Plan (ESMMP) are broadly divided into two parts: an **Environmental and Social Management Plan (ESMP)** and **Environmental and Social Monitoring Plan**.

The Environmental and Social Management Plan provides a logical framework within which identified negative impacts shall be mitigated and monitored and positive impacts enhanced. It indicates the expected impact, action to mitigate it, time frame, and responsible institution and the estimated cost. It translates proposed mitigation and management measures into actions to be undertaken during the construction and operational phases of the project. It establishes roles, responsibilities, and implementing procedures for effective execution of the mitigation measures.

The Environmental and Social Monitoring Plan details monitoring activities and measures to be undertaken during construction and operation phases. It provides key parameters to be monitored, indicators and means of verification, frequency and timeframe, responsible institution and the estimated cost. The costs for implementation and monitoring of the mitigation measures are just indicative. Appropriate bills of quantities should clearly give actual figures. In any case the consultant used informed judgment to come up with these figures. The three schemes are very close and are almost similar in terms of proposed irrigation systems land husbandry techniques and environmental and social baselines. Apart from the source of water, the other difference is only the size of projects features as shown in this summary table.

No	Main Features	Blocks			Total
		B1 (Kabare)	B2 (Ihema)	B3 (Nasho)	
1	Gross Command Area (Ha)	600.0	830.0	1,070.0	2,500
2	Net Irrigation Area (Ha)	482.8	636.5	898.9	2,018.2
3	Number of Sub-blocks (No)	5	2	3	10
4	Sub-blocks served	B1-1 to B1-5	B2-1 to B2-2	B3-1 to B3-3	
5	Number of CPT (No)	10	14	16	40
6	Drainage Channels (m)	15,118	35,663	30,211	80,992
7	Main pipeline to CPT & Sprinkler (m)	24,776	21,842	26,958	73,576
8	Distribution and infield pipeline to Sprinkler (m)	38,460	53,206	62,415	154,081
9	Access road (m)	26,209	28,041	25,261	79,511

Source: Feasibility study, 2020

For easy monitoring and implementation of proposed mitigation measures, it was proposed to present Environmental and Social Management Plans by blocks. Key difference between blocks being block size source of irrigation water and the number of proposed structures. In terms of physical environment, biological environment and Socio-economic baseline information or proposed technologies both irrigation and land husbandry, there is no much difference. Other differences are from resettlement impacts based on the size of proposed structure such as balancing water storages, pressure pipe, grazing area and cattle sheds inside the command area (see table 11&12 in Chapter 2).

These Environmental and Social Management Plans translate mitigation measures described in chapter 7 into implementation actions with estimated cost. Further, a monitoring Plan is provided and include general monitoring plan as well as monitoring plan for specific parameters.

8.1. Environmental and Social Management Plan for three Blocks

Table 81: Environmental and Social Management Plan for Nasho Block

Adverse Impacts	Proposed Mitigation/Enhancement measures	Implementat ion schedule	Responsible Institution	Occurrence	Estimated costs (US\$)
Planning and design phase					
Encroachment of protected areas	- A buffer zone of 50m should be kept from lake shores in detailed design	Detailed design	Designing consultant	Once	Design budget
Ecological imbalances and loss of ecological services	- Both water availability, water requirement and environmental flow has been calculated during feasibility study and this should be confirmed during detailed design. Climate change scenarios and future development should be also considered. - Detailed design should provide water management and monitoring tools such as irrigation calendar, water monitoring system and efficient irrigation system/technologies	Detailed design	Designing consultant	Once	Design budget
Water and soil pollution	- 50m buffer zone from lakes shores should be maintained and well demarcated and restoration activities of lake shores should be included in watershed protection package during detailed design; - Recommended application rate for fertilizers should be confirmed in detailed design and the project budget should considered organic manure; - As part of project preparation, KIIWP management should hire a consultant to prepare an Integrated Pest Management Plan; - Extensive farmers training should be planned and provided before the operational phase and extension services should be provided to farmers.	Detailed design Before operational phase Before operational phase	Designing consultant RAB/KIIWP RAB/KIIWP	Once Once Ongoing	Design budget Operation budget Community development Budget
Compliance with environmental Flows.	- Detailed design should provide water management and monitoring tools such as irrigation calendar, water monitoring system and efficient irrigation system/technologies to ensure that all users are served and ecological functions are maintained - Water abstraction permit should be obtained from Rwanda Water Board (RWB) and environmental flow instructed by the authority should be complied with.	Detailed design Before operational phase	Designing consultant RAB/KIIWP	Once Once	Design budget N/A
Uncontrolled sourcing of construction material and establishment of work camps	- Detailed design should identify Quarry sites / borrow pits to prevent uncontrolled sourcing of construction material. - Detailed design shall also identify suitable locations for construction work camps, stockpile areas, storage areas, and disposal areas and other facilities near to the project locations. - The contractor will be requested to prepare environmental Management and Rehabilitation plans for quarries, borrow pits and working areas	Detailed design Before sourcing material	Designing consultant Contractor	Once Once	Design budget 8,000 ²⁵
Climate Risks and impacts	- The design team should consider irrigation system that use efficiently available water	Detailed design	Designing consultant	Once	Design budget

²⁵ According to RAPEP price for a simplified Management plan is around 2000USD and +- 4 plans will be required per block

Planning and construction Phase					
Labour influx and conflict with local community	<ul style="list-style-type: none"> - Preparation and Implementation of employment and recruitment Policy including code of conduct - Grievance redress mechanism will be established and made operational - Effort Should be made to use local communities especially for works which do not requires high technical skills 	Planning and Mobilization	Contractor RAB/SPIU IFAD, District	Once Ongoing	2,000 Operational Budget
High Community Expectations	<ul style="list-style-type: none"> - Local administration – particularly at cell level – will need to manage these expectations through consultation with local community and other stakeholders; - Stakeholders and consultation with local community should be integral part of project implementation. - Stakeholder Communication Strategy detailing how community expectations can be managed, and the roles that the authorities and KIIWP Project Teams in implementing the Communication Strategy. 	Planning and Mobilization	RAB/SPIU IFAD, District	Ongoing	Operational Budget
Physical and Economic Displacement	<ul style="list-style-type: none"> - To prepare and implement a Resettlement Action Plan Prior and construction works or land take. - Proper compensation measures and livelihood restoration programmes should be discussed and agreed with affected community in compliance with existing regulations - Conduct consultation with local communities who have grazing areas and cattle sheds in commend area and agree on the relocation outside command area 	Designing phase	RAB/SPIU IFAD, District	Once happened	RAP budget
Income losses from missed farming season during construction period	<ul style="list-style-type: none"> - A livelihoods restoration plan including cash for work program will be prepared and affected should be given an affirmative priority in employment; - A clear implementation program indicating areas to be levelled and partitioned, dates when they will occur and a monitoring exercise involving project staff, sector agronomists and established cooperative committees should establish. It should also be shared with the local farmers as an awareness campaign. 	Planning stage	RAB/SPIU IFAD	As needed	Operational Cost
Workers occupational health and safety hazards	<ul style="list-style-type: none"> - Workers on the site should be provided with appropriate protective gears such as; wellington boots, helmets, nose masks, eye goggles and overalls. - The contractor together with local authorities is required to enforce acquiring medical insurance “mituelle de sante” for all workers as a means of affordability of treatment and - Toolbox talks on OHS, emergency response plans, labour management, traffic management, first aid training and response, etc... should be included in contractor obligations; - A qualified ESHS officer will be included in contractor key staff - First aid Kits and first aid helper will be provided at each working area and medical agreement will be established with nearest health Center in case of emergence or serious injuries. - The contractor will be required to have life insurance for all workers; 	Construction stage	Contactor and Supervising engineer		5,000 24,000 ²⁶ 5,000 5,000

²⁶ ESHS officer salary for 24months implementation period with a monthly payment of 1000\$/month

Traffic congestion and injuries or fatalities	<ul style="list-style-type: none"> - Provision of training to train drivers - Preparation and traffic management plan including signage and speed limit 	Construction phase	Contractor		2,000
Possible increases of HIV/AIDS and communicable diseases	<ul style="list-style-type: none"> - Regular sensitization on ways of HIV/AIDS prevention, importance of proper hygiene is important during execution of this project. - The contractor is requested to arrange a health and hygiene training for workers in cooperation with health centre near the construction site, in order to prevent infectious diseases 	Construction Phase	Contractor with Health Centers and Local Authorities	At least three times	3,000 ²⁷
Child labour, forced labour, discrimination and abusive dismissal		Construction and Recruitment Phases	Contractor, Supervising engineer and local authority	As required	NA
Loss of flora and fauna during site clearance	<ul style="list-style-type: none"> - One staff need to be trained and made responsible for handling and relocating nests to trees, which will not be affected, should be appointed. - Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal. - Careful supervision of clearing activities so that only areas required for infrastructure and agricultural infrastructure are cleared - Location of pumping station should consider areas where there is no much natural vegetation and if there is no other alternative; the design team will consider reducing the number of them. - Respect 50m buffer zone for other project components which does not have to be near lakes 	Construction Phase	Contractor	Ongoing	NA
Loss of flora and fauna in Command area and Command area catchment	<ul style="list-style-type: none"> - Lost local species (such as <i>Ipomoea involucrata</i> and <i>Acanthus pubescens</i>) can be offset by applying them on water catchment protection and in protection of water balance reservoirs and irrigation canals and benches; - Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal. - Avoid cutting trees which are beyond the area designated for construction 	Contractor	Construction Phase	Ongoing	Part of land husbandry budget
Loss of nesting habitats	<ul style="list-style-type: none"> - During field survey, almost all nests were live and this may be the case if construction are scheduled in nesting period as provided in baseline data. Therefore, where possible, clearance works will be scheduled during nesting-off period; - Before clearance and tree cutting, a rapid survey will be done to identify live nests and relocate them or avoid them. 	Construction phase	Contractor and Supervising firm		NA 2,000

²⁷ At least three awareness and outreach campaign will be undertaken

Potential encroachment of lake buffer zone and wetlands for borrow pits, disposal area or construction yard	<ul style="list-style-type: none"> - During detailed design the national requirements for buffer zones must be accommodated. - Excessive use of chemical fertilizers should be avoid; - Borrow pits, disposal area or construction yard should be located outside buffer one 	Construction phase	Contractor and Supervising firm		NA
Soil erosion	<ul style="list-style-type: none"> - Only clear areas earmarked for construction; - Create contour drains during construction; especially in borrow pits and PHIs areas. - Planting vegetation on the cleared sites immediately after construction of ditches and soil bunds' embankments and waterways, cut off drains/ gullies; - Avoid earthworks during heavy rains (mid-March to mid-May), especially in access roads works; - Disposal of unused stockpiled topsoil before rains. 	Construction phase	Contractor and Supervising firm		NA Part of Land husbandry works
Air and Noise Pollution	<ul style="list-style-type: none"> - Spray water regularly when clearing land to reduce the dust, especially under roads works; - Works should be executed during daytime, ie from 7.00 am to 18.00 pm - Generators for use at the site shall have silencers to reduce on the noise emitted and regularly maintained; - Workers will be provided with personal protective equipment. - Avoiding burning of any kinds of waste or construction materials 		Contractor and Supervising firm		Construction budget
Loss of soil fertility	<ul style="list-style-type: none"> - Application of good quality organic materials including compost, green manure, mulch, etc. to improve soil properties. - Biological measures including agroforestry and grasses plantation will be implemented to reduce erosion but also improved soil nutrient; - Application of lime after construction to reduce soil acidity. However, given the sandy soil observed in the area but also potential impacts on soil and water, the minimum rate is advised(2t/ha) 	During Land husbandry works	Contractor and Supervising firm		Land husbandry budget
Borrow Pit and quarry Impacts	<ul style="list-style-type: none"> - Once borrow pits are identified, borrow pits management Plan will be prepared and implemented and should include backfilling procedures, rehabilitation plan that proposes how pits should be accessed and egressed, excavated, top soil preserved, reinstatement methods, drainage methods etc; - Develop and implement an EMP including Borrow Pits Closure Plan (BPCP). - If the contractor open new query or borrow pits will be required to prepare and implement the BPCP before the handover the project facilities. - The borrow pits are immediately backfilled after excavation related works and replanted with vegetation. 	During construction	Contractor and Supervising firm		10,000
Fire outbreak	<ul style="list-style-type: none"> - Specific area restricted to only authorize personnel, should be allocated for fuel storage. - Such an area should have sufficient fire extinguishing equipment to stop fires escalating. - Water tank automobiles with hose pipes need to be part of the equipment required at the sites, for purposes of extinguishing fires. 				2,000

	<ul style="list-style-type: none"> - Fire management drills for the workers should regularly be done based Fire breaks emergency response plan, 				
Operation Phase					
Water conflicts arising from the creation of irrigation scheme	<ul style="list-style-type: none"> - Create and operationalize Cooperative and WUA that include all users (farmers, cattle keepers, fishermen) to manage water distribution, maintenance of the irrigation infrastructure and resolve arising conflicts over water distribution within Ndego site. - Creation of grievance of water users association to help in the management of grievances and implement irrigation calendar ; 	Before operation	RAB/Kayonz a district	Ongoing	Operational cost
Limited access to Pasture, Grazing and water for cattle	<ul style="list-style-type: none"> - Alternative watering points (eg. troughs) for livestock and for domestic should be provided at locations agreed with the communities and livestock owners; - Newly approved Land use master Plan will be implemented and local level land use plans need to be developed which demarcate land use for different purposes. - All grazing areas inside the command area will be identified and relocated in consultation with local communities. 	Before operation	RAB/Kayonz a district	Ongoing	20,000 ²⁸ Operational cost RAP budget
Human wild life conflict	<ul style="list-style-type: none"> - Local Community will be sensitised on the importance of protection of wild animals and report any case to local authorities and Park rangers - The cases registered will be reported to GRCs and reported to the national insurance guarantee firm for compensation of losses 	Operation	RAB/Kayonz a district	Ongoing	2,000
Lack of ownership and sustainability	<ul style="list-style-type: none"> - To involve community in all stages of the development of project activities subprojects, including siting of infrastructure. - Community should be consulted on their ability to contribute, and the modalities of how they can or are able to contribute, since not all members of the communities have access to cash or loans at any given time. - Youth, women and vulnerable people need to be identified and given a special attention and where needed assistance should be provided to vulnerable people. 	Operation	RAB/Kayonz a district	Ongoing	2,000
Vandalism of irrigation infrastructure	<ul style="list-style-type: none"> - Early establishment of farm organization (i.e. into groups, cooperative and WUA) as the management structure at the project site, sensitization of farmers to ensure project ownership and effecting community policing as a means of ascertaining security, will collectively avoid vandalism. 	Operation	RAB/Kayonz a district	Ongoing	2,000
Increased Spread of Water Borne Diseases	<ul style="list-style-type: none"> - Bi-annual survey of health records in Health Care Facilities (HCFs) to ascertain the spread of malaria and other water borne diseases. - The project should also develop water points or, in collaboration with WASAC, supply water to PAPs for domestic uses in order to restrict locals from using water from the drains/canals for domestic consumption. Awareness meetings on hygiene of potable water will be encouraged. - Mosquito repelling plants/trees such as Artemisia, Geranium and Neem around homesteads and fields should be promoted. 	Operation	RAB/Ministry of Health	Once year	5,000
Damages of developed	<ul style="list-style-type: none"> - There should be provision of troughs for cattle; - A buffer zone of 2m should be established along the main drainage canals and 10m 	Before operational	RAB/Contrac	Once	5,000

²⁸ At least Two cattle watering point and two water points are need by block and based on same experience one would cost around 5,000USD

infrastructures	<ul style="list-style-type: none"> in the surroundings of the balancing storages. - Regular cleaning and repair/ maintenance of damaged infrastructures through community works, etc. - Training of schemes users on maintenance of irrigation, land husbandry infrastructures, access roads and post-harvest infrastructures (PHIs). - Prepare and implement operation and maintenance 	Phase	tor		Maintenance budget
Wastage of water	<ul style="list-style-type: none"> - Frequent inspection and repairs of leaking infrastructure is necessary to reduce on losses of water through leakages. - Water allocation infrastructure such as; off take structures of metal flood gates, wooden beams should only be managed by trained technicians. This will avoid excessive distribution of water thereby preventing wastage of water from the central drain 	Operation	RAB/SPIU)	Ongoing	Operational and maintenance budget
Reduced level of the lake water and Akagera river water flow	<ul style="list-style-type: none"> - There is a need to install master meters as part of the infrastructure to be developed at selected points to monitor lake level. The master meter will be used to control the amounts of water abstracted from the lakes (Kibare and Nasho), thus allowing for management of water abstraction and water flow downstream. - Lake levels in Lake Kibare should not be dropped below 1280 m.a.s.l. while in Nasho lake, the lake level should not be allowed to drop below 1283 m.a.s.l. Setting the thresholds depends on the purpose of water abstraction 	Operation	RAB/SPIU)		Operational and maintenance budget
Surface Water and ground water Pollution	<ul style="list-style-type: none"> - to prepare the Integrated Pest Management Plan for the entire project which will provide guidance on the judicious use of agrochemicals in the cultivation and production of crops. - Farmers will also be trained in techniques of agrochemical applications (handling, labelling and application of agro-chemicals under field conditions).The training should be incorporated in a farmer's field school (FFS) curriculum or farming as business (FAB) approach. - Soil nutrient management plan should be prepared 	Operation	RAB/SPIU)	Ongoing	10,000 for three schemes
Canal Siltation	<ul style="list-style-type: none"> - Farmers should proceed with regular removal of silt and sediments in canals; - The project team should provide training for the local farmers on how to operate and maintain the water intake points, CPT and canals to ensure that there is no blockage or flooding. - Catchment protection through biological measures will be implemented 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational cost
Loss of aquatic biodiversity	<ul style="list-style-type: none"> - The use of compost/organic farming instead of inorganic fertilizers and the adoption of IPM practices should be encouraged to reduce the amount of chemicals that end up in the water. - A buffer zone of 50m from lakes has to be respected in project design 	Operational phase	RAB/WUAs and farmers	Ongoing	NA
Emergence of Pests and Crop Diseases	<ul style="list-style-type: none"> - To mitigate against emergence of pests and diseases an incorporation of IPM approaches are proposed. These measures should involve rotational cropping practices which preserve greater diversity in habitat thus reducing impact of pest and diseases. Maize or bean varieties used in this project should be selected from the ones already introduced in Rwanda in order to avoid new diseases and pests. Other diseases tolerant crops can also be used 	Operational phase	RAB/WUAs and farmers	Ongoing	NA

Water weeds and reduction of aquatic life	<ul style="list-style-type: none"> - Attention should be taken to avoid invasive species during re-vegetation of the area. The water hyacinth (<i>Eichornia crassipes</i>), responsible for much disruption of aquatic systems, must not be introduced in marshlands ecosystem. Wherever it appears, it should mechanically be controlled. - Periodic manual removal of weeds from the BS and canals is proposed, to avoid the possibility of an uncontrollable invasion of the irrigation facilities by weeds. - Nutrients should not be allowed to enter the BS and canals. This should be achieved through practicing protection of the catchments and rational application of fertilizer in farms. 	Operational phase	RAB/WUAs and farmers	Ongoing	2,000
Water losses from evaporation and leakages	<ul style="list-style-type: none"> - Regular inspection of balancing reservoir and canal to detect possible leakages early enough and make repaired if required as to reduce on avoidable water losses. 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational & maintenance budget
Floods from balancing reservoir over flow or collapse	<ul style="list-style-type: none"> - A Spillway has been designed will act as a flood control structure. This means that should the water level exceed reservoir height above ground, water will be evacuated via the spillway thereby avoiding the dam from being damaged or destroyed by water flowing on, over or against it. - A Cut-off trench shall be included in the design of the dam to reduce seepage and improve stability of the dam, preventing it from tipping to allow water from the reservoir to flood downstream. - Regular monitoring is essential to detect seepage and prevent failure. Downstream from the reservoir, seepage may be measured by increased flow from ground water springs in existence prior to the reservoir as might be caused by the pool of water behind the dyke. - Also regular reservoir water level measures might indicate seepage. Continuous and sudden drop in the normal reservoir level could be sign that there is actual seepage that requires treatment to avoid collapse of the reservoir - As part of normal operating procedures the instruments will be monitored regularly to observe changes that occur and to confirm that movements, foundation pressures and seepage values are within acceptable limits. 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational and maintenance budget
Climate Risks and impacts	<ul style="list-style-type: none"> - During operational phase farmers will be trained on efficient water use techniques and conservation during the irrigation - Establishment of clear irrigation calendar and inform the local community about it 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational and maintenance budget
Total budget	-				116,000

Table 82: Environmental and Social Management Plan for Kibare scheme

Adverse Impacts	Proposed Mitigation/Enhancement measures	Implementat ion schedule	Responsible Institution	Occurrence	Estimated costs (US\$)
Planning and design phase					
Encroachment of protected areas	- A buffer zone of 50m should be kept from lake shores in detailed design	Detailed design	Designing consultant	Once	Design budget
Ecological imbalances and loss of ecological services	- Both water availability, water requirement and environmental flow has been calculated during feasibility study and this should be confirmed during detailed design. Climate change scenarios and future development should be also considered. - Detailed design should provide water management and monitoring tools such as irrigation calendar, water monitoring system and efficient irrigation system/technologies	Detailed design	Designing consultant	Once	Design budget
Water and soil pollution	- 50m buffer zone from lakes shores should be maintained and well demarcated and restoration activities of lake shores should be included in watershed protection package during detailed design; - Recommended application rate for fertilizers should be confirmed in detailed design and the project budget should considered organic manure; - As part of project preparation, KIIWP management should hire a consultant to prepare an Integrated Pest Management Plan; - Extensive farmers training should be planned and provided before the operational phase and extension services should be provided to farmers.	Detailed design Before operational phase Before operational phase	Designing consultant RAB/KIIWP RAB/KIIWP	Once Once Ongoing	Design budget Operation budget Community development Budget
Compliance with environmental Flows.	- Detailed design should provide water management and monitoring tools such as irrigation calendar, water monitoring system and efficient irrigation system/technologies to ensure that all users are served and ecological functions are maintained - Water abstraction permit should be obtained from Rwanda Water Board (RWB) and environmental flow instructed by the authority should be complied with.	Detailed design Before operational phase	Designing consultant RAB/KIIWP	Once Once	Design budget N/A
Uncontrolled sourcing of construction material and establishment of work camps	- Detailed design should identify Quarry sites / borrow pits to prevent uncontrolled sourcing of construction material. - Detailed design shall also identify suitable locations for construction work camps, stockpile areas, storage areas, and disposal areas and other facilities near to the project locations. - The contractor will be requested to prepare environmental Management and Rehabilitation plans for quarries, borrow pits and working areas	Detailed design Before sourcing material	Designing consultant Contractor	Once Once	Design budget 8,000 ²⁹

²⁹ According to RAPEP price for a simplified Management plan is around 2000USD and +- 4 plans will be required per block

Climate Risks and impacts	<ul style="list-style-type: none"> - The design team should consider irrigation system that use efficiently available water 	Detailed design	Designing consultant	Once	Design budget
Planning and construction Phase					
Labour influx and conflict with local community	<ul style="list-style-type: none"> - Preparation and Implementation of employment and recruitment Policy including code of conduct - Grievance redress mechanism will be established and made operational - Effort Should be made to use local communities especially for works which do not requires high technical skills 	Planning and Mobilization	Contractor RAB/SPIU IFAD, District	Once Ongoing	2,000 Operational Budget
High Community Expectations	<ul style="list-style-type: none"> - Local administration – particularly at cell level – will need to manage these expectations through consultation with local community and other stakeholders; - Stakeholders and consultation with local community should be integral part of project implementation. - Stakeholder Communication Strategy detailing how community expectations can be managed, and the roles that the authorities and KIIWP Project Teams in implementing the Communication Strategy. 	Planning and Mobilization	RAB/SPIU IFAD, District	Ongoing	Operational Budget
Physical and Economic Displacement	<ul style="list-style-type: none"> - To prepare and implement a Resettlement Action Plan Prior and construction works or land take. - Proper compensation measures and livelihood restoration programmes should be discussed and agreed with affected community in compliance with existing regulations - Conduct consultation with local communities who have grazing areas and cattle sheds in commend area and agree on the relocation outside command area 	Designing phase	RAB/SPIU IFAD, District	Once happened	RAP budget
Income losses from missed farming season during construction period	<ul style="list-style-type: none"> - A livelihoods restoration plan including cash for work program will be prepared and affected should be given an affirmative priority in employment; - A clear implementation program indicating areas to be levelled and partitioned, dates when they will occur and a monitoring exercise involving project staff, sector agronomists and established cooperative committees should establish. It should also be shared with the local farmers as an awareness campaign. 	Planning stage	RAB/SPIU IFAD	As needed	Operational Cost
Workers occupational health and safety hazards	<ul style="list-style-type: none"> - Workers on the site should be provided with appropriate protective gears such as; wellington boots, helmets, nose masks, eye goggles and overalls. - The contractor together with local authorities is required to enforce acquiring medical insurance “mituelle de sante” for all workers as a means of affordability of treatment and - Toolbox talks on OHS, emergency response plans, labour management, traffic management, first aid training and response, etc... should be included in contractor obligations; - A qualified ESHS officer will be included in contractor key staff - First aid Kits and first aid helper will be provided at each working area and medical 	Construction stage	Contactor and Supervising engineer		5,000 24,000 ³⁰

³⁰ ESHS officer salary for 24months implementation period with a monthly payment of 1000\$/month

	<p>agreement will be established with nearest health Center in case of emergence or serious injuries.</p> <ul style="list-style-type: none"> - The contractor will be required to have life insurance for all workers; 				5,000
					5,000
Traffic congestion and injuries or fatalities	<ul style="list-style-type: none"> - Provision of training to train drivers - Preparation and traffic management plan including signage and speed limit 	Construction phase	Contractor		2,000
Possible increases of HIV/AIDS and communicable diseases	<ul style="list-style-type: none"> - Regular sensitization on ways of HIV/AIDS prevention, importance of proper hygiene is important during execution of this project. - The contractor is requested to arrange a health and hygiene training for workers in cooperation with health centre near the construction site, in order to prevent infectious diseases 	Construction Phase	Contractor with Health Centers and Local Authorities	At least three times	3,000 ³¹
Child labour, forced labour, discrimination and abusive dismissal		Construction and Recruitment Phases	Contractor, Supervising engineer and local authority	As required	NA
Loss of flora and fauna during site clearance	<ul style="list-style-type: none"> - One staff need to be trained and made responsible for handling and relocating nests to trees, which will not be affected, should be appointed. - Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal. - Careful supervision of clearing activities so that only areas required for infrastructure and agricultural infrastructure are cleared - Location of pumping station should consider areas where there is no much natural vegetation and if there is no other alternative; the design team will consider reducing the number of them. - Respect 50m buffer zone for other project components which does not have to be near lakes 	Construction Phase	Contractor	Ongoing	NA
Loss of flora and fauna in Command area and Command area catchment	<ul style="list-style-type: none"> - Lost local species (such as <i>Ipomoea involucrata</i> and <i>Acanthus pubescens</i>) can be offset by applying them on water catchment protection and in protection of water balance reservoirs and irrigation canals and benches; - Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal. - Avoid cutting trees which are beyond the area designated for construction 	Contractor	Construction Phase	Ongoing	Part of land husbandry budget
Loss of nesting habitats	<ul style="list-style-type: none"> - During field survey, almost all nests were live and this may be the case if construction are scheduled in nesting period as provided in baseline data. Therefore, where possible, clearance works will be scheduled during nesting-off period; 	Construction phase	Contractor and Supervising firm		NA

³¹ At least three awareness and outreach campaign will be undertaken

	<ul style="list-style-type: none"> - Before clearance and tree cutting, a rapid survey will be done to identify live nests and relocate them or avoid them. 				2,000
Potential encroachment of lake buffer zone and wetlands for borrow pits, disposal area or construction yard	<ul style="list-style-type: none"> - During detailed design the national requirements for buffer zones must be accommodated. - Excessive use of chemical fertilizers should be avoid; - Borrow pits, disposal area or construction yard should be located outside buffer one 	Construction phase	Contractor and Supervising firm		NA
Soil erosion	<ul style="list-style-type: none"> - Only clear areas earmarked for construction; - Create contour drains during construction; especially in borrow pits and PHIs areas. - Planting vegetation on the cleared sites immediately after construction of ditches and soil bunds' embankments and waterways, cut off drains/ gullies; - Avoid earthworks during heavy rains (mid-March to mid-May), especially in access roads works; - Disposal of unused stockpiled topsoil before rains. 	Construction phase	Contractor and Supervising firm		NA Part of Land husbandry works
Air and Noise Pollution	<ul style="list-style-type: none"> - Spray water regularly when clearing land to reduce the dust, especially under roads works; - Works should be executed during daytime, ie from 7.00 am to 18.00 pm - Generators for use at the site shall have silencers to reduce on the noise emitted and regularly maintained; - Workers will be provided with personal protective equipment. - Avoiding burning of any kinds of waste or construction materials 		Contractor and Supervising firm		Construction budget
Loss of soil fertility	<ul style="list-style-type: none"> - Application of good quality organic materials including compost, green manure, mulch, etc. to improve soil properties. - Biological measures including agroforestry and grasses plantation will be implemented to reduce erosion but also improved soil nutrient; - Application of lime after construction to reduce soil acidity. However, given the sandy soil observed in the area but also potential impacts on soil and water, the minimum rate is advised(2t/ha) 	During Land husbandry works	Contractor and Supervising firm		Land husbandry budget
Borrow Pit and quarry Impacts	<ul style="list-style-type: none"> - Once borrow pits are identified, borrow pits management Plan will be prepared and implemented and should include backfilling procedures, rehabilitation plan that proposes how pits should be accessed and egressed, excavated, top soil preserved, reinstatement methods, drainage methods etc; - Develop and implement an EMP including Borrow Pits Closure Plan (BPCP). - If the contractor open new query or borrow pits will be required to prepare and implement the BPCP before the handover the project facilities. - The borrow pits are immediately backfilled after excavation related works and replanted with vegetation. 	During construction	Contractor and Supervising firm		10,000
Fire outbreak	<ul style="list-style-type: none"> - Specific area restricted to only authorize personnel, should be allocated for fuel storage. - Such an area should have sufficient fire extinguishing equipment to stop fires escalating. 				2,000

	<ul style="list-style-type: none"> - Water tank automobiles with hose pipes need to be part of the equipment required at the sites, for purposes of extinguishing fires. - Fire management drills for the workers should regularly be done based Fire breaks emergency response plan, 				
Operation Phase					
Water conflicts arising from the creation of irrigation scheme	<ul style="list-style-type: none"> - Create and operationalize Cooperative and WUA that include all users (farmers, cattle keepers, fishermen) to manage water distribution, maintenance of the irrigation infrastructure and resolve arising conflicts over water distribution within Ndego site. - Creation of grievance of water users association to help in the management of grievances and implement irrigation calendar ; 	Before operation	RAB/Kayonz a district	Ongoing	Operational cost
Limited access to Pasture, Grazing and water for cattle	<ul style="list-style-type: none"> - Alternative watering points (eg. troughs) for livestock and for domestic should be provided at locations agreed with the communities and livestock owners; - Newly approved Land use master Plan will be implemented and local level land use plans need to be developed which demarcate land use for different purposes. - All grazing areas inside the command area will be identified and relocated in consultation with local communities. 	Before operation	RAB/Kayonz a district	Ongoing	20,000 ³² Operational cost RAP budget
Human wild life conflict	<ul style="list-style-type: none"> - Local Community will be sensitised on the importance of protection of wild animals and report any case to local authorities and Park rangers - The cases registered will be reported to GRCs and reported to the national insurance guarantee firm for compensation of losses 	Operation	RAB/Kayonz a district	Ongoing	2,000
Lack of ownership and sustainability	<ul style="list-style-type: none"> - To involve community in all stages of the development of project activities subprojects, including siting of infrastructure. - Community should be consulted on their ability to contribute, and the modalities of how they can or are able to contribute, since not all members of the communities have access to cash or loans at any given time. - Youth, women and vulnerable people need to be identified and given a special attention and where needed assistance should be provided to vulnerable people. 	Operation	RAB/Kayonz a district	Ongoing	2,000
Vandalism of irrigation infrastructure	<ul style="list-style-type: none"> - Early establishment of farm organization (i.e. into groups, cooperative and WUA) as the management structure at the project site, sensitization of farmers to ensure project ownership and effecting community policing as a means of ascertaining security, will collectively avoid vandalism. 	Operation	RAB/Kayonz a district	Ongoing	2,000
Increased Spread of Water Borne Diseases	<ul style="list-style-type: none"> - Bi-annual survey of health records in Health Care Facilities (HCFs) to ascertain the spread of malaria and other water borne diseases. - The project should also develop water points or, in collaboration with WASAC, supply water to PAPs for domestic uses in order to restrict locals from using water from the drains/canals for domestic consumption. Awareness meetings on hygiene of potable water will be encouraged. 	Operation	RAB/Ministry of Health	Once year	5,000

³² At least Two cattle watering point and two water points are need by block and based on same experience one would cost around 5,000USD

	<ul style="list-style-type: none"> - Mosquito repelling plants/trees such as Artemisia, Geranium and Neem around homesteads and fields should be promoted. 				
Damages of developed infrastructures	<ul style="list-style-type: none"> - There should be provision of troughs for cattle; - A buffer zone of 2m should be established along the main drainage canals and 10m in the surroundings of the balancing storages. - Regular cleaning and repair/ maintenance of damaged infrastructures through community works, etc. - Training of schemes users on maintenance of irrigation, land husbandry infrastructures, access roads and post-harvest infrastructures (PHIs). - Prepare and implement operation and maintenance 	Before operational Phase	RAB/Contractor	Once	5,000 Maintenance budget
Wastage of water	<ul style="list-style-type: none"> - Frequent inspection and repairs of leaking infrastructure is necessary to reduce on losses of water through leakages. - Water allocation infrastructure such as; off take structures of metal flood gates, wooden beams should only be managed by trained technicians. This will avoid excessive distribution of water thereby preventing wastage of water from the central drain 	Operation	RAB/SPIU)	Ongoing	Operational and maintenance budget
Reduced level of the lake water and Akagera river water flow	<ul style="list-style-type: none"> - There is a need to install master meters as part of the infrastructure to be developed at selected points to monitor lake level. The master meter will be used to control the amounts of water abstracted from the lakes (Kibare and Nasho), thus allowing for management of water abstraction and water flow downstream. - Lake levels in Lake Kibare should not be dropped below 1280 m.a.s.l. while in Nasho lake, the lake level should not be allowed to drop below 1283 m.a.s.l. Setting the thresholds depends on the purpose of water abstraction 	Operation	RAB/SPIU)		Operational and maintenance budget
Surface Water and ground water Pollution	<ul style="list-style-type: none"> - to prepare the Integrated Pest Management Plan for the entire project which will provide guidance on the judicious use of agrochemicals in the cultivation and production of crops. - Farmers will also be trained in techniques of agrochemical applications (handling, labelling and application of agro-chemicals under field conditions).The training should be incorporated in a farmer's field school (FFS) curriculum or farming as business (FAB) approach. - Soil nutrient management plan should be prepared 	Operation	RAB/SPIU)	Ongoing	N/A ³³
Canal Siltation	<ul style="list-style-type: none"> - Farmers should proceed with regular removal of silt and sediments in canals; - The project team should provide training for the local farmers on how to operate and maintain the water intake points, CPT and canals to ensure that there is no blockage or flooding. - Catchment protection through biological measures will be implemented 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational cost
Loss of aquatic biodiversity	<ul style="list-style-type: none"> - The use of compost/organic farming instead of inorganic fertilizers and the adoption of IPM practices should be encouraged to reduce the amount of chemicals that end up in the water. - A buffer zone of 50m from lakes has to be respected in project design 	Operational phase	RAB/WUAs and farmers	Ongoing	NA
Emergence of Pests and Crop Diseases	<ul style="list-style-type: none"> - To mitigate against emergence of pests and diseases an incorporation of IPM approaches are proposed. These measures should involve rotational cropping 	Operational	RAB/WUAs	Ongoing	NA

³³ One IPM will be enough for all three schemes

	practices which preserve greater diversity in habitat thus reducing impact of pest and diseases. Maize or bean varieties used in this project should be selected from the ones already introduced in Rwanda in order to avoid new diseases and pests. Other diseases tolerant crops can also be used	phase	and farmers		
Water weeds and reduction of aquatic life	<ul style="list-style-type: none"> - Attention should be taken to avoid invasive species during re-vegetation of the area. The water hyacinth (<i>Eichornia crassipes</i>), responsible for much disruption of aquatic systems, must not be introduced in marshlands ecosystem. Wherever it appears, it should mechanically be controlled. - Periodic manual removal of weeds from the BS and canals is proposed, to avoid the possibility of an uncontrollable invasion of the irrigation facilities by weeds. - Nutrients should not be allowed to enter the BS and canals. This should be achieved through practicing protection of the catchments and rational application of fertilizer in farms. 	Operational phase	RAB/WUAs and farmers	Ongoing	2,000
Water losses from evaporation and leakages	<ul style="list-style-type: none"> - Regular inspection of balancing reservoir and canal to detect possible leakages early enough and make repaired if required as to reduce on avoidable water losses. 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational & maintenance budget
Floods from balancing reservoir over flow or collapse	<ul style="list-style-type: none"> - A Spillway has been designed will act as a flood control structure. This means that should the water level exceed reservoir height above ground, water will be evacuated via the spillway thereby avoiding the dam from being damaged or destroyed by water flowing on, over or against it. - A Cut-off trench shall be included in the design of the dam to reduce seepage and improve stability of the dam, preventing it from tipping to allow water from the reservoir to flood downstream. - Regular monitoring is essential to detect seepage and prevent failure. Downstream from the reservoir, seepage may be measured by increased flow from ground water springs in existence prior to the reservoir as might be caused by the pool of water behind the dyke. - Also regular reservoir water level measures might indicate seepage. Continuous and sudden drop in the normal reservoir level could be sign that there is actual seepage that requires treatment to avoid collapse of the reservoir - As part of normal operating procedures the instruments will be monitored regularly to observe changes that occur and to confirm that movements, foundation pressures and seepage values are within acceptable limits. 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational and maintenance budget
Climate Risks and impacts	<ul style="list-style-type: none"> - During operational phase farmers will be trained on efficient water use techniques and conservation during the irrigation - Establishment of clear irrigation calendar and inform the local community about it 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational and maintenance budget
Total budget	-				106,000

Table 83: Environmental and Social Management Plan for Ihema irrigation scheme

Adverse Impacts	Proposed Mitigation/Enhancement measures	Implementation schedule	Responsible Institution	Occurrence	Estimated costs (US\$)
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Planning and design phase						
Encroachment of protected areas	<ul style="list-style-type: none"> - The option 3 that was proposing to abstract water from lake Ihema is no longer considered and this should be kept during detailed design; - The current delineation of Ihema block has slightly encroached Ihema wetlands which under full protection. The detailed design study should map out this wetland and a buffer zone of 50m should be observed - A buffer zone of 50m should be kept from lake shores in detailed design 	Detailed design	Designing consultant	Once	Design budget	
Water and soil pollution	<ul style="list-style-type: none"> - 50m buffer zone from lakes shores should be maintained and well demarcated and restoration activities of lake shores should be included in watershed protection package during detailed design; - Recommended application rate for fertilizers should be confirmed in detailed design and the project budget should considered organic manure; - As part of project preparation, KIIWP management should hire a consultant to prepare an Integrated Pest Management Plan; - Extensive farmers training should be planned and provided before the operational phase and extension services should be provided to farmers. 	Detailed design Before operational phase Before operational phase	Designing consultant RAB/KIIWP RAB/KIIWP	Once Once Ongoing	Design budget Operation budget Community development Budget	
Uncontrolled sourcing of construction material and establishment of work camps	<ul style="list-style-type: none"> - Detailed design should identify Quarry sites / borrow pits to prevent uncontrolled sourcing of construction material. - Detailed design shall also identify suitable locations for construction work camps, stockpile areas, storage areas, and disposal areas and other facilities near to the project locations. - The contractor will be requested to prepare environmental Management and Rehabilitation plans for quarries, borrow pits and working areas 	Detailed design Before sourcing material	Designing consultant Contractor	Once Once	Design budget 8,000 ³⁴	
Climate Risks and impacts	<ul style="list-style-type: none"> - The design team should consider irrigation system that use efficiently available water 	Detailed design	Designing consultant	Once	Design budget	
Planning and construction Phase						
Labour influx and conflict with local community	<ul style="list-style-type: none"> - Preparation and Implementation of employment and recruitment Policy including code of conduct - Grievance redress mechanism will be established and made operational - Effort Should be made to use local communities especially for works which do not requires high technical skills 	Planning and Mobilization	Contractor RAB/SPIU IFAD, District	Once Ongoing	2,000 Operational Budget	
High Community Expectations	<ul style="list-style-type: none"> - Local administration – particularly at cell level – will need to manage these expectations through consultation with local community and other stakeholders; - Stakeholders and consultation with local community should be integral part of project implementation. - Stakeholder Communication Strategy detailing how community expectations can 	Planning and Mobilization	RAB/SPIU IFAD, District	Ongoing	Operational Budget	

³⁴ According to RAPEP price for a simplified Management plan is around 2000USD and +- 4 plans will be required per block

	be managed, and the roles that the authorities and KIIWP Project Teams in implementing the Communication Strategy.				
Physical and Economic Displacement	<ul style="list-style-type: none"> - To prepare and implement a Resettlement Action Plan Prior and construction works or land take. - Proper compensation measures and livelihood restoration programmes should be discussed and agreed with affected community in compliance with existing regulations - Conduct consultation with local communities who have grazing areas and cattle sheds in command area and agree on the relocation outside command area 	Designing phase	RAB/SPIU IFAD, District	Once happened	RAP budget
Income losses from missed farming season during construction period	<ul style="list-style-type: none"> - A livelihoods restoration plan including cash for work program will be prepared and affected should be given an affirmative priority in employment; - A clear implementation program indicating areas to be levelled and partitioned, dates when they will occur and a monitoring exercise involving project staff, sector agronomists and established cooperative committees should establish. It should also be shared with the local farmers as an awareness campaign. 	Planning stage	RAB/SPIU IFAD	As needed	Operational Cost
Workers occupational health and safety hazards	<ul style="list-style-type: none"> - Workers on the site should be provided with appropriate protective gears such as; wellington boots, helmets, nose masks, eye goggles and overalls. - The contractor together with local authorities is required to enforce acquiring medical insurance “mituelle de sante” for all workers as a means of affordability of treatment and - Toolbox talks on OHS, emergency response plans, labour management, traffic management, first aid training and response, etc... should be included in contractor obligations; - A qualified ESHS officer will be included in contractor key staff - First aid Kits and first aid helper will be provided at each working area and medical agreement will be established with nearest health Center in case of emergence or serious injuries. - The contractor will be required to have life insurance for all workers; 	Construction stage	Contractor and Supervising engineer		3,000 12,000 ³⁵ 5,000 5,000
Traffic congestion and injuries or fatalities	<ul style="list-style-type: none"> - Provision of training to train drivers - Preparation and traffic management plan including signage and speed limit 	Construction phase	Contractor		2,000
Possible increases of HIV/AIDS and communicable diseases	<ul style="list-style-type: none"> - Regular sensitization on ways of HIV/AIDS prevention, importance of proper hygiene is important during execution of this project. - The contractor is requested to arrange a health and hygiene training for workers in cooperation with health centre near the construction site, in order to prevent infectious diseases 	Construction Phase	Contractor with Health Centers and Local Authorities	At least three times	3,000 ³⁶

³⁵ ESHS officer salary for 12 months implementation period given that water abstraction will be done from Kibare block and this block will need reduced implementation period with a monthly payment of 1000\$/month

³⁶ At least three awareness and outreach campaign will be undertaken

Child labour, forced labour, discrimination and abusive dismissal		Construction and Recruitment Phases	Contractor, Supervising engineer and local authority	As required	NA
Loss of flora and fauna during site clearance	<ul style="list-style-type: none"> - One staff need to be trained and made responsible for handling and relocating nests to trees, which will not be affected, should be appointed. - Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal. - Careful supervision of clearing activities so that only areas required for infrastructure and agricultural infrastructure are cleared - Respect 50m buffer zone in delineation of command area for other project components which does not have to be near lakes 	Construction Phase	Contractor	Ongoing	NA
Loss of flora and fauna in Command area and Command area catchment	<ul style="list-style-type: none"> - Lost local species (such as <i>Ipomoea involucrata</i> and <i>Acanthus pubescens</i>) can be offset by applying them on water catchment protection and in protection of water balance reservoirs and irrigation canals and benches; - Avoid any killing of animal during the construction work. Before construction works start, workers need to be sensitized and briefed to avoid any killing of animal. - Avoid cutting trees which are beyond the area designated for construction 	Contractor	Construction Phase	Ongoing	Part of land husbandry budget
Potential encroachment of lake buffer zone and wetlands for borrow pits, disposal area or construction yard	<ul style="list-style-type: none"> - During detailed design the national requirements for buffer zones must be accommodated. - Excessive use of chemical fertilizers should be avoid; - Borrow pits, disposal area or construction yard should be located outside buffer one 	Construction phase	Contractor and Supervising firm		NA
Soil erosion	<ul style="list-style-type: none"> - Only clear areas earmarked for construction; - Create contour drains during construction; especially in borrow pits and PHIs areas. - Planting vegetation on the cleared sites immediately after construction of ditches and soil bunds' embankments and waterways, cut off drains/ gullies; - Avoid earthworks during heavy rains (mid-March to mid-May), especially in access roads works; - Disposal of unused stockpiled topsoil before rains. 	Construction phase	Contractor and Supervising firm		NA Part of Land husbandry works
Air and Noise Pollution	<ul style="list-style-type: none"> - Spray water regularly when clearing land to reduce the dust, especially under roads works; - Works should be executed during daytime, ie from 7.00 am to 18.00 pm - Generators for use at the site shall have silencers to reduce on the noise emitted and regularly maintained; - Workers will be provided with personal protective equipment. - Avoiding burning of any kinds of waste or construction materials 		Contractor and Supervising firm		Construction budget
Loss of soil fertility	<ul style="list-style-type: none"> - Application of good quality organic materials including compost, green manure, mulch, etc. to improve soil properties. 	During Land husbandry	Contractor and		Land husbandry

	<ul style="list-style-type: none"> - Biological measures including agroforestry and grasses plantation will be implemented to reduce erosion but also improved soil nutrient; - Application of lime after construction to reduce soil acidity. However, given the sandy soil observed in the area but also potential impacts on soil and water, the minimum rate is advised(2t/ha) 	works	Supervising firm		budget
Borrow Pit and quarry Impacts	<ul style="list-style-type: none"> - Once borrow pits are identified, borrow pits management Plan will be prepared and implemented and should include backfilling procedures, rehabilitation plan that proposes how pits should be accessed and egressed, excavated, top soil preserved, reinstatement methods, drainage methods etc; - Develop and implement an EMP including Borrow Pits Closure Plan (BPCP). - If the contractor open new query or borrow pits will be required to prepare and implement the BPCP before the handover the project facilities. - The borrow pits are immediately backfilled after excavation related works and replanted with vegetation. 	During construction	Contractor and Supervising firm		5,000
Fire outbreak	<ul style="list-style-type: none"> - Specific area restricted to only authorize personnel, should be allocated for fuel storage. - Such an area should have sufficient fire extinguishing equipment to stop fires escalating. - Water tank automobiles with hose pipes need to be part of the equipment required at the sites, for purposes of extinguishing fires. - Fire management drills for the workers should regularly be done based Fire breaks emergency response plan, 				2,000
Operation Phase					
Water conflicts arising from the creation of irrigation scheme	<ul style="list-style-type: none"> - Create and operationalize Cooperative and WUA that include all users (farmers, cattle keepers, fishermen) to manage water distribution, maintenance of the irrigation infrastructure and resolve arising conflicts over water distribution within Ndego site. - Creation of grievance of water users association to help in the management of grievances and implement irrigation calendar ; 	Before operation	RAB/Kayonza district	Ongoing	Operational cost
Limited access to Pasture, Grazing and water for cattle	<ul style="list-style-type: none"> - Newly approved Land use master Plan will be implemented and local level land use plans need to be developed which demarcate land use for different purposes. - All grazing areas inside the command area will be identified and relocated in consultation with local communities. 	Before operation	RAB/Kayonza district	Ongoing	Operational cost RAP budget
Human wild life conflict	<ul style="list-style-type: none"> - Local Community will be sensitised on the importance of protection of wild animals and report any case to local authorities and Park rangers - The cases registered will be reported to GRCs and reported to the national insurance guarantee firm for compensation of losses 	Operation	RAB/Kayonza district	Ongoing	2,000
Lack of ownership and sustainability	<ul style="list-style-type: none"> - To involve community in all stages of the development of project activities subprojects, including siting of infrastructure. - Community should be consulted on their ability to contribute, and the modalities of how they can or are able to contribute, since not all members of the communities 	Operation	RAB/Kayonza district	Ongoing	2,000

	<p>have access to cash or loans at any given time.</p> <ul style="list-style-type: none"> - Youth, women and vulnerable people need to be identified and given a special attention and where needed assistance should be provided to vulnerable people. 				
Vandalism of irrigation infrastructure	<ul style="list-style-type: none"> - Early establishment of farm organization (i.e. into groups, cooperative and WUA) as the management structure at the project site, sensitization of farmers to ensure project ownership and effecting community policing as a means of ascertaining security, will collectively avoid vandalism. 	Operation	RAB/Kayonza district	Ongoing	2,000
Increased Spread of Water Borne Diseases	<ul style="list-style-type: none"> - Bi-annual survey of health records in Health Care Facilities (HCFs) to ascertain the spread of malaria and other water borne diseases. - The project should also develop water points or, in collaboration with WASAC, supply water to PAPs for domestic uses in order to restrict locals from using water from the drains/canals for domestic consumption. Awareness meetings on hygiene of potable water will be encouraged. - Mosquito repelling plants/trees such as Artemisia, Geranium and Neem around homesteads and fields should be promoted. 	Operation	RAB/Ministry of Health	Once year	5,000
Damages of developed infrastructures	<ul style="list-style-type: none"> - A buffer zone of 2m should be established along the main drainage canals and 10m in the surroundings of the balancing storages. - Regular cleaning and repair/ maintenance of damaged infrastructures through community works, etc. - Training of schemes users on maintenance of irrigation, land husbandry infrastructures, access roads and post-harvest infrastructures (PHIs). - Prepare and implement operation and maintenance 	Before operational Phase	RAB/Contractor	Once	Maintenance budget
Wastage of water	<ul style="list-style-type: none"> - Frequent inspection and repairs of leaking infrastructure is necessary to reduce on losses of water through leakages. - Water allocation infrastructure such as; off take structures of metal flood gates, wooden beams should only be managed by trained technicians. This will avoid excessive distribution of water thereby preventing wastage of water from the central drain 	Operation	RAB/SPIU)	Ongoing	Operational and maintenance budget
Surface Water and ground water Pollution	<ul style="list-style-type: none"> - to prepare the Integrated Pest Management Plan for the entire project which will provide guidance on the judicious use of agrochemicals in the cultivation and production of crops. - Farmers will also be trained in techniques of agrochemical applications (handling, labelling and application of agro-chemicals under field conditions).The training should be incorporated in a farmer's field school (FFS) curriculum or farming as business (FAB) approach. - Soil nutrient management plan should be prepared 	Operation	RAB/SPIU)	Ongoing	N/A ³⁷
Canal Siltation	<ul style="list-style-type: none"> - Farmers should proceed with regular removal of silt and sediments in canals; - The project team should provide training for the local farmers on how to operate and maintain the water intake points, CPT and canals to ensure that there is no blockage or flooding. 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational cost

³⁷ One IPM will be enough for three schemes

	- Catchment protection through biological measures will be implemented				
Loss of aquatic biodiversity	<ul style="list-style-type: none"> - The use of compost/organic farming instead of inorganic fertilizers and the adoption of IPM practices should be encouraged to reduce the amount of chemicals that end up in the water. - A buffer zone of 50m from lakes has to be respected in delineating command area project design 	Operational phase	RAB/WUAs and farmers	Ongoing	NA
Emergence of Pests and Crop Diseases	- To mitigate against emergence of pests and diseases an incorporation of IPM approaches are proposed. These measures should involve rotational cropping practices which preserve greater diversity in habitat thus reducing impact of pest and diseases. Maize or bean varieties used in this project should be selected from the ones already introduced in Rwanda in order to avoid new diseases and pests. Other diseases tolerant crops can also be used	Operational phase	RAB/WUAs and farmers	Ongoing	NA
Water weeds and reduction of aquatic life	<ul style="list-style-type: none"> - Attention should be taken to avoid invasive species during re-vegetation of the area. The water hyacinth (<i>Eichornia crassipes</i>), responsible for much disruption of aquatic systems, must not be introduced in marshlands ecosystem. Wherever it appears, it should mechanically be controlled. - Periodic manual removal of weeds from the BS and canals is proposed, to avoid the possibility of an uncontrollable invasion of the irrigation facilities by weeds. - Nutrients should not be allowed to enter the BS and canals. This should be achieved through practicing protection of the catchments and rational application of fertilizer in farms. 	Operational phase	RAB/WUAs and farmers	Ongoing	2,000
Water losses from evaporation and leakages	- Regular inspection of balancing reservoir and canal to detect possible leakages early enough and make repaired if required as to reduce on avoidable water losses.	Operational phase	RAB/WUAs and farmers	Ongoing	O&M budget
Floods from balancing reservoir over flow or collapse	<ul style="list-style-type: none"> - A Spillway has been designed will act as a flood control structure. This means that should the water level exceed reservoir height above ground, water will be evacuated via the spillway thereby avoiding the dam from being damaged or destroyed by water flowing on, over or against it. - A Cut-off trench shall be included in the design of the dam to reduce seepage and improve stability of the dam, preventing it from tipping to allow water from the reservoir to flood downstream. - Regular monitoring is essential to detect seepage and prevent failure. Downstream from the reservoir, seepage may be measured by increased flow from ground water springs in existence prior to the reservoir as might be caused by the pool of water behind the dyke. - Also regular reservoir water level measures might indicate seepage. Continuous and sudden drop in the normal reservoir level could be sign that there is actual seepage that requires treatment to avoid collapse of the reservoir 	Operational phase	RAB/WUAs and farmers	Ongoing	Operational and maintenance budget
Climate Risks and impacts	<ul style="list-style-type: none"> - During operational phase farmers will be trained on efficient water use techniques and conservation during the irrigation - Establishment of clear irrigation calendar and inform the local community about it 	Operational phase	RAB/WUAs and farmers	Ongoing	O&M budget
Total budget	-				60,000

8.2. Environmental and Social Monitoring Plan

8.2.1. Overall environmental and Social Monitoring

The Environmental and Social Monitoring Plan section describes the monitoring plan and proposes key indicators to be monitored. It also indicates measurements of parameters, responsibility and cost estimates of outcomes of the proposed mitigation measures. The ESMP for Ndego project in each block is depicted in table below.

Table 84: Environmental and Social Monitoring Plan

Adverse Impacts	Proposed Mitigation/Enhancement measures	Monitoring indicator	Means of verification	Responsible institution	Timeframe/Frequency	Estimated costs (US\$)
PLANNING AND CONSTRUCTION PHASES						
Loss of properties due to irrigation, LH, PHI and access roads works	Compensation for affected assets	Number of PAPs	Compensation report, site visits report	RAB/KIIWP	Once	1,000
Grievance raised by affected families	Grievance Redress Mechanisms put in place	Operational GRCs created	Complaints recorded and resolved	Cooperative/W UA and District	Continuous	2,000
Workers health and safety including injuries, etc	Preparation and implementation of Contractor's Occupational Health and Safety plan (OHSP)	OHSP report	Field visits report	Contractor, RAB/KIIWP	Every month	construction contract
	Provision of First Aid Kit, one per site and provide training its use	Number of First Aid Kit	Field report	Contractor	once	None
	Life insurance for workers	Number of workers insured	Field report	Contractor	Once	None
Conflicts over project beneficiaries and stakeholders	Consultation meetings with potential beneficiaries and stakeholders	Meetings organized	Minutes of the meetings and attendance lists	District, RAB/KIIWP	one meeting with target group	None
Communicable diseases spread	Health insurance for workers (Mutuelle de Santé or any other insurance)	Number of workers with health insurance	Field report	Contractor, supervising firm	Regularly	None
	Sensitisation of workers and communities on communicable diseases and HIV	Number of sensitization meeting	Minutes and attendance list	Contractor	Twice a month	NA
	Training of workers on occupational and health measures and adherence to them	Number of trained people	Training report	Contractor, RAB/KIIWP	As required	2,000
	Spraying water regularly to suppress excessive dust during construction	Water spraying report	Field report	Contractor	On daily	None
Loss some natural tree species	Planting of trees to replace the ones lost	Tree loss assessment report and Number of trees planted	Tree planting report and field observation	Contractor, RAB/KIIWP	As required	2,000

Soil erosion	<ul style="list-style-type: none"> - Only clear areas earmarked for construction - Creation of temporary drains before the permanent drainage system or contour drains during construction to control storm water efficiently especially in access roads, borrow pits and PHIs areas - Planting of vegetation (native, non-invasive species) on cleared site immediately after construction of ditches and soil bunds' embankments and waterways, cut off drains/ gullies - Avoid earthworks during heavy rains (mid-March to mid-May); - Disposal of unused stockpiled topsoil before rains 	Ha protected	Field verification	Contractor	Once	Construction contract
Contamination of water bodies	<ul style="list-style-type: none"> - Restrict re-fuelling, oil change, maintenance works, repair works will need to allocated a restricted area, far from the water bodies; - Stock for fuels shall need to have a cemented floor and a sand stock for use in the absorption of spilled oil. 	Status of contamination	Field verification report	Contractor	As required	None
Air and Noise pollution	<ul style="list-style-type: none"> - Spraying water regularly when clearing land to reduce the dust during access road construction; - Works should be executed during daytime, ie from 7.00 am to 18.00 pm - Generators for use at the site shall have silencers to reduce on the noise emitted and regularly maintained; - Furthermore, workers will be provided with personal protective equipment. - Avoiding burning of any kinds of waste or construction materials 	Water spraying report; Working hours report, number of workers with PPE	Field verification report	Contractor	As required	None
Increase of Gender based violence (GBV) cases, prostitutions and use of child labour	<ul style="list-style-type: none"> - Reinforcement of the laws on child labour, sexual harassment/ prostitutions and gender equity; - Awareness meetings on GBV, child labour, prostitutions preventions and child protection 	Awareness meetings organized	Minutes of the meetings	RAB/KIWP and District, Contractor and supervising firm	As required	None
Influx of people and risk of diseases transmission	Conducting HIV/AIDS, COVID-19, various diseases awareness and prevention campaigns amongst all members of the workforce and surrounding community.	Awareness meetings organized	Minutes of the meetings	RAB/KIWP and District, Contractor and supervising firm	As required	None
OPERATIONAL PHASE						
Modification of Kibare and Nasho levels and Akagera	Maintain 10% of flow as environmental flow for the survival of the existing ecosystem before it is considered degraded (Montana, 1997).	Quantity of released water	Flow measurement	Water User's Association, RAB/KIWP, RWRB,	Quarterly	No cost applicable

flow for downstream usage				REMA and RDB		
	-Adopt adequate measures for water losses / wastage -Reparation of damaged canals, structures and pipes;	Calendar for water distribution Status of facilities	Water distribution report Report on the status of facilities Field visit	Cooperative, WUA & RAB/KIWP, Kayonza district	Seasonally As needed	5,000
Water wastage	-Frequent inspection and repairs of leaking infrastructure; -Adopt water saving irrigation approach. -Creation of Water User's Association (WUAs) to manage quantities of apportioned water for each crop.	Infrastructure status Calendar for water distribution and infrastructures for runoff management Existing farmers organizations	Report on the status of facilities Water distribution report District or RGB certificate Field visit	RAB/KIWP, Kayonza district	Regularly Seasonally Once after construction completion	None
Water pollution	Training of local farmers on the safe use of pesticides and fertilizers.	Number of farmers trained	Training report	RAB/KIWP and District	Every season	Operation cost
	Creation of buffer zones along drainage canals, BS, etc.	Area (ha) created	Map, field visit	RAB/KIWP and District	Once	Operation cost
	Rational application of fertilizers, pesticides and organic materials	Types, quantity and timing of application, PPE in use	Application report	Cooperative	Seasonally	None
	Irrigation Water quality tests to understand the impact of the project on the quality of water.	Level of biochemical parameters	Laboratory results	MINAGRI /RAB	Tests once every 2 years	5,000
Water logging and salinization	- Regulated amounts of fertilizer applied based on actual nutrients required; - Adequate application of pesticides; - Training of farmers to regulate quantities of water used and application of agrochemicals.	Number of trained people	Training report	Formed Cooperatives/ WUA.	At the beginning of each season	Operation cost
Increased Spread of Water Borne Diseases	-Undertake bi-annual survey in project sites and collect health records from surrounding Health Care Facilities (HCFs); -Supply Insecticide Treated Nets for malaria control and carry out Indoor Residual Spraying in affected households. -Capacity building of schemes users on waterborne diseases trend and prevention -Awareness meetings on hygiene of potable water will be encouraged.	Number of Surveys on waterborne undertaken Cases of waterborne diseases, Number of mosquito nets released or indoor sprays Number of farmers trained Meetings done	Surveys report List of beneficiaries Training manual and report Minutes of meetings	RAB/KIWP and District, MINISANTE	Biannually As needed Seasonally Seasonally	5,000 None None

Risks of occupational health and safety	Use of personal protective equipment during application of fertilizer and pesticides	Number of farmers using PPEs	Field visits	Cooperative, Kayonza District	When applying chemicals	None
Emergence of Pests and Crop Diseases	Adoption of IPM approaches and other good agricultural practices; Use of diseases tolerant crops	Cases of crop pests and diseases recorded	Report on pest & diseases	Cooperative, District	Seasonally	None
Water weeds invasion	Avoiding invasive species during re-vegetation of the area and periodic manual removal of weeds	Types of weeds in the area	Weeds Inventory report	Cooperative, WUA District	Seasonally	None
Conflicts over irrigation water use	Capacity building of Grievance redress committees (GRCs) in every block and monitor GRM process	Issues recorded and meetings organized	Minutes or reports on complaints resolution	GRCs and Cooperatives/ WUAs	As needed	2,000
Vandalism of irrigation infrastructure	Sensitization of farmers to ensure project ownership and effecting community policing as a means of ascertaining security, will collectively avoid vandalism.	Number of sensitization meeting	Sensitization report	Cooperatives, WUA Kayonza district	As required	Operation budget
Sedimentation levels in the water storages and canals	Land husbandry techniques on the catchment area of the BS and canals and training of beneficiaries on infrastructures maintenance	Ha of protected area	Field measurement	RAB/KIIWP	Seasonally	Operation budget
Floods from BS over flow or collapse	- Regular inspection of likely areas of weakness along the BS (such as; cracks, fissures) and repair is crucial to avoid such calamities.	- Monitoring report	- Field verification	WUA MINAGRI/IF AD SPIU	Ongoing	Operation cost
Drowning of children and livestock	- Sensitization of locals on the dangers of swimming and fetching water in the reservoir.	Number of people who attended meeting	Report Sensitization meeting	RAB/KIIWP and District	Once year	None
	- Establishing of warning signposts around BS and make public awareness	Presence of signposts	Field verification	RAB/KIIWP and District	Once	1,000
Total budget						43,000

8.2.2. Environmental monitoring for specific parameters

The environmental and social management plans were proposed during ESIA preparation and need to be implemented and well monitored for the KIIWP compliance with safeguards. On top of monitoring the EMP implementation, specific parameters need to be monitored throughout the project operation phase, to assess the project impact on the environment and livelihoods of schemes users. This monitoring is proposed for water quality, disease transmission and seepage/leakage.

a. Water Quality

This mainly focused on determining the intensity/level and concentration of pesticides and fertilizer content in the command area water networks. Water sampling points should be at the upstream, middle and at the mouth of the command area. These samples should be taken under the supervision of KIIWP Environmental Specialist (ES) for laboratory analysis. The results should be used to design appropriate water quality management programs as well as sustainable ecosystem management. The same will apply to analysis of water quantities in relation to the abstraction impacts.

b. Diseases spreading

In order to monitor the possible impacts of the schemes development to malaria and bilharzia transmission in the area, the KIIWP ES together with Kayonza District Environmental Officer (DEO) and staff in charge of public health should undertake periodic surveys of the health records around the schemes to ascertain prevalence of disease spread. The surveys should be done once every six months (preferably one during rainy season and the 2nd in dry season in a year). The results can be used to assist KIIWP increase its interventions on waterborne diseases prevention.

c. Seepage and leakage

Measurement of seepage through the balancing storages and drainage canals, foundations & abutments of the storages may indicate erosion or blocking of downstream drains and relief wells by increase or decrease of seepage respectively at constant reservoir level. Seepage and erosion may take place along the lines of poor compaction and through the cracks in formation and fills. This may be indicated by such measurement. Measurement of seepage water at interface of dam and its foundation will provide direct indication of the efficiency of cut off and indicate about the necessary remedial measures. The chemical analysis of water will provide the information of seepage of water through the foundation drainage arrangement and any foundation material being washed out.

The table below indicates project impacts, parameters and indicator to monitor, frequency, cost as well as responsible institutions.

Table 85: Environmental monitoring for specific parameters

Impact	Parameter	Monitoring Indicator	Method	Frequency of Measurement	Responsibility	Costs Estimates (USD)
Physical Environment						
Water Pollution	Water quality	Nutrient Load (Nitrates, phosphates, potassium, sodium, etc.), pesticide residue, COD & BOD, Turbidity	Samples should be taken at BS or pipes level, within and downstream the scheme	Once 2 years	RAB/KIIWP and Cooperatives	5,000
Reduced Water level/flow	Quantity	Flow rates per second	lake/river gauging	Continuous	RAB/KIIWP, REMA, RDB, RWRB	20,000
Water wastage	Water availability	Flow rates per second	Install water meters at the intake point	Continuous	RAB/KIIWP, REMA, RDB, RWRB	
Soil erosion	Soil loss	Soil productivity, gullies/rills, water turbidity	Observation and water tests	continuous	RAB/KIIWP and Cooperatives	1,000

Impact	Parameter	Monitoring Indicator	Method	Frequency of Measurement	Responsibility	Costs Estimates (USD)
Flooding	Flooding area	Floods downstream of project area or in the middle of the command area	Observation and reported cases of flooding	continuous	Cooperatives and WUAs	None
Socio-economic Environment						
Water-borne Diseases	Disease prevalence	Increased cases of malaria and bilharzias among other water borne diseases	Review of health records	Quarterly	RAB/KIIWP, community and Ministry of Health	5,000
Safety hazards	Safety of livestock and humans	Reported cases of incidences and accidents Seepages and leakages reported or observed on the lakes Colour, turbidity and change in seepage chemical content	Review and evaluation of incidents and accidents register Direct observation of seepage water	Continuous monitoring of leakages, seepages, movements through instrumentation	KIIWP (engineer)	Part of the project M&E budget
Total Budget for monitoring						31,000

8.3. Implementation arrangement for ESMP

8.3.1. Rwanda Agriculture Board

RAB through KIIWP SPIU is the lead agency in the implementation of this ESMP and the project. The role of RAB/KIIWP is to implement mitigation measures, building the capacity of other actors in SPIU, and in environmental management. The SPIU IFAD Coordinator will be the focal point for training in KIIWP and will liaise with RAB and the ministry of agriculture and animal resources for technical support. The capacity building activities should be through hands-on experience approach. The project should establish one capacity building scheme which will act as the field school. The role of RAB will be to ensure that the irrigation, land husbandry, access roads and PHIs are constructed according to the specifications of international technical and safety standards.

RAB/KIIWP should designate Environmental Specialist (ES), to formally address environmental and social issues on a routine basis, who will have an oversight of environmental aspects of the construction contracts, including the enforcement of all monitoring provisions, the locations of construction and labour camps, etc. Before the commencement of construction, the designated ES will receive training in the environmental and social issues associated with irrigation facilities.

8.3.2. Rwanda Environment Management Authority

Rwanda Development Board (RDB) will issue an ESIA certificate of approval, authorizing KIIWP to start civil works. However, Rwanda Environment Management Authority (REMA) has the mandate to oversee the Project compliance with national environmental regulations.

8.3.3. Rwanda Water Resources Board

The Rwanda Water Resource Board (RWRB) is a government body under the Ministry of Environment that plays a key role in the management of water resources at a catchment level. During KIIWP implementation, RWRB will provide permission for the use of water resources (water permit) and will monitor the compliance with water permit conditions by the KIIWP as well as other agreements related to natural water resources management and distribution at the regional and international level.

8.3.4. Kayonza District

The project will be implemented by KIIWP in Kayonza District. The latter will closely work with RAB/KIIWP to follow up the civil works and compliance with environmental and social safeguards. Through District Environmental Officer, Kayonza district will carry out regular monitoring and inspection work to ensure that the project is implemented in compliance with the environmental management and monitoring plan.

8.3.5. Contractor

The Contractor shall prepare a Construction ESMP (CESMP) based on this ESMP and detailed feasibility report prior to the commencement of civil works. The CESMP will be submitted by the Contractor to the Supervision Consultant and RAB/SPIU IFAD for review and approval. No civil works shall commence until a CESMP has been approved by RAB/SPIU IFAD. The Contractor shall hire an Environmental and Social Development Specialist to implement the CESMP.

8.3.6. Supervision Consultant/Firm

The Supervision Firm/Consultant shall be hired to supervise the implementation of the CESMP by the Contractor. It is recommended that the supervising engineer has an E&S as in his key experts

8.3.7. Environmental and social safeguards training

The training program will cover measurement techniques in the field, tools for the prediction of pollutants, conservation of water bodies including wetlands and lakes etc. Rwanda Environmental Management Authority, Rwanda Water Resources Board and Rwanda Development Board may be consulted for such training. The need for additional and specialized training will be examined and appropriate training will be undertaken as required. Training of personnel to be deployed on the proposed project during construction and operation, with regard to environmental and social safeguards requirements and compliance should be the integral part of the planning. In addition all employees will be trained on health and safety, methods of disaster prevention, action required in case of emergency, fire protection, environmental risk analysis etc.

Capacity to quantitatively monitor water sediments or turbidity (by suitable portable test equipment) and noise is always advantageous, but monitoring will primarily involve ensuring that actions taken are in accordance with contract and specification clauses, and specified mitigation measures. Some awareness trainings will be provided to the contractor personnel to ensure that this occurs effectively.

The Project's environmental and social training programmes will include several levels of competency, depending on each individual's level of involvement and responsibility:

- **ESMP induction training and awareness:** this training will be for visitors or individuals who do not have direct roles or responsibilities for implementing the ESMP, and will cover basic Project environmental and social commitments.
- **ESMP Management Training and Awareness:** this training focuses attention on management, covering key aspects of the ESMP and providing an overview of the Project's environmental and social impact management expectations and the supporting processes and procedures prescribed in the ESMS to meet performance expectations.
- **ESMP Job-specific training and awareness:** job-specific training will be provided to all personnel who have direct roles and responsibilities for implementing or managing components of the ESMP including EPC contractor workers. This training will also include all people whose specific work activities may have an environmental or social impact.
- **Onsite,** these provisions and responsibilities will apply to all contractors and subcontractors. Those responsible for performing site inspections will receive training by drawing on external resources as necessary. Upon completion of training and once deemed competent by management, staff will be ready to train other people. The Project will require contractor to institute training programmes for their personnel. The EPC contractors and subcontractors will be responsible for implementing relevant and adequate training programmes to maintain the required competency levels. Contractor training programmes will be subject to approval by Project Management and will be assessed to confirm that:
 - training programmes are adequate;
 - all relevant personnel have been trained; and
 - Competency is achieved.

Contractors will be required to report on their training activities, and the Project will maintain records of all training delivered. The table below provide key training to be provided

Table 86: ESHS training plan;

Training course	Unskilled labour	Skilled labour	Supervisors	Drivers	Safety men	Timeframe	Responsible
Intro to the OHS	x	x	X	x	x	After each recruitment and at each site visit	EPC contractor
Induction training and awareness	x	x	X	x	x	After each recruitment and at each site visit	EPC contractor
Emergency response	x	x	X	x	x	After each recruitment	EPC contractor
Hazards& controls			X			After each recruitment	EPC contractor
Foreman responsibilities			*			After recruitment	EPC contractor
Managing safely			X			After each recruitment	EPC contractor
Managing rule breaking				x		After each recruitment	EPC contractor
Fire prevention	*	*	X		x	After each recruitment	EPC contractor
First aid	*	*	*			After each recruitment	EPC contractor
Confined space entry	x	x	X			After each recruitment	EPC contractor
Back safety/ lifting safety	x	x	X			After each recruitment	EPC contractor
PPE	x	x	X	x	x	After each recruitment	EPC contractor
Fall protection		*	*			After each recruitment	EPC contractor
Small/ power tools		*	*			After each recruitment	EPC contractor
Hand safety	x	x	X	x	x	After each recruitment	EPC contractor
Scaffold construction			x			After each recruitment	EPC contractor
Fork lift operations	x	x	x			After each recruitment	EPC contractor

Training course	Unskilled labour	Skilled labour	Supervisors	Drivers	Safety men	Timeframe	Responsible
Hazard recognition	x	x	x	x	x	After each recruitment	EPC contractor
Health & hygiene	*	*	x		x	On quarterly basis	EPC contractor
HIV/AIDS and Communicable disease	*	*	x		x	On quarterly basis	EPC contractor
Environmental awareness	x	x	x		x	On quarterly basis	EPC contractor
Ladder safety	x	x	x		*	Before construction work	EPC contractor
Excavation safety	x	x	x		x	Before excavation work	EPC contractor
Risk assessment		x	x		*	After each recruitment	EPC contractor
Lifting operations		x	x			Before construction work	EPC contractor
Safe use of chemicals	x	x	x	x	x	Before commissioning	EPC contractor
Accident prevention	x	x	x	x	x	After each recruitment	EPC contractor
Sexual abuse and sexual exploitation	x	x	x	x	x	On quarterly basis	EPC contractor
Chance finds procedures	x	x	x	x	x	Before excavations	EPC contractor

Key: x= compulsory

***=selected personnel**

Training will be provided by ESHS officer in EPC contractor team and outsource qualified expert and sub consultant hired by EPC contractor. The number of people to be trained for each topic will be known after recruitment of labours and screen them so as to define the training appropriate for each category depending on the expertise and knowledge.

8.3.8. Community awareness, outreach and training

In addition to the ESHS training provided by the contractor, the project will provided training, awareness and outreach program to the local communities. Trainings will be provided to different committee established including Water users association and Grievance redress Committees on conflict resolution and grievances management. Local communities will be also trained on different topics including HIV/AIDS, Sexual Exploitation; Gender Based Violence, water borne diseases etc.

Table 87: Community outreach and training

Training	Targeted group	Estimated budget (\$)
Conflict resolution and Grievances management	Grievances redress committees Water users association	6,000
HIV/AIDS, Sexual Exploitation; Gender Based Violence, water borne diseases	Local community in three schemes	8,000
Total		14,000

8.4. Monitoring and reporting procedures

8.4.1. Monitoring and reporting

The baseline data should be collected before the project begins. This will help in monitoring and controlling environmental impacts caused by the development of the project. The project designated ES will visually assess contractor's practices and, if high pollutant levels are suspected, instruct the contractor to make corrections. Photographic records will be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. All applicable regulations need to be enforced by the Project manager and designated ES. Under the Environment law (2018), water quality discharge standards, air pollution emission standards and noise standards have been established. It is a legal obligation of the Contractor that any discharges from the work sites meet these standards. Steps will be taken by the Project manager and designated E&S to ensure that regular monitoring of water quality parameters such as pH, suspended solids, turbidity, magnesium, oil and grease are carried out as provided in the contract. Regular monitoring of noise and dust will also be carried out as provided in the environmental monitoring program. The monitoring of accident frequency and diseases spread as compared to baseline will also be done.

Throughout the construction period of KIIWP activities, the Contractor and the Supervising firm will both provide the monthly progress report on the subproject compliance with environmental and social safeguards. The report will be submitted to RAB/SPIU KIIWP for review and approval. The Project Environmental Specialist will prepare periodic environmental and social consolidated reports (three month progress report) on the monitoring progress of KIIWP project in the district. These reports should be shared with REMA and World Bank for information.

8.4.2. Record Keeping

Monitoring form should be devised for documentation, analysis and record of parameter. The form should focus attention on environmental issues and provide feedback for the future stages of the work. Mitigation and enhancement measures adopted in final design will be explicitly under the bill of quantities (BOQ) so that performance and completion is readily documented. Daily project diaries would record environmental problems (spills, dust, noise, etc.) as well as safety incidents and will be retained as part of accepted modern contract management and summarized in Quarterly Environmental Reports.

8.5. Grievance Redress Mechanism

Establishment of irrigation schemes may raise complaints among local communities mainly due to conflict water users, from resettlement, conflict between workers and local community. In this situation, Grievance procedures are required to ensure that PAPs are able to lodge complaints or concerns, without cost, and with the assurance of a timely and satisfactory resolution of the issue. The procedures also ensure that the entitlements are effectively transferred to the intended beneficiaries. Stakeholders will be informed of the intention to implement the grievance mechanism, and the procedure will be communicated at the time that the RAPs are finalized. Grievances may arise from members of communities who are dissatisfied with eligibility criteria use, community planning and actual implementation or compensation.

8.5.1. Process of grievance

The overall process of grievance is as follows:

1. Local community through water users association, Resettlement committees and local authorities will be given copies of grievance procedures as a guide on how to handle the grievances.
2. The process of grievance redress will start with registration of the grievances to be address for reference, and to enable progress updates of the cases.
3. The project will use a local mechanism, which includes resettlement committees, peers and local leaders of the affected people. These will ensure equity across cases, eliminate nuisance claims and satisfy legitimate claimants at low cost.
4. The response time will depend on the issue to be addressed but it should be addressed with efficiency.
5. Compensation will be paid to individual PAPs only after a written consent of the PAPs, including both husband and wife.

8.5.2. Procedure of grievance

The aggrieved person should file his/ her grievance, relating to any issue associated with the resettlement process or compensation, in writing to the block Grievance Redress Committee (GRC). The grievance note should be signed and dated by the aggrieved person. The designated RAB officer and the GRC will consult to determine the validity of claims. If valid, the Committee will notify the complainant and s/he will be assisted. GRC will respond within 7 days during which time any meetings and discussions to be held with the aggrieved person will be conducted. If the grievance relates to valuation of assets, a second or even a third valuation will be undertaken, until it is accepted by both parties. These should be undertaken by separate independent valuers than the person who carried out the initial valuation.

If the aggrieved person does not receive a response or is not satisfied with the outcome within the agreed time, she/he may lodge his/her grievance to the relevant local administration such as the District Land Bureau, also mandated to help resolve such matters. If requested, or deemed necessary by the subproject Committee, the District Project Coordination officer will assist the aggrieved person in this matter.

The relevant Local Administration will then attempt to resolve the problem (through dialogue and negotiation) within 30 days of the complaint being lodged. If no agreement is reached at this stage, then the complaint is dealt with through the local courts (Abunzi) where possible. Where matters cannot be resolved through local

routes, the grievance will be referred to higher authorities at the national level. The Resettlement and Compensation Committee will provide assistance at all stages to the aggrieved person to facilitate resolution of their complaint and ensure that the matter is addressed in the optimal way possible.

If administrative ways of grievance redress is not enough to address the complaint, then the unsatisfied person may refer to judicial system. Based on the nature of complaints, the process will start from mediators for assets below 3 million Rwandan francs and if the value is more than three million, the process will start from intermediate courts, high court and to Supreme Court. The proposed grievance redress system is as illustrated follows:

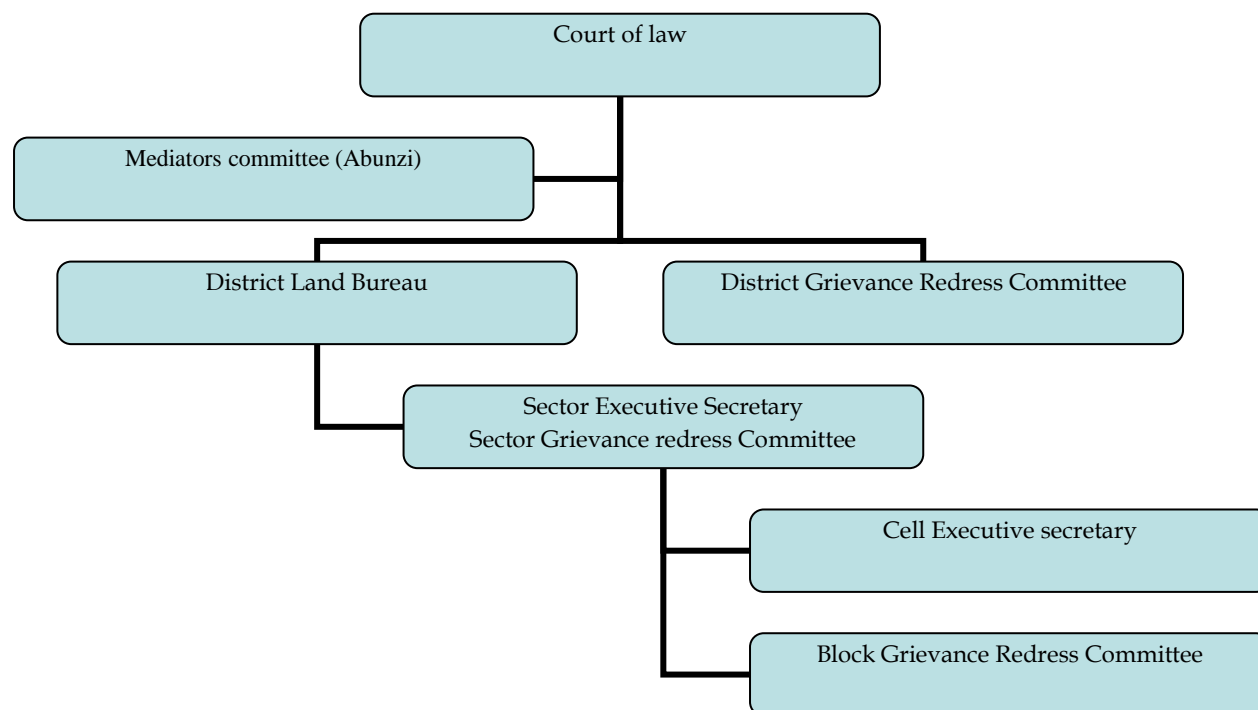


Figure 40: Proposed GRM flow chart

8.5.3. Grievance log

At each level, GRC will ensure that each complaint has an individual reference number, and is appropriately tracked and recorded actions are completed. The log will contain record of the person responsible for an individual complaint, and records dates for the following events:

- Date the complaint was reported;
- Date the Grievance Log was added onto the project database;
- Date information on proposed corrective action sent to complainant (if appropriate);
- The date the complaint was closed out; and
- Date response was sent to complainant.

The District Project Coordination officer will be responsible for:

- Providing the resettlement and compensation committee with a weekly report detailing the number and status of complaints;
- Any outstanding issues to be addressed; and
- Monthly reports, including analysis of the type of complaints, levels of complaints, actions to reduce complaints and initiator of such action.

8.5.4. Composition of GRC

- Grievance redress committee should be inclusive and should include representative from:
- Representative from sectors
- Representative of cells that are affected
- Representative from any other key sector office involved in the project;
- Two representatives of PAP by cells (equal gender representation).

- Representative of different water users(cattle keepers, Fishermen, farmers, Water users association etc)
- Representative of women and youth
- Contractor representatives etc

8.6. Estimated budget for ESMPs implementation and monitoring

The most important aspects of the implementation are the appointment of the Environmental Specialist to oversee the implementation of the environmental mitigation measures incorporated in the design and contract specifications. Development and delivery of an environmental training program for selected staff and Project coordinators responsible for overseeing the construction contracts can commence immediately thereafter. This will be an on-going process since contracts will be awarded over a period stretching over many months. Most of the planned mitigation measure will be implemented along with project activities and is provided in Environmental Management Plan and environmental monitoring Plan.

Table 88: Summary of estimated ESIA implementation budget

No	Item	Estimated Budget (USD)
1	Environmental and Social Management	
	Nasho Block	116,000
	Kibare Block	106,000
	Ihema block	60,000
2	Environmental and Social Monitoring Plan	72,000
3	Trainings and community outreach	14,000
	Grand Total	308,000

CHAPTER NINE: CONCLUSION AND RECOMMENDATIONS

9.1. CONCLUSION

Kayonza District Irrigation and Integrated Watershed Management Project (KIIWP) is a project financed by IFAD that will operate in drought prone areas of Kayonza District, Ndego inclusive. Ndego project targets 2,000 ha net (or 2,500 ha gross irrigation area) for irrigation development with potential water sources from the two lakes (Kibare and Nasho) around Ndego Sector in Kayonza District. The targeted irrigation area is made of 3 blocks, two abstracting water from Kibare lake and the last from Lake Nasho. The blocks are designated as Kibare, Ihema and Nasho Blocks, interchangeably named as Block 1 to 3, respectively. Most of the irrigation area is located in Nasho block.

Based on the findings from the feasibility study, Ndego irrigation area is dominantly sandy and Pressurized System was proposed as irrigation method. The balancing storages (BS), Centre Pivot (CPT) pipelines and Pipe networks are among the proposed irrigation infrastructures under this option. Land husbandry technologies proposed for the command area include drainage systems, levelling, contour bunds, contour buffer strips, contour ploughing, application of lime and organic materials as well as biological measures. The catchment area will also be protected with land husbandry techniques and will be rain fed.

The implementation of KIIWP in Ndego site is likely to have several positive impacts. The positive impacts from the proposed activities include employment creation and poverty reduction, soil fertility improvement and hillside restoration, rural development, irrigation efficiency, improved access roads, among others. The adverse impacts include reduced water level in lakes during BS filling, soil fertility loss due to land husbandry works, injuries, surface water pollution due to agrochemicals use, influx of people in search for employment, increased spread of waterborne diseases, emergency of crop pest and diseases, etc.

The adverse impacts from the irrigation, land husbandry, access roads and post-harvest infrastructures constructions can be mitigated. The proposed mitigation measures to minimize negative impacts are the stabilization with vegetation of land husbandry infrastructures immediately after their construction; backfilling and stabilization of borrow pits; establishment of silt trap zone along drainage canals and around balancing storages; compensation of land, crops and trees on BS, borrow pits, PHI sites; regulating water abstraction for irrigation and other uses; adoption of water saving irrigation approach by beneficiaries, capacity building of beneficiaries in agrochemicals application, awareness campaign on the prevention of water borne disease and hazards related to unrestricted entry into the BS; etc.

Given the nature and location of the proposed project, considering the identified adverse impacts and proposed management and monitoring plans, the ESIA team concludes that, the project is feasible and there are no major negative environmental and social impacts that could result from its implementation which cannot be mitigated.

In terms of resettlement implications, there is no physical resettlement expected from project implementation. However, land acquisition is required for pressure pipes, pumping station and water balance storages. Further, loss of income is expected during land husbandry works.

9.2. RECOMMENDATIONS

Based on Project Description, Environmental and Social Baseline Data, Environmental Impacts and Environmental Mitigation Measures, the following conclusions can be formulated:

- Before construction, the contractor should be requested to prepare and implement an Occupational Health and Safety Plan (OHS);
- The project beneficiaries should be trained on good farming techniques, pest and diseases management and maintenance of land husbandry and water harvesting and irrigation infrastructures;
- Beneficiaries should also be trained in efficient irrigation water management;
- Awareness campaign and sensitizations on the prevention of water borne diseases, mainly malaria and bilharzias and hazards related to unrestricted entry into the BS or drainage canals;
- Monitoring plan developed in this study should be implemented to monitor the indicators during and after the project lifecycle. Emphasis should be on water quality (nitrates, potassium, phosphates and pesticides residues);

- In addition to command area catchment protection provided in the project design, the developer shall consider the buffer of at least 10m for the protection of the balancing storages or fence them with barbed wire.
- Periodical maintenance of irrigation facilities by RAB/KIIWP, Kayonza District and/or Schemes users.
- It is recommended to prepare an Abbreviated Resettlement Plan (A-RAP) and livelihood restoration plan to address income loss and land acquisition once detailed design are completed. A preliminary RAP is provided as appendix to this ESIA
- The only sensitive ecologic area that is likely is the buffer one where pumping station will be installed. Therefore, the final design should consider reducing the number of pumping stations where possible and bigger station that use minimum space to minimize ecological disturbance around lakes;
- During detailed design burrow pits and Quarries should be identified in order to assess potential impacts associated with them,
- Schemes operational and maintained manual should be prepared and include environmental and social requirement;
- Environmental and Social requirement should be included in bidding documents and E&S staffs included in key staffs for both Contractor and Supervising contractor;
- Water level monitoring plan and equipment should be purchased and installed on two lakes to avoid water abstraction.
- The design team should explore the possibility of shifting the pipeline from Kibare pumping station Ihema block outside residential area;
- Identify other location of Pumping station PS N1 and PS K3 and preferably put them outside the buffer zone the possibility of having only two pumping stations for Kibare lake, one for Ihema block and one for Kibare block or even have one serving both Kibare and Ihema blocks to minimize impacts.

REFERENCES

1. SPIU IFAD, Environmental and Social mangament Framework for KWIIP, 2018
2. SMEC, 2020. Feasibility Study and Detail Study of 2000 ha net Hillside Irrigation at Ndego in Kayonza District, Eastern Province, 336p.
3. IFAD. 2017. Social, Environmental and Climate Assessment Procedures. www.ifad.org/en/document-detail/asset/39563472
4. IFAD. 2019. Kayonza Irrigation and Integrated Watershed Management Project (KIIWP1), Project Design Report (PDR). 130p.
5. RAB. 2018. Environmental and Social Management Framework for KIIWP. 295p
6. MINAGRI. 2018. Strategic plans for agriculture transformation 2018-24
7. Government of Rwanda. 2018. Law 48/2018 of 13/08/2018 on Environment.
8. Kayonza District. 2018. Second District Health Strategic Plan 2018/19 – 2023/24. 109p.
9. REMA. 2015. Baseline Climate Change Vulnerability Index
10. Kayonza District. 2012. Final report of Implementation of Kayonza town master plan. 384 p
11. NISR. 2012. Fourth Population and Housing Census, Characteristics of households and housing. 256p
12. Fischer, E. 2011. Biodiversity Inventory of Key Wetlands in Rwanda. Final Report. REMA.
13. REMA. 2009. State of the Environment Report 2009
14. East African Community, 2004. East African protocol on environment and natural resources management
15. Government of Rwanda, 2008. Ministerial order No. 007/2008. Establishing the List of Animal and Plant Species, 2008.
16. Government of Rwanda, 2008. Ministerial order No.003/2008. Relating to the requirements and procedure for Environmental Impact Assessment, 2008.
17. Government of Rwanda, 2004. Sector policy on water and sanitation
18. International Convention, 1992. Presidential Order n° 017/01 of 18 March 1995. The Convention on Biological Diversity and its Habitat
19. Fischer, E.; Dumbo, B. (2011). Biodiversity Inventory for Key Wetlands in Rwanda; Rwanda Environment Management Authority. Kigali, Rwanda
20. Gatali, C. (2013). Herbivory and biodiversity conservation of the savannah habitats in Akagera National Park, Rwanda. PhD thesis, University of Gothenburg, Sweden. ISBN: 978-91-85529-56-8
21. Kanyamibwa, S. (1998). Impact of war on conservation: Rwandan environment and wildlife in agony. Biodiversity and Conservation 7: 1399-1406
22. REMA (2015). Study to Establish a National List of Threatened Terrestrial Ecosystems and Species in Need of Protection in Rwanda. Rwanda Environment Management Authority. Kigali, Rwanda
23. REMA (2016). Impacts of Invasive Alien Species (Flowering plants, Fish and Insects) in Natural Forests, Agro- ecosystems, Lakes and Wetland Ecosystems in Rwanda and Their Management Plans. Rwanda Environment Management Authority, Kigali, Rwanda.
24. REMA (2019). Economic Assessment of Akagera Wetland Complex: Identifying Finance Solutions for Improved Management. Rwanda Environment Management Authority. Kigali, Rwanda
25. Vande weghe, J.P. & Vande weghe, G.R. 2011. Birds in Rwanda: an atlas and handbook. Kigali, Rwanda: Rwanda Development Board (RDB)

Annex 1: List of consulted People at technical level

Names	Institutions	Position	Contact
Usabyimbabazi Madeleine	RAB/SPIU	Environmental and Climate change Specialist and Client project manager	madousa2020@yahoo.fr
Muligande Benjamin,	RAB/SPIU	Social safeguards Specialist;	muligandeben2007@gmail.com
Dr. SIRIKARE N. Sylvere	RAB/SPIU	KIIWP Focal Person	sylvere.sirikare@rab.gov.rw
Ndagijimana Andre,	RAB/SPIU	Project Specialist	ndagabruce@gmail.com
Mucyo Papias	RAB	Ag. Irrigation Program Leader	papy2020@gmail.com
Munyandinda Vital	Rwanda Water Board	Head of water Permit Department	munyandinda3@gmail.com
Ngaboyamahina Théogène	REMA	Environment Inspection and regulation officer	tngabo@rema.gov.rw
Jacqueline Musoni	RDB	Environment Review Specialist	jacqueline.musoni@rdb.rw
Habamenshi Didace	MINAGRI	Environmental and Social safeguards Specialist	didaceha@yahoo.fr
NGABONZIZA Hussein	Kayonza District	District agronomist	hussein.ngabonziza@kayonza.gov.rw
NDAZIBONEYE Justin	Kayonza District	Land administration officer	justin.ndaziboneye@kayonza.gov.rw
MUDENGE J. Paul	Kayonza District	District environment officer	jp.mudenge@kayonza.gov.rw
Cleophas Nshimiyimana	Ndego sector	Land manager	0785202113
Kavaruganda Jean Pierre	Ndego sector	Sector Agronomist	0785047961
Reberaho Francois	Ndego sector	Sector council president	0788554653
Hategekimana Alphonse	Hingaweze	President	0788447370
Theoneste Gashirabake	Hingaweze	Member	0783815399
Stan Nsabimana	Bramin	Assistant Farm Manager	nsabimana@gmail.com

Annex 2: List of consulted at community level

No	Names	Block	ID
1	DUSABAMAHORO Leonidas	Nasho	1198680150819090
2	MUKARUKAKA LAURENCE	Nasho	1195770043332010
3	UWAMAHORO Esperance	Nasho	1197570043566000
4	DUKUZUMUREMYI Juvenal	Nasho	1197480081965050
5	YIRIRWAHANDI Hirary	Nasho	1198680150824040
6	UZAKUNDA	Nasho	1199280121247070
7	NSANZUMUHIRE Joseph	Kibare	1196980058898020
8	NAHONYIRIMPUHWE Celestin	Kibare	1196380055978000
9	MANIRAREBA Jean	Nasho	1198580151346040
10	NAHAYO Pierre	Kibare	1197980106038040
11	KANYANDEKWE Felecien	Nasho	1195580040751090
12	KARANGWA Joseph	Kibare	1195180023964020
13	NSANZIMANA Claver	Kibare	1198280160294030
14	BIJAMWA Emmanuel	Kibare	1196580028606110
15	NGEZAHAYO August	Kibare	1197980105994030
16	BAZIRA Leonidas	Kibare	1194980023235090
17	RWASIBO Martin	Kibare	1196880065254020
18	RWAGASORE Jonathan	Nasho	1197680082415050
19	GATO Speciose	Nasho	1195770043316080
20	NSENGIYUMVA Protas	Kibare	1197780088404010
21	NYIRANDIRAHISHA Bonefride	Kibare	1194270026200000

No	Names	Block	ID
22	NTEZIRYAYO Theogene	Kibare	1196480058484060
23	BIGIRUMWAMI Alex	Kibare	1196080059117040
24	SEMASENGE Innocent	Ihema	1196780054868010
25	NDAYISENGA Jonas	Ihema	1195880050724060
26	MINANI Sylvestre	Ihema	1197980106052090
27	BUZINDU Gratien	Ihema	1195780043364040
28	MINANI Sylvestre	Ihema	1197980106052090
29	UKWIBISHAKA Sauveur	Ihema	1196780069927000
30	KAMUZINZI Emmanuel	Ihema	1196480073054070
31	MUNYANZIZA Vincent	Ihema	1197080022335020
32	NSENGIMANA Callixte	Ihema	1196680022030090
33	HATANGIMBABAZI Jonathan	Ihema	1197680082500010

Annex 3: List of all Fuana and Flora Species found in project area and their conservation status

Taxonomic Class	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status	Protected species in Rwanda	Location
Mammalia	Perissodactyla	Rhinocerotidae	<i>Diceros bicornis</i>	Black rhino	Inkura	Critically Endangered	Yes	Akagera Complex
	Artiodactyla	Bovidae	<i>Syncerus caffer</i>	African buffalo	Imbogo	Near Threatened	Yes	Akagera Complex
	Proboscidea	Elephantidae	<i>Loxodonta africana</i>	Elephant	Inzovu	Vulnerable	Yes	Akagera Complex
	Artiodactyla	Giraffidae	<i>Giraffa camelopardalis</i>	Giraffe		Vulnerable		Akagera Complex
	Artiodactyla	Hippopotamidae	<i>Hippopotamus amphibius</i>	Hippo	Imvubu	Vulnerable	Yes	Lake
	Carnivora	Hyaenidae	<i>Crocuta crocuta</i>	Spotted hyena	Impyisi	Least Concern		Akagera Complex
	Carnivora	Felidae	<i>Panthera pardus</i>	Leopard	Ingwe	Vulnerable	Yes	Akagera Complex
	Carnivora	Felidae	<i>Panthera leo</i>	Lion	Intare	Vulnerable	Yes	Akagera Complex
	Artiodactyla	Bovidae	<i>Tragelaphus scriptus</i>	Bushbuck		Least Concern	Yes	Akagera Complex
	Artiodactyla	Bovidae	<i>Sylvicapra grimmia</i>	Common duiker		Least Concern		Akagera Complex
	Artiodactyla	Bovidae	<i>Taurotragus oryx</i>	Eland		Least Concern		Akagera Complex
	Artiodactyla	Bovidae	<i>Aepyceros melampus</i>	Impala	Impala	Least Concern		Akagera Complex
	Artiodactyla	Bovidae	<i>Oreotragus oreotragus</i>	Klipspringer	Igihondamabere	Least Concern	Yes	Akagera Complex
	Artiodactyla	Bovidae	<i>Ourebia ourebi</i>	Oribi		Least Concern		Akagera Complex
	Artiodactyla	Bovidae	<i>Redunca redunca</i>	Reedbuck		Least Concern		Akagera Complex
	Artiodactyla	Bovidae	<i>Hippotragus equinus</i>	Roan antelope	Inkoronko	Least Concern	Yes	Akagera Complex
	Artiodactyla	Bovidae	<i>Tragelaphus spekii</i>	Sitatunga	Inzobe	Least Concern	Yes	Akagera Complex
	Artiodactyla	Bovidae	<i>Damaliscus lunatus jimela</i>	Topi		Vulnerable		Akagera Complex
	Artiodactyla	Bovidae	<i>Kobus ellipsiprymnus</i>	Waterbuck		Least Concern		Akagera Complex
	Perissodactyla	Equidae	<i>Equus burchelli</i>	Zebra	Imparage	Near Threatened		Akagera Complex
	Artiodactyla	Suidae	<i>Potamochoerus larvatus</i>	Bushpig		Least Concern		Akagera Complex
	Artiodactyla	Suidae	<i>Phacochoerus africanus</i>	Warthog		Least Concern		Akagera Complex
	Primates	Cercopithecidae	<i>Papio anubis</i>	Olive baboons		Least Concern		Akagera Complex
	Primates	Cercopithecidae	<i>Chlorocebus pygerythrus</i>	Vervet monkey		Least Concern		Akagera Complex
	Primates	Cercopithecidae	<i>Cercopithecus mitis</i>	Blue monkey		Least Concern		Akagera Complex
	Carnivora	Herpestidae	<i>Atilax paludinosus</i>	Marsh Mongoose		Least Concern		Akagera Complex
Birds	Gruiformes	Gruidae	<i>Balearica regulorum</i>	Grey Crowned Crane	Umusambi	Endangered	Yes	Akagera Complex
	Pelecaniformes	Ardeidae	<i>Bubulcus ibis</i>	Cattle Egret++	Inyange	Least Concern	Yes	Akagera Complex
	Charadriiformes	Charadriidae	<i>Ardea melanocephala</i>	Black-Headed Heron	Uruyongoyongo	Least Concern	Yes	Akagera Complex
	Pelecaniformes	Scopidae	<i>Scopus umbretta</i>	Hamerkop	Sarupfuna	Not assessed	Yes	Akagera Complex
	Ciconiiformes	Ciconiidae	<i>Anastomus lamelligeru</i>	African Open-Billed Stork		Least Concern		Akagera Complex
	Coraciiformes	Alcedinidae	<i>Corythornis cristatus</i>	Malachite Kingfisher	Murobyi	Least Concern		Akagera Complex
	Ciconiiformes	Ciconiidae	<i>Mycteria ibis</i>	Yellow-Billed Stork		Least Concern		Akagera Complex
	Charadriiformes	Charadriidae	<i>Venellus senegallus</i>	African Wattled Lapwing	Inkurakura	Not assessed		Akagera Complex

Taxonomic Class	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status	Protected species in Rwanda	Location
	Pelecaniformes	Threskiornithidae	<i>Bostrychia Hagedash</i>	Hadada Ibis	Nyirabarazana y'inkara	Least Concern		Akagera Complex
	Coliiformes	Coliidae	<i>Colius striatus</i>	Spickled Mousebird	Umusure	Least Concern		Command Area
	Passeriformes	Sturnidae	<i>Lamprotonis purpuroptera</i>	Rueppell's glossy-starling		Least concern		Command Area
	Passeriformes	Motacillidae	<i>Motacilla aguimp</i>	African-Pied Wagtail	Inyamanza	Least Concern		Command Area
	Passeriformes	Corvidae	<i>Corvus albus</i>	Pied Crow	Icyiyoni	Least Concern		Command Area
	Passeriformes	Passeridae	<i>Passer griseus</i>	Common Grey-Headed Sparrow++	Igishwi	Least Concern		Command Area
	Passeriformes	Estrildidae	<i>Lagonosticta rubricata</i>	African Firefinch	Ifundi	Least Concern		Command Area
	Passeriformes	Ploceidae	<i>Ploceus pelzelni</i>	Slender-Billed weaver	Isandi	Not assessed		Command Area
	Accipitriformes	Accipitridae	<i>Polyboroides typus</i>	African Harrier Hawk	Ikizu	Least Concern		Command Area
	Columbiformes	Columbidae	<i>Columba guinea</i>	Speckled Pigeon	Inuma	Least Concern		Command Area
	Accipitriformes	Accipitridae	<i>Milvus migrans</i>	Black kite	Sakabaka	Least Concern		Command Area
	Passeriformes	Leiothrichidae	<i>Turdoides jardineii</i>	Arrow-Marked Babbler	Ikijwangajwanga	Least Concern	Yes	Command Area
	Gruiformes	Rallidae	<i>Amaurornis flavirostris</i>	Black Crake		Least Concern		Akagera Complex
	Passeriformes	Ploceidae	<i>Amblyospiza albifrons</i>	Thick-billed weaver		Least Concern		Akagera Complex
	Passeriformes	Motacillidae	<i>Anthus leucophrys</i>	Plain-backed pipit		Least Concern		Akagera Complex
	Pelecaniformes	Ardeidae	<i>Ardea purpureus</i>	Purple heron		Least Concern		Akagera Complex
			<i>Cisticola sp.</i>					Akagera Complex
	Coraciiformes	Coraciidae	<i>Coracias caudata</i>	Lilac-breasted roller		Least Concern		Akagera Complex
	Musophagiformes	Musophagidae	<i>Corythaixoides personatus</i>	Bare-faced go-away-bird		Least Concern		Akagera Complex
	Passeriformes	Cisticolidae	<i>Eminia lepida</i>	Grey-capped warbler		Least Concern		Akagera Complex
	Passeriformes	Estrildidae	<i>Estrilda astrild</i>	Common waxbill		Least Concern		Akagera Complex
	Passeriformes	Estrildidae	<i>Estrilda paludicola</i>	Fawn-breasted waxbill		Least Concern		Akagera Complex
	Passeriformes	Ploceidae	<i>Euplectes albonotatus</i>	White-winged widowbird		Least Concern		Akagera Complex
	Passeriformes	Ploceidae	<i>Euplectes axillaris</i>	Fan-tailed widowbird		Least Concern		Command Area Catchment
	Coraciiformes	Halcyonidae	<i>Halcyon senegalensis</i>	Woodland kingfisher		Least Concern		Akagera Complex
	Passeriformes	Estrildidae	<i>Lagonosticta senegala</i>	Red-billed firefinch		Least Concern		Akagera Complex
	Passeriformes	Sturnidae	<i>Lamprotonis caudatus</i>	Long-tailed glossy starling		Least Concern		Akagera Complex
	Passeriformes	Sturnidae	<i>Lamprotonis chalybaeus</i>	Greater blue-eared starling		Least Concern		Akagera Complex
	Passeriformes	Malaconotidae	<i>Laniarius erythrogaster</i>	Black-headed gonolek		Least Concern		Akagera Complex
	Passeriformes	Malaconotidae	<i>Laniarius mufumbiri</i>	Papyrus gonolek		Near Threatened		Akagera Complex
	Passeriformes	Acrocephalidae	<i>Calamonastides gracilirostris</i>	Papyrus yellow warbler		Vulnerable		Akagera Complex
	Coraciiformes	Meropidae	<i>Merops pusillus</i>	Little bee-eater		Least Concern		Command Area Catchment
	Passeriformes	Muscicapidae	<i>Muscicapa aquatica</i>	Swamp flycatcher		Least Concern		Akagera Complex
	Passeriformes	Nectariniidae	<i>Nectarinia chloropygia</i>	Olive-bellied sunbird		Least Concern	Yes	Command Area Catchment

Taxonomic Class	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status	Protected species in Rwanda	Location
	Passeriformes	Nectariniidae	<i>Nectarinia erythrocerca</i>	Red-chested sunbird		Least Concern	Yes	Akagera Complex
	Passeriformes	Ploceidae	<i>Ploceus baglafecht</i>	Baglafecht weaver		Least Concern		Akagera Complex
	Passeriformes	Ploceidae	<i>Ploceus melanocephalus</i>	Black-headed weaver		Least Concern		Akagera Complex
	Passeriformes	Ploceidae	<i>Ploceus cucullatus</i>	Village weaver		Least Concern		Akagera Complex
	Passeriformes	Ploceidae	<i>Ploceus ocularis</i>	Spectacled weaver		Least Concern		Akagera Complex
	Piciformes	Lybiidae	<i>Pogoniulus bilineatus</i>	Yellow-rumped tinkerbird		Least Concern		Akagera Complex
	Passeriformes	Pycnonotidae	<i>Pycnonotus barbatus</i>	Common bulbul		Least Concern		Akagera Complex
	Passeriformes	Ploceidae	<i>Quelea quelea</i>	Red-billed quelea		Least Concern		Akagera Complex
	Passeriformes	Fringillidae	<i>Serinus mozambicus</i>	Yellow-fronted canary		Least Concern		Akagera Complex
	Columbiformes	Columbidae	<i>Streptopelia capicola</i>	Ring-necked dove		Least Concern		Akagera Complex
	Columbiformes	Columbidae	<i>Streptopelia semitorquata</i>	Red-eyed dove		Least Concern		Akagera Complex
	Columbiformes	Columbidae	<i>Streptopelia senegalensis</i>	Laughing dove		Least Concern		Akagera Complex
	Passeriformes	Leiotherichidae	<i>Turdoides sharpei</i>	Black-lored babbler		Least Concern		Akagera Complex
	Columbiformes	Columbidae	<i>Turtur afer</i>	Blue-spotted wood dove		Least Concern		Command Area Catchment
	Passeriformes	Estrildidae	<i>Uraeginthus bengalus</i>	Red-cheeked cordon-bleu		Least Concern		Akagera Complex
	Coliiformes	Coliidae	<i>Urocolius macrourus</i>	Blue-naped mousebird		Least Concern		Akagera Complex
	Passeriformes	Viduidae	<i>Vidua macroura</i>	Pin-tailed whydah		Least Concern		Akagera Complex
Amphibia	Anura	Arthroleptidae	<i>Leptopelis bocagii</i>	Bocage's tree frog		Least Concern		Akagera complex
	Anura	Bufonidae	<i>Amietophrynus regularis</i>	African common toad		Least Concern		Akagera complex
	Anura	Hyperoliidae	<i>Afrixalus quadrivittatus</i>			Least Concern		Akagera complex
	Anura	Hyperoliidae	<i>Hyperolius acuticeps</i>			Least Concern		Akagera complex
	Anura	Hyperoliidae	<i>Hyperolius kivuensis</i>			Least Concern		Akagera complex
	Anura	Hyperoliidae	<i>Hyperolius viridiflavus</i>			Least Concern		Akagera complex
	Anura	Hyperoliidae	<i>Kassina senegalensis</i>	Senegal running frog		Least Concern		Akagera complex
	Anura	Phrynobatrachidae	<i>Phrynobatrachus kakamikro</i>			Least Concern		Akagera complex
	Anura	Phrynobatrachidae	<i>Phrynobatrachus natalensis</i>	Natal dwarf puddle frog		Least Concern		Akagera complex
	Anura	Phrynobatrachidae	<i>Phrynobatrachus sp.</i>			-		Akagera complex
	Anura	Pipidae	<i>Xenopus victorianus</i>	Lake Victoria clawed frog		Least Concern		Akagera complex
	Anura	Ptychadenidae	<i>Ptychadena mascareniensis</i>	Mascarene grass frog		Least Concern		Akagera complex
	Anura	Ptychadenidae	<i>Ptychadena porosissima</i>			Least Concern		Akagera complex
	Anura	Ptychadenidae	<i>Ptychadena sp.</i>			-		Akagera complex
	Anura	Pyxicephalidae	<i>Amietia angolensis</i>	Angola river frog		Least Concern		Akagera complex
	Anura	Ranidae	<i>Hylarana albolabris</i>			Least Concern		Akagera complex
	Anura	Ranidae	<i>Hylarana galamensis</i>			Least Concern		Akagera complex
Reptilia	Squamata	Chamaeleonidae	<i>Chamaeleo anchietae</i>			-		Akagera Complex

Taxonomic Class	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status	Protected species in Rwanda	Location
	Squamata	Chamaeleonidae	<i>Trioceros ellioti</i>	Elliot's chameleon		-		Akagera Complex
	Squamata	Varanidae	<i>Varanus niloticus</i>	Nile monitor		-		Akagera Complex
	Squamata	Colubridae	<i>Dasypeltis scabra</i>	egg-eating snake		Least Concern		Command Area Catchment
	Squamata	Colubridae	<i>Grayia thollonii</i>			-		Command Area Catchment
	Squamata	Lamprophiidae	<i>Psammophis mossambicus</i>			-		Command Area Catchment
	Squamata	Elapidae	<i>Naja melanoleuca</i>	Forest cobra		-		Command Area Catchment
	Squamata	Elapidae	<i>Naja nigricollis</i>	Black-necked spitting cobra	Incira	-		Command Area Catchment
	Squamata	Colubridae	<i>Philothamnus heterolepidotus</i>	African Green Snake	Incarwatsi	Not Evaluated	No	Command Area Catchment
	Squamata	Lamprophiidae	<i>Psammophis sibilans</i>	Striped Sand Snake	Imbarabara	Least Concern	No	Command Area Catchment
	Squamata	Pythonidae	<i>Python sebae</i>	African rock python	Ururiramire	-	Yes	Akagera Complex
	Squamata	Viperidae	<i>Bitis arietans</i>	Puff adder	Impiri	-	Yes	Command Area Catchment
	Testudines	Pelomedusidae	<i>Pelusius subniger</i>	East African black mud turtle		-	Yes	Akagera Complex
	Testudines	Testudinidae	<i>Kinixys spekii</i>	Speke's hinge-back tortoise		-	Yes	Akagera Complex
	Crocodylia	Crocodylidae	<i>Crocodylus niloticus</i>	Nile crocodile		Least Concern	Yes	Lake
Fish	Synbranchiformes	<u>Mastacembelidae</u>	<i>Mastacembelus frenatus</i>	spiny eel fish		Least Concern		Lake
	Siluriformes	Bagridae	<i>Bagrus docmak</i>	Bagrid catfishes		Least Concern		Lake
	Siluriformes	Clariidae	<i>Clarias liocephalus</i>			Least Concern		Lake
	Siluriformes	Clariidae	<i>Clarias gariepinus</i>	African sharptooth catfish		Least Concern		Lake
	Siluriformes	Schilbeidae	<i>Schilbe intermedius</i>	Silver butter catfish		Least Concern		Lake
	Siluriformes	Mochokidae	<i>Synodontis rwandae</i>			Vulnerable		Lake
	Osteoglossiformes	Mormyridae	<i>Marcusenius victoriae</i>	Victoria stonebasher		Least Concern		Lake
	Osteoglossiformes	Mormyridae	<i>Pollimyrus nigricans</i>	Dark stonebasher		Least Concern		Lake
	Osteoglossiformes	Mormyridae	<i>Gnathonemus longibarbis</i>	Longnose stonebasher		Least Concern		Lake
	Characiformes	Alestidae	<i>Brycinus jacksonii</i>	Victoria robber		Least Concern		Lake
	Cypriniformes	Cyprinidae	<i>Labeo victorianus</i>	Ningu		Critically Endangered		Lake
	Siluriformes	Mochokidae	<i>Synodontis afrofischeri</i>	Fischer's Victoria squeaker		Least Concern		Lake
	Osteoglossiformes	Mormyridae	<i>Petrocephalus catostoma</i>			Least Concern		Lake
	Cichliformes	Cichlidae	<i>Oreochromis niloticus</i>	Nile tilapia		Least Concern		Lake
	Cichliformes	Cichlidae	<i>Oreochromis leucostictus</i>	Blue-spotted tilapia		Least Concern		Lake

Taxonomic Class	Order	Family	Scientific Name	Common Name	Vernacular Name	IUCN Conservation Status	Protected species in Rwanda	Location
	Cichliformes	Cichlidae	<i>Oreochromis macrochir</i>	Longfin tilapia		Vulnerable		Lake
	Cypriniformes	Cyprinidae	<i>Barbus paludinosus</i>	Straightfin barb		Least Concern		Lake
	Cypriniformes	Cyprinidae	<i>Barbus acuticeps</i>			Near Threatened		Lake
	Cypriniformes	Cyprinidae	<i>Barbus kerstenii</i>	Redspot bar				Lake
	Lepidosireniformes	Protopteridae	<i>Protopterus aethiopicus</i>	Marbled lungfish		Least Concern		Lake
	Cichliformes	Cichlidae	<i>Astatoreochromis alluaudi</i>	Alluaud's haplo		Least Concern		Lake
	Cichliformes	Cichlidae	<i>Haplochromis burtoni</i>			Least Concern		Lake
	Cichliformes	Cichlidae	<i>Tilapia rendalli</i>	Redbreast tilapia		Least Concern		Lake
	Cypriniformes	Cyprinidae	<i>Cyprinus carpio</i>	common carp		Vulnerable		Lake

ANNEX 4: RECORDED NATIVE SPECIES AND ITS MAIN USE

No	Scientific name	Kinyarwanda name	Morphological form	Abundance ¹⁸	Origin/Conservation Status ¹⁹	Main use
1.	<i>Abutilon angulatum</i>	Umuhatura	Herb	C	Indigenous/NA	Traditional medicine
2.	<i>Acacia brevispica</i>	Umugeyo	Tree	O	Indigenous/NA	Firewood, bee forage
3.	<i>Acacia gerrardii</i>	Umutongore/Umugunga	Tree	C	Indigenous/NA	Timber, firewood
4.	<i>Acacia hockii</i>	Umugenge	Shrub	C	Indigenous/NA	Firewood, live fencing, bee forage
5.	<i>Acacia polyacantha</i>	Umugu	Tree	C	Indigenous/NA	Timber, firewood
6.	<i>Acacia sp</i>	Umutyaza	Tree	O	Indigenous/NA	Timber, firewood
7.	<i>Acacia senegal</i>	Nyegera/Bwara	Tree	O	Indigenous/NA	Firewood
8.	<i>Afrocarthium lactescens</i>	Umukondokondo	Shrub	C	Indigenous/NA	Traditional medicine
9.	<i>Albizia petersiana</i>	Umumeyu	Tree	O	Indigenous/NA	Timber, firewood
10.	<i>Albizia versicolor</i>	Umububa	Tree	O	Indigenous/NA	Timber, firewood
11.	<i>Allophylus africanus</i>	Umutete	Shrub	O	Indigenous/NA	Traditional medicine, firewood
12.	<i>Aloe macrosiphon</i>	Igikakarubamba	Herb	C	Indigenous/NA	Traditional medicine
13.	<i>Asparagus falcatus</i>	Umushabishabi	Herb	C	Indigenous/NA	Traditional medicine
14.	<i>Boscia angustifolia</i> var. <i>corymbosa</i>	Umuzizi	Tree	C	Indigenous/NA	Poles, firewood, edible fruits
15.	<i>Bothriochloa insculpta</i>	Umukenke	Herb	C	Indigenous/NA	Fodder
16.	<i>Capparis tomentosa</i>	Umukorokombe	Shrub	C	Indigenous/NA	Traditional medicine
17.	<i>Carissa spinarum</i>	Umuyonza	Shrub	C	Indigenous/NA	Edible fruits, traditional medicine
18.	<i>Cissus quadrangularis</i>	Urubogora	Liana	C	Indigenous/NA	Unknown
19.	<i>Combretum molle</i>	Umurama	Tree	C	Indigenous/NA	Timber, firewood
20.	<i>Cyperus articulatus</i>	Urukirakenja	Herb	C	Indigenous/LC	Mulch, handicrafts
21.	<i>Cyperus dives</i>	Ibigaga	Herb	C	Indigenous/NA	Mulch
22.	<i>Cyperus latifolius</i>	Urukangaga	Herb	C	Indigenous/NA	Mulch, handicrafts
23.	<i>Cyperus papyrus</i>	Urufunzo	Herb	C	Indigenous/NA	Mulch, handicrafts
24.	<i>Dichrostachys cinerea</i>	Umuyebe	Shrub	C	Indigenous/LC	Fire, live fence
25.	<i>Entada abyssinica</i>	Umusange	Tree	O	Indigenous/NA	Traditional medicine
26.	<i>Eragrostis sp</i>	Umutsina	Herb	C	Indigenous/NA	Fodder
27.	<i>Erythrina abyssinica</i>	Umuko	Tree	C	Indigenous/NA	Timber, firewood, traditional medicine
28.	<i>Euclea racemosa</i> subsp. <i>schimperii</i>	Umushikiri	Shrub	O	Indigenous/NA	Firewood, traditional medicine
29.	<i>Euphorbia candelabrum</i>	Umuduha	Tree	C	Indigenous/NA	Ornament
30.	<i>Euphorbia tirucalli</i>	Umuyenzi	Tree	C	Indigenous/LC	Live fence
31.	<i>Flacourtia indica</i>	Urutaka	Shrub	R	Indigenous/NA	Edible fruits, traditional medicine
32.	<i>Grewia similis</i>	Umukomagore	Tree	O	Indigenous/NA	Firewood
33.	<i>Gymnosporia senegalsis</i>	Umweza	Shrub	C	Indigenous/NA	Traditional medicine
34.	<i>Haplocoelum foliolosum</i>	Umujwiri	Tree	O	Indigenous/NA	Timber, charcoal
35.	<i>Hygrophila auriculata</i>	Gangabukari	Herb	C	Indigenous/LC	Traditional medicine
36.	<i>Hyparrhenia rufa</i>	Umubaribari	Herb	C	Indigenous/NA	Fodder
37.	<i>Juncus effusus</i>	Ubusuna	Herb	C	Indigenous/LC	Mulch, handicrafts
38.	<i>Lannea schimperii</i>	Umumuna	Tree	O	Indigenous/NA	Firewood
39.	<i>Leonotis nepetifolia</i>	Igicumucumu	Herb	C	Indigenous/NA	Traditional medicine
40.	<i>Ludwigia abyssinica</i>	Umuzigangore	Herb	C	Indigenous/NA	Traditional medicine
41.	<i>Maerua triphylla</i>	Umuryanka	Tree	O	Indigenous/NA	Traditional medicine
42.	<i>Markhamia obtusifolia</i>	Umukundambazo	Tree	C	Indigenous/NA	Timber, charcoal
43.	<i>Ocimum sp</i>	Umwanya	Herb	C	Indigenous/NA	Traditional medicine
44.	<i>Olea europaea</i> var. <i>africana</i>	Umunzenze	Tree	O	Indigenous/NA	Timber, firewood
45.	<i>Ozoroa insignis</i>	Umukerenge	Tree	O	Indigenous/NA	Timber, firewood
46.	<i>Pappea capensis</i>	Umuremampongo	Tree	O	Indigenous/NA	Timber, firewood
47.	<i>Parinari curatellifolia</i>	Umunazi	Tree	O	Indigenous/LC	Timber, firewood, edible fruit
48.	<i>Pennisetum purpureum</i>	Urubingo	Tree	C	Indigenous/NA	Fodder
49.	<i>Phoenix reclinata</i>	Umukindo	Herb	C	Indigenous/NA	Ornament
50.	<i>Polygonum spp</i>	Igorogonzo	Herb	C	Indigenous/NA	Traditional medicine
51.	<i>Searsia pyroides</i>	Umusagara	Shrub	C	Indigenous/NA	Firewood, traditional medicine
52.	<i>Scutia myrtina</i>	Umugasa	Shrub	C	Indigenous/NA	Firewood, live fence, traditional medicine
53.	<i>Vepris nobilis</i>	Umuzo	Tree	C	Indigenous/NA	Timber, firewood
54.	<i>Vernonia amygdalina</i>	Umubirizi	Tree	C	Indigenous/NA	Traditional medicine
55.	<i>Zanthoxylum chalybeum</i>	Intareyirungu	Tree	R	Indigenous/NA	Traditional medicine
56.	<i>Ziziphus mucronata</i>	Umuganzacyaro	Tree	O	Indigenous/NA	Timber, charcoal

Appendix 1: Preliminary Abbreviated Resettlement Action Plan

REPUBLIC OF RWANDA



**MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES (MINAGRI)
RWANDA AGRICULTURE AND ANIMAL RESOURCES DEVELOPMENT BOARD (RAB)**

PRELIMINARY DRAFT REPORT

**ABBREVIATED RESETTLEMENT ACTION (ARAP) OF THREE IRRIGATION SCHEMES IN NDEGO
SECTOR, KAYONZA DISTRICT, EASTERN PROVINCE IN RWANDA.**

November, 2020

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1. INTRODUCTION

1.1. Project area and Project activities

The Ndego project is part of a larger scale investment by GoR to develop up to 7000ha of irrigated land over four sites in Kayonza district. This is in supporting the government of Rwanda to achieve its strategic goals of economic transformation whose focus is to unlocking rural growth in order to increase agricultural production, increase beneficiary farmers' income, reduce poverty, and improve living conditions.

The Ndego site is located in Ndego sector, Kayonza District, in the Eastern Province of Rwanda. The Targeted irrigated area is around 2,000ha net divided into three blocks, block ihema, block Kibare and block Nasho, or designated as s Block 1,2 and 3. Initially, it was proposed to abstract irrigation water in three lakes, Lake ihema, Lake Kibare Lake Nasho. Unfortunately, lake ihema is no longer considered due to other water use planned on the Lake and Water for Kibare and ihema blocks will be extracted from lake Kibare and the water resources assessment indicates that the lake has enough water to cater for the two blocks. respectively.

Key project features include: (i) Land husbandry works whereby the proposed technology include a drainage system, land levelling, contour buffer strips, contour ditches, contour bunds, agroforestry trees and shrubs, contour ploughing, silt traps and application of lime, mulching and compost. This will cover approximately 2000ha divided into three blocks, (ii) Development of irrigation system that consist of pumping stations to abstract water from two lakes, main and secondary canals, water storages tanks and irrigation technologies, and (iii) Associated facilities including Access roads; Storage with Cold Room, and Office

1.2. Scope of initial RAP

Under the proposed project there is no physical displacement expected. However, it is anticipated that lands will be acquired at pumping station, water-balancing storages and at pressure pipelines. Further, loss of income, trees and perennial crops is expected during land husbandry works. Therefore, the aim of the RAP report is to develop an action plan that ensures that the Project Affected Persons (PAPs) livelihoods and standards of living are improved or at least restored, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. The RAP for Ndego irrigation project is developed in accordance with IFAD's Social Environmental and Climate Assessment Procedures (SECAP, 2017) and National regulation related to land and expropriations. The scope of work undertaken during the preparation of this initial RAP preparation included:

- Project description;
- Analysis of the objective of resettlement programmes;
- Analysis of potential project impacts through identification of the PAPs, estimating their number and evaluating the impacts of the project on them;
- Conducting social-economic studies including census surveys, land tenure and transfer systems;
- Consultation with community and other stakeholders;
- Analysis of the legal framework;
- Analysis of institutional framework covering the identification of agencies responsible for resettlement activities,
- Grievances address mechanisms that evaluate availability of affordable and accessible procedures for third party settlement of disputes arising from resettlement.
- Organizational responsibilities for implementing resettling, including identification of agencies responsible for delivery of resettlement measure and provision of services
- RAP Implementation schedule covering all resettlement activities from preparation through implementation.
- Cost and budget shows itemized best cost for all activities;

- Monitoring and evaluation mechanisms-Arrangements for monitoring of resettlement activities by the implementing agency, supplemented by independent monitors as considered appropriate by IFAD and implementing entity.

1.3. Methodology

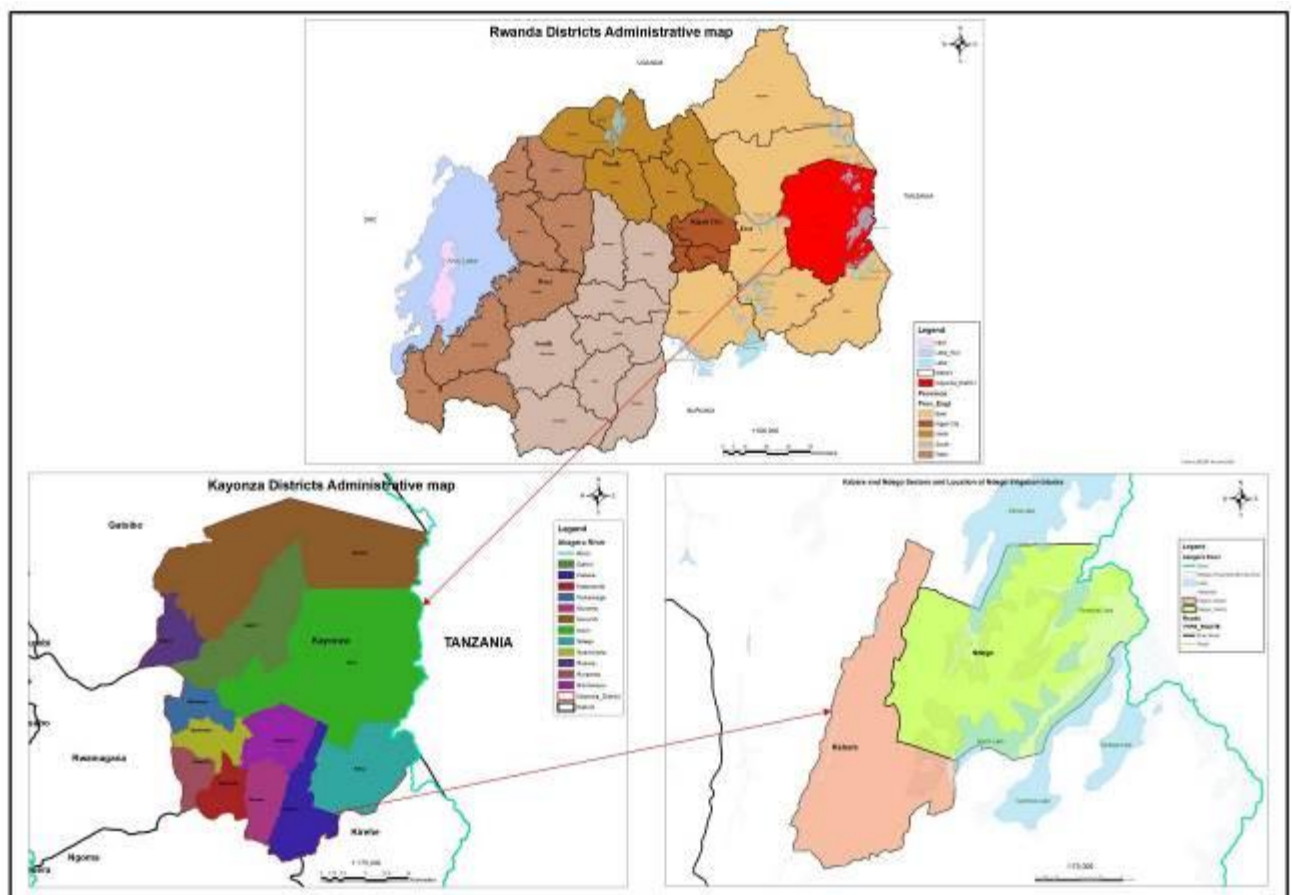
The preparation of this resettlement action plan result of the combination of desk study and field surveys. The desk study involved review of previous study documents and analysis of the proposed project maps; and field surveys to establish the location of the proposed pumping station , balance water storages, irrigation canals and related infrastructure. The document consulted include The project feasibility study, Environmental and Social Management Framework, IFAD's Social Environmental and Climate Assessment Procedures (SECAP, 2017) and National Regulations in regards to expropriation, compensation and land ownership. The field survey consisted on conducting household census of identified PAPs; conducting baseline socio-economic survey on the project area as well as census and measurement of lands and crops which are likely to be affected. Discussions with PAPs and key stakeholders including MINAGRI staffs, District Administration were also another tools used along the preparation of this RAP.

2. PROJECT DESCRIPTION

2.4. Project location

Ndego Hillside Irrigation Project site is composed of three irrigation schemes mainly located in Ndego Sector of Kayonza District, Eastern Province in Rwanda. Ndego Sector is one of 12 Sectors forming Kayonza District. This has borders with Rwamagana district on the West, Gatsibo district on the North, Ngoma and Kirehe districts on the South and Tanzania on the East.

Figure 1: Administrative location of project area



Source: BESST LTD with Available administrative Maps, 2020

The project site is accessed from Kigali-Kabarondo – Rwinkwavu – Nyankora - Ndego road at about 120 Km from Kigali City. The total distance from Kabarondo to the site is about 37km. It targets an irrigation area of around 2,018 ha net with potential water sources from the three lakes around Ndego Sector and this represents 11.3% of the total Sector area. The area is composed of 3 blocks, two (Kibare and Ihema blocks) tapping water from Lake Kibare and the 3rd from Lake Nasho. The irrigation areas are designated as Kibare, Ihema

and Nasho Blocks, interchangeably named as Block 1 to 3, respectively. Most of the irrigation area are situated in Nasho block.

2.5. Project description

2.5.1. Overview on KIIWP Project

Kayonza District Irrigation and Integrated Watershed Management Project (KIIWP) is an IFAD funded project that will be implemented in the most drought-prone Sectors of Kayonza District in Eastern Province, Rwanda. The district is bordered to the north and north-west by Gatsibo District, Rwamagana District to the west, Ngoma District to the south-west and Kirehe District to the south. It shares its eastern border with Tanzania.

The Project area includes eight drought-prone sectors of the District of Kayonza, namely Gahini, Kabare, Kabarando, Murama, Murundi, Mwiri, Ndego and Rwinkwavu sectors. These sectors are relatively hot and semi-arid with rainfall averaging 900 mm per year. However, the abundant surface water resources, mostly lakes, suggest that there is a good potential for irrigation estimated at some 30,000ha for Kayonza District. About 80% of the total active population in the District is engaged in agriculture as their main economic activity and source of income. In the eight drought-prone sectors targeted by the Project, 58% of all households raise some type of livestock, 24% have cows.

KIIWP directly targets 28,000 households in the eight Project sectors broken down as follows:

- 21,925 households that are members of the 54 farmer cooperatives growing rice, maize and beans or horticulture in these sectors, and will be supported through Farming as a Business (FAAB) skills, cooperative strengthening, and backward/forward linkages. Depending on their locations, a large part of these households will also benefit from other specific activities.
- 6,415 households that are not members of these cooperatives, but may be supported by other specific activities

Out of the total direct target households, 21,585 will receive specific support as follows:

- ✓ 7,350 households benefiting from terracing and agro-forestry (estimated on basis of average 0,3 ha land area per household);
- ✓ 2,225 households farming in marshlands and hillsides that will be developed by KIIWP (estimated on basis of average 0.3 ha land area per household);
- ✓ 5,560 households in marshland schemes where no infrastructure development will take place, but organizational strengthening activities are geared towards sustainable water management by Water Users Organizations (WUOs);
- ✓ 4,350 households to be included in small/holder schemes in Ndego pumping schemes;
- ✓ 400 households benefiting from water harvesting infrastructure;
- ✓ 1,700 households that have cows and benefit from water for animals.

Indirectly, all households farming in the watersheds (another 22,000 households) will be targeted under Catchment Rehabilitation and Protection Component and will thus benefit from improved water retention and improved soil fertility. Business development opportunities and market linkages will also benefit other farming families.

KIIWP project will comprise of two core technical components and a third component supporting institutional development and Project coordination. These components and their sub-components are presented below.

Component 1: Strengthening Resilience to Drought

- Sub-component 1.1: Catchment Rehabilitation and Protection
- Sub-component 1.2: Irrigation Development
- Sub-component 1.3: Infrastructure Management Institutions

Component 2: Support to Farm Business Development

- Sub-Component 2.1: Enhancing Climate Smart Agriculture (CSA) Practices and Technologies.
- Sub-component 2.2: Developing Farming as a Business (FaaB) Skills
- Sub-Component 2.3: Supporting Backward and Forward Market Linkages

Component 3: Institutional Development and Project Coordination

- Sub-component 3.1: Policy and Institutional Development
- Sub-component 3.2: Project Coordination

The current study concerns Ndego Sector, one of the 8 KIIWP sites to be developed in Kayonza District. The entire targeted watershed is portioned into 2 sub-watersheds as follows: the command area (CA) and the command area catchment (CAC). The command area catchment covers 2,491.75ha and the command area is 2018.2 ha split into three blocks touching Kibare, Ihema and Nasho lakes respectively. The total command area is currently used for agriculture, as shown on land use map below.

2.5.2. Ndego Project layout

Three options were identified in feasibility study and the following maps presents key components of Ndego irrigation system including water sources (lakes) pumping stations, balancing storage, centre pivots and roads network).

2.6. Description of Project activities

The construction of irrigation infrastructures and the implementation of land husbandry technologies are planned as the main activities of Ndego project. The irrigation facilities will only be installed in the command area while the command area catchment will remain rainfed. The land husbandry infrastructures will be executed both in CA and CAC. Land husbandry technologies were proposed based on the nature of the project watershed features of the command area catchment and the command area (ie slope category, soil depth). Access roads and post-harvest infrastructures are among other activities to be supported in Ndego area.

2.5.1. Irrigation Targets and options

Ndego project targets 2,000 ha net (or 2,500 ha gross irrigation area) for irrigation development with potential water sources from the two lakes (Kibare and Nasho) around Ndego Sector in Kayonza District. The targeted irrigation area is made of 3 blocks, two abstracting water from Kibare lake and the last from Lake Nasho. The blocks are designated as Kibare, Ihema and Nasho Blocks, interchangeably named as Block 1 to 3, respectively. Most of the irrigation area is located in Nasho block. The Table 1 below depicts irrigation blocks, their size as well as the source of water of irrigation.

Table 1: Target Blocks and Water Source

SNo	Site name (Block)	Gross Irrigation area (Ha)	Net target area (Ha)	Water source
1	Kibare	600	482.8	Lake Kibare
2	Ihema	830	636.5	Lake Kibare
3	Nasho	1,070	898.9	Lake Nasho
	Total	2,500	2,018.2	

Source: SMEC (2020). Final Feasibility Study at Ndego in Kayonza District

The two lakes are connected to Akagera river which provides significant amount of recharge and it was assumed that 0.1% of Akagera river flow recharges Lake Ihema, Lake Kibare and Lake Nasho. Ndego irrigation area is dominantly sandy. The soil infiltration rate of Ndego sites is greater than 3.0cm/hr which is high (SMEC, 2020). The surface irrigation system is not the preferred choice with such soil characteristics; hence another method or system should be considered. Three options were assessed and accordingly, about 2,024ha, 2, 017 ha and 2,018 ha are proposed for options 1, 2 and 3B. The preliminary findings are shown in the table below.

Table2: Findings on assessed options

SNo	Main features	Unit	Quantity		
			Option 1	Option 2	Option 3
1	Gross Area	Ha	2,500	2,500	2,500
2	Net Irrigation area		2,024	2,017	2,018
3	No of sub-blocks	No	15	12	10
4	No of CPT		-	29	40
5	Main canals lengths	m	57,408	36,792	
6	Secondary canals		44,663	30,400	
7	Tertiary canals		45,056	13,194	
8	Tertiary pipes		84,996	65,740	
9	Drainage canals		140,594	80,992	80,992
10	Main pipeline to CPT			26,953	73,576
11	Main pipeline to Sprinkler			5,325	
12	Distribution/infield pipeline to sprinkler				154,081
13	Access road		76,256	75,290	79,511

Source: SMEC 2020, feasibility study

SMEC (2020) states that the analysis of all options at feasibility stage reveal that Option 3 is superior since the proposed irrigation systems are more suitable for the sandy soil types, more cost efficient, more diverse, more water efficient and may be constructed in a shorter time duration. The farmers will be able to start farming and generating revenues earlier and recommend either Option 3 (Option 3B) to be developed during detailed design phase.

2.5.2. Development of Irrigation layouts

At the feasibility study stage, preliminary assessment and comparison were conducted on the main system for all the blocks and engineering estimates were prepared based on the preliminary layout. The soil and land

characteristics, pressure requirements, beneficiaries' interest and loss of soil fertility as a result of land preparation were considered as main factors. Taking into consideration these factors, four options considered and studied for the preparation of preliminary irrigation layouts include:

- ✓ Option 1 - Open channel conveyance for surface irrigation
- ✓ Option 2/2B- Piped conveyance for pressurized and open channel conveyance for surface irrigation
- ✓ Option 3/3B- Fully pressurized irrigation (Center Pivot Technology and Sprinkler)
- ✓ Option 4- Piped gravity conveyance, mixed distribution and surface irrigation application

The Option 3/3B (fully pressurized irrigation) was found to be economically viable. As mentioned above, the pressure required for surface varies up to 60.0m in most of the areas and 67.5m for B3/BS4 (net). To convert this system to fully pressurized irrigation, additional pumping head of 25 to 30m is required so that sprinkling to the required diameter can be possible. This requires 90m pumping head (net), or 100m including head losses of 10%, and this is above the head threshold. Therefore, this option was previously dropped since it is above the threshold head of 65m.

2.5.3. Main irrigation blocks

Ndego site is split into 3 blocks (Kibare, Ihema and Nasho). For the good operation and management of the irrigation system in Ndego sites, the blocks within the project were subdivided into sub-blocks. These will help in entertaining different irrigation methods, regulating pressure heads and minimizes investment and operation costs. Block numbers and their designations are following the main canals/pipelines. Main irrigation sub-blocks for Kibare, Ihema and Nasho are five, two and three respectively. The naming and area coverage of blocks and sub blocks are shown in Table 3 below.

Table 3: Irrigation areas and designations for pressurized irrigation (Option-3)

Block No	Sub Block designations	Designations		Remarks
		Off taking main pipeline	Branch pipes	
B1	B1/BS1 PP B 1-1	B 1-1 MP	BP 1 – BP21	Sprinkler
	B 1-2	B1-2 MP	BP 1 – BP5	
		B1-2 CPT MP	BP 1 – BP10	CPT
	B 1-3	B 1-3 MP	BP 1 – BP2	Sprinkler
	B 1-4	B 1-4 MP	BP 1 – BP14	
	B 1-5	B 1-5 MP	BP 1	
		B 1-5A MP	B1- CPT BP	CPT
B2	B2/BS1 PP			
	B2/BS2 PP			
	B 2 – 1	B2-1 MP	BP1 – BP 31	Sprinkler
		B2-1 CPT MP		CPT
		B2-1 CPT BP MP		
	B 2 – 2	B2-2 MP	BP 1 – BP9	Sprinkler
		B2-2 CPT MP		
B3	B3/BS1 PP			
	B3-1	B3-1 MP	BP1 – BP31	Sprinkler
		B3-1 CPT MP		CPT
	B3-2	B3-2 MP	BP1 – BP3	Sprinkler
		B3-2 CPT MP		CPT
		B3-2 CPT MP BP		
	B3-3	B3-3 MP	BP 1 – BP 12	Sprinkler

MP -MAIN PIPELINE, CPT- CENTRE PIVOT SYSTEM, BP-BRANCH PIPELINE, BS-BALANCING STORAGE, BP -BRANCH PIPE

Source: SMEC (2020), Feasibility Study Report

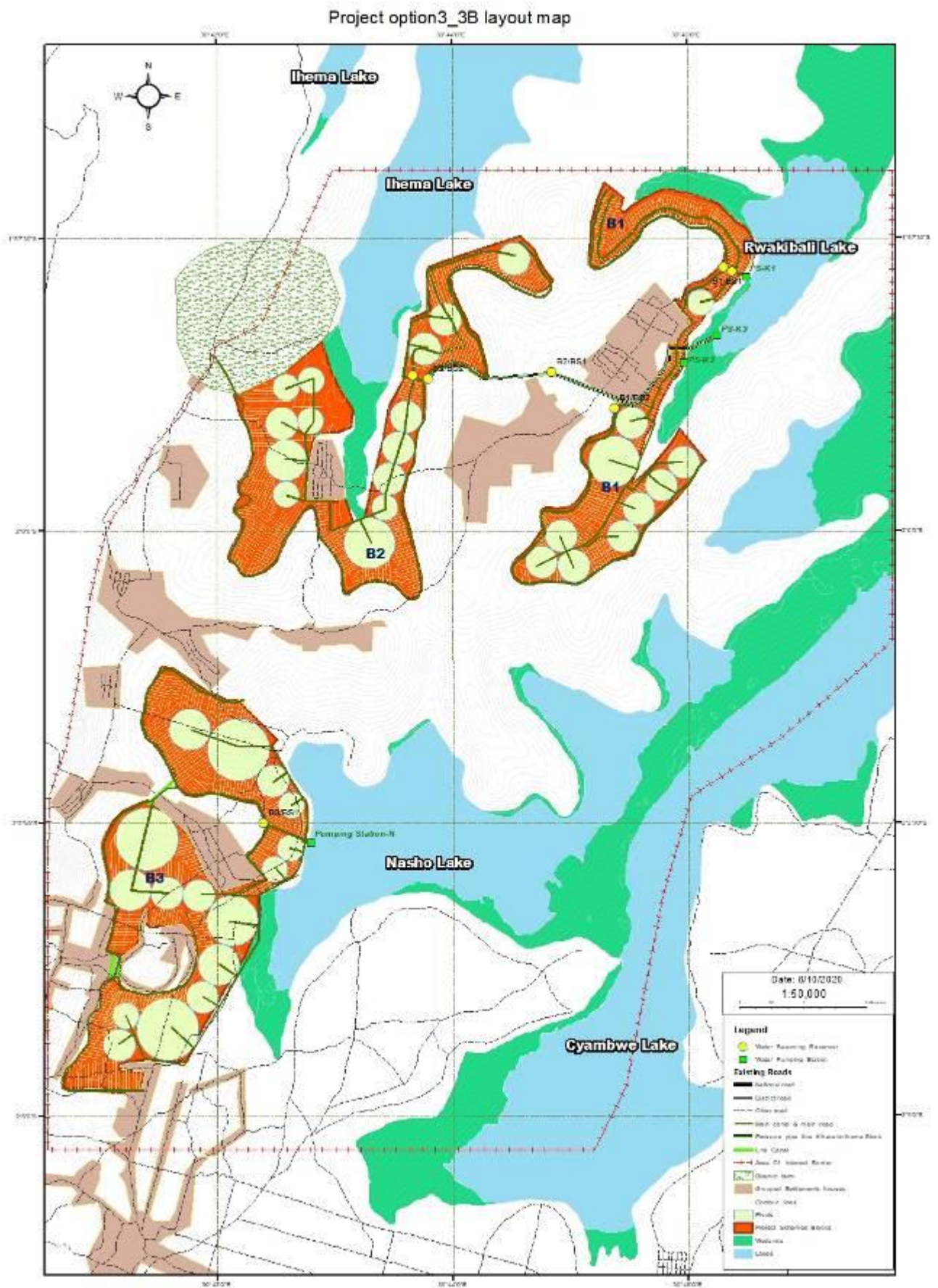


Figure 3 : Main features of Ndego irrigation schemes
Source: Adapted from Feasibility study, (2020)

Table 4: Main features of the irrigation method per block

No	Main Features	Blocks			Total
		B1 (Kabare)	B2 (Ihema)	B3 (Nasho)	
1	Gross Command Area (Ha)	600.0	830.0	1,070.0	2,500
2	Net Irrigation Area (Ha)	482.8	636.5	898.9	2,018.2
3	Number of Sub-blocks (No)	5	2	3	10
4	Sub-blocks served	B1-1 to B1-5	B2-1 to B2-2	B3-1 to B3-3	
5	Number of CPT (No)	10	14	16	40
6	Drainage Channels (m)	15,118	35,663	30,211	80,992
7	Main pipeline to CPT & Sprinkler (m)	24,776	21,842	26,958	73,576
8	Distribution and infield pipeline to Sprinkler (m)	38,460	53,206	62,415	154,081
9	Access road (m)	26,209	28,041	25,261	79,511

Source: Feasibility study 2020,

The potential net irrigation area per sub-blocks, regardless of the land suitability in terms of soil fertility and depth is presented in the following Table.

Table 5: Allocation of net irrigation by blocks for proposed irrigation method

Block	Sub-block designations	Gross Area (Ha)	Net area (Ha)		Total (ha)
			Sprinkler	CPT	
B1	B1-1		78.1		78.1
	B1-2		27.5	13	40.5
	B1-3		47.7		47.7
	B1-4		18.3		18.3
	B1-5		88.2	210	298.2
	Total	600	259.8	223	482.8
B2	B2-1		249.1	228	477.1
	B2-2		99.4	60	159.4
	Total	830	384.5	288	636.5
B3	B3-1		176.1	141	317.1
	B3-2		27.3		27.3
	B3-3		169.5	385	554.5
	Total	1,070	372.9	526	898.9
Project Area Total (Ha)		2,500	981.2	1,037	2,018.2

2.5.4. Irrigation System Components and methods

The proposed Ndego Project consists of the following main components:

- ✓ Intake Works/Pumping stations;
- ✓ Pipeline and related structures;
- ✓ Irrigation canals, drain channels and related structures;
- ✓ Sprinkler system;
- ✓ Centre pivot;
- ✓ Different hydraulic structures;
- ✓ Water storage facilities (Balancing storage reservoirs)
- ✓ Land husbandry technologies;
- ✓ Road networks.

6) Balancing storages

Five balancing storages (BS) are proposed at the same locations: two in Kibare, two in Ihema and one in Nasho Block. The next **Table** presents the storage capacity of balancing storage and net irrigation area per block.

Table 6: Balancing storages and net irrigation command area per block

Balancing storage	Off taking pipeline	Net irrigation are (Ha)	Storage Capacity (m3)
Kibare Irrigation Block: Block 1			
B1/BS1	B1-3 MP	47.7	713
	B1-4 MP	18.3	
B1/BS2	B1-5A MP	12.3	3,100
	B1-5 MP	75.9	
Ihema Irrigation Block: Block 2			
B2/BS1	B2-1 CPT BP MP	73.0	691
B2/BS2	B2-1 MP	249.1	3,272

Balancing storage	Off taking pipeline	Net irrigation are (Ha)	Storage Capacity (m3)
	B2-2 MP	99.4	
Ihema Irrigation Block: Block 3			
B3/B S1	B3-1 MP	176.6	
	B3-2 MP	27.3	4,698
	B3-3 MP	128.0	
	B3-2 CPT BP MP	169.0	

Source: SMEC (2020).Feasibility study report

7) Allocation of Dragline sprinkler and CPT irrigation

The following main criteria are followed to prepare option 3/3B layout. These are:

- ✓ The maximum pumping head considered ranges between 65 and 70m. Medium head sprinklers and CPT irrigation requires operating head of 25 to 30m (minimum) so that to enable sprinkling to the designed diameters. Therefore, areas with higher elevations (i.e greater than 1325.0 El) which requires to exceed the specified pumping head of 65 to 70m, are proposed to be irrigated by boosting from the balancing storages;
- ✓ Minimum available CPT size is 6.5Ha with a diameter of 288.0m (Manufacturers Manual). For Ndego Project, this size is excluded from the layout as this will cause to remove a lot of surveyed and suitable land from the proposed irrigation layout. The minimum CPT size considered in the layout preparation is 13Ha, with a diameter of 410m. Therefore, any potential command area with a width of less than 410m won't be developed with CPT alternative. Instead, sprinkler systems are proposed in these areas, provided that the head requirement mentioned above is satisfied;
- ✓ After analysing the experience in Rwanda with implemented irrigation projects, the drip system alternative got dropped. This method is not welcomed by the farmers and operation experts, due to complicated tasks during farm preparation, farming and harvesting. In addition, this system incurs a lot of expenses as a result of replacement costs for the laterals and re modification of the spacing from the proposed ones.

8) Centre Pivot (CPT) pipelines

Three types of pipelines are aligned in the CPT layouts. Main pipelines (MP) convey flow by pumping from pumping station at the lakes or boosting from balancing storages, branch pipelines (BP) branched from the main pipelines and a distribution pipe connected to the CPT inlet. Depending on the layouts, the main lines are also directly connected to the CPTs inlet. The systematic and clear understanding of the layouts, the pipeline and the CPT system are designated as discussed below:

B1-CPT MP = Block 1 main pipeline to CPT's

B1-CPT MP BP = Block 1 main pipeline to CPT's by Booster Pumps

CPTs for each Block are designated by initial of the Block as KCPT, ICPT and NCPT for Kibare, Ihema and Nasho respectively.

9) Pipe networks/Lengths

The general preliminary pipeline layouts for each Block were prepared and the total pipe length for centre pivot irrigation for main pipeline, branch and distribution to the CPTs is 41.5 km and irrigation area of 1,037Ha. The Table below indicates the summary of pipelines lengths per block as well as corresponding irrigation areas.

Table 7: Summary of pipelines lengths and irrigation area per block

Block	No of main pipelines	No of branch lines	Pipe lengths (m)			Total irrigation area (ha)
			Main pipeline	Branch pipe	Distribution to CPT	
Kibare	2	1	4,340	1,808	4,821	223
Ihema	4		11,826	95	1,543	288
Nasho	3		12,783		4,381	526
Total			28,949	1,903	10,682	1,037

Source: SMEC (2020)

For inspection and maintenance purpose, the main and branch pipelines to the distribution pipes to CPT inlet are provided with 6.0m access road.

10) Sprinkler Irrigation

Two types of pipelines are aligned in the Sprinkler layouts. The main pipelines convey flow from pumping station and branch /secondary pipelines connected to the sprinkler laterals. Sprinkler systems are designated as discussed below:

B1-1MP = Block 1 main pipeline 1

B1-2MP = Block 1 main pipeline 2

- **Selected Sprinkler sizes**

The sprinkler sizes exercised in Ndedo project are medium heads from 25 to 30m head.

Pipe networks/Lengths

Typical sprinkler arrangement is shown in Figure 6 below.

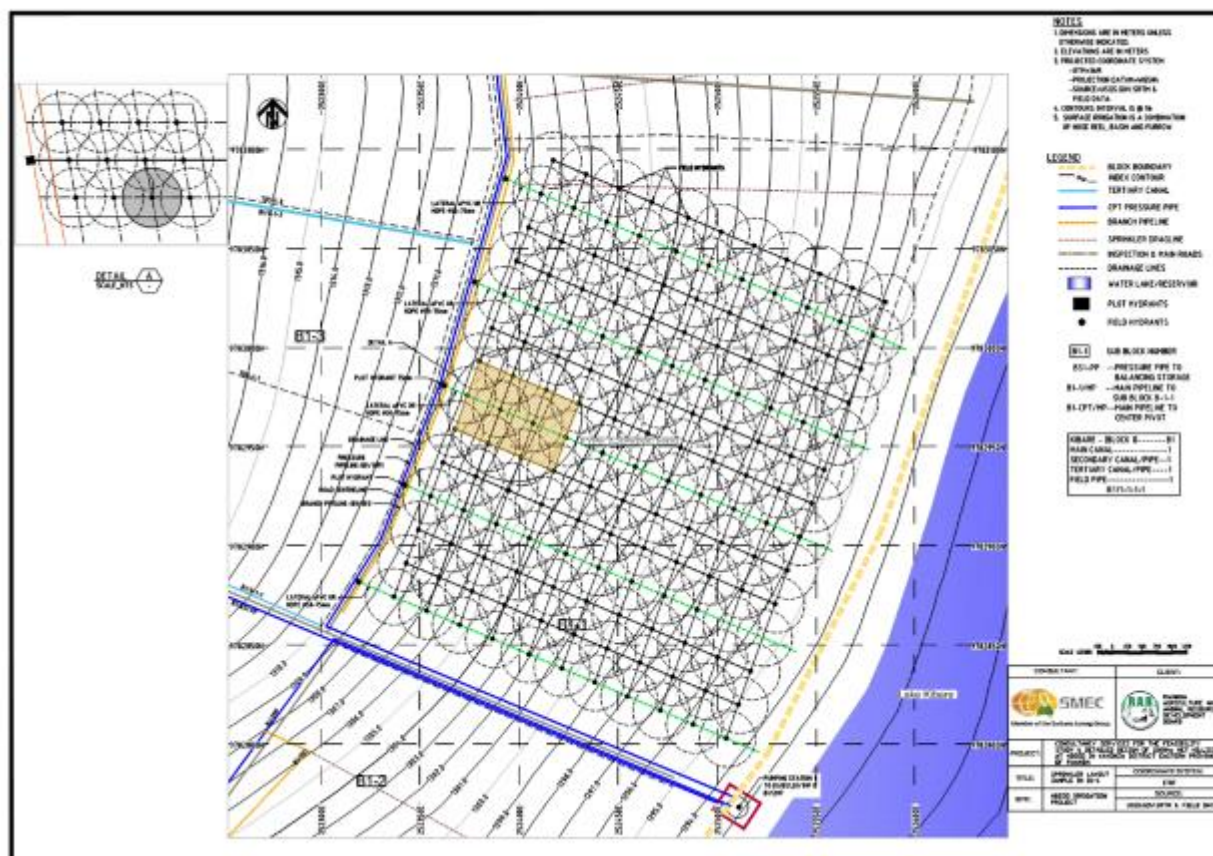


Figure 5: Typical sprinkler arrangement in block B1-1

Source: Feasibility study

The total main pipeline lengths are 42.8km and irrigation area of 981.2ha. The distribution and lateral lengths are presented in the following Table.

Table 89: Pipe network characteristics

Blocks	Main pipeline (m)	Distribution (m)	Laterals (m)	Total by block
B1-1	4,412	7,929	13,416	
B1-2	2,520	2,837	1,386	
B1-3	3,673	4,056	7,558	
B1-4	50	1,079	1,921	
B1-5A	1,413	1,456	2,169	
B1-5	5,720	7,419	12,010	
	17,788	24,776	38,460	81,024
B2-1	8,847	16,811	37,918	
B2-2	3,348	5,031	15,288	
	12,195	21,842	53,206	87,243
B3-1	4,150	9,722	27,665	
B3-2	1,708	2,072	4,523	
B3-3	7,032	15,164	30,227	
	12,890	26,958	62,415	102,263
	42,873	73,576	154,081	270,530

Source: Feasibility study, 2020

2.5.5. Irrigation area coverage by type

A net irrigation area of 2,018ha is available in this option as shown in the Table below. The net irrigation area per block and for each irrigation system is presented in the following table.

Table 8: Irrigation area coverage by type

Block	Irrigation Area (Ha)				Total Net (Ha)
	Sprinkler		CPT		
	Direct pumping	Booster pump	Direct pumping	Booster pump	
Kibare	105.6	154.2	223		482.8
Ihema		348.5	215	73	636.5
Nasho		372.9	398	128	898.9
Total	105.6	875.6	836	201	2,018.2

Source: SMEC (2020)

2.6. Land Husbandry Infrastructures

2.6.1. Targeted areas

The command area catchment (CAC) and the command area (CA) are split into three blocks touching Kibare, Ihema and Nasho lakes respectively. The net CAC and CA cover 2,491.75 ha and 2,018.2 ha respectively. The proposed area for the treatment of both CAC and CA is illustrated in the following table.

Table 9: Land Husbandry area per block

No	Site	Blocks			Total
		B1 (Kibare)	B2 (Ihema)	B3 (Nasho)	
1	Net Command Area Catchment (ha)	439.25	1,077.75	974.75	2,491.75
2	Net Command Area (Ha)	482.8	636.5	898.9	2,018.20
	Total area	922.05	1,714.25	1,873.65	4,509.95

Source: Feasibility study SMEC (2020)

2.6.2. Land Husbandry technologies

Ndego project area falls in the dry-low-land agro climatic zone with a gently sloping landscape ranging between 0 to 16%. Land husbandry technologies were proposed based on the soil nature and slopes of the command area catchment and the command area.

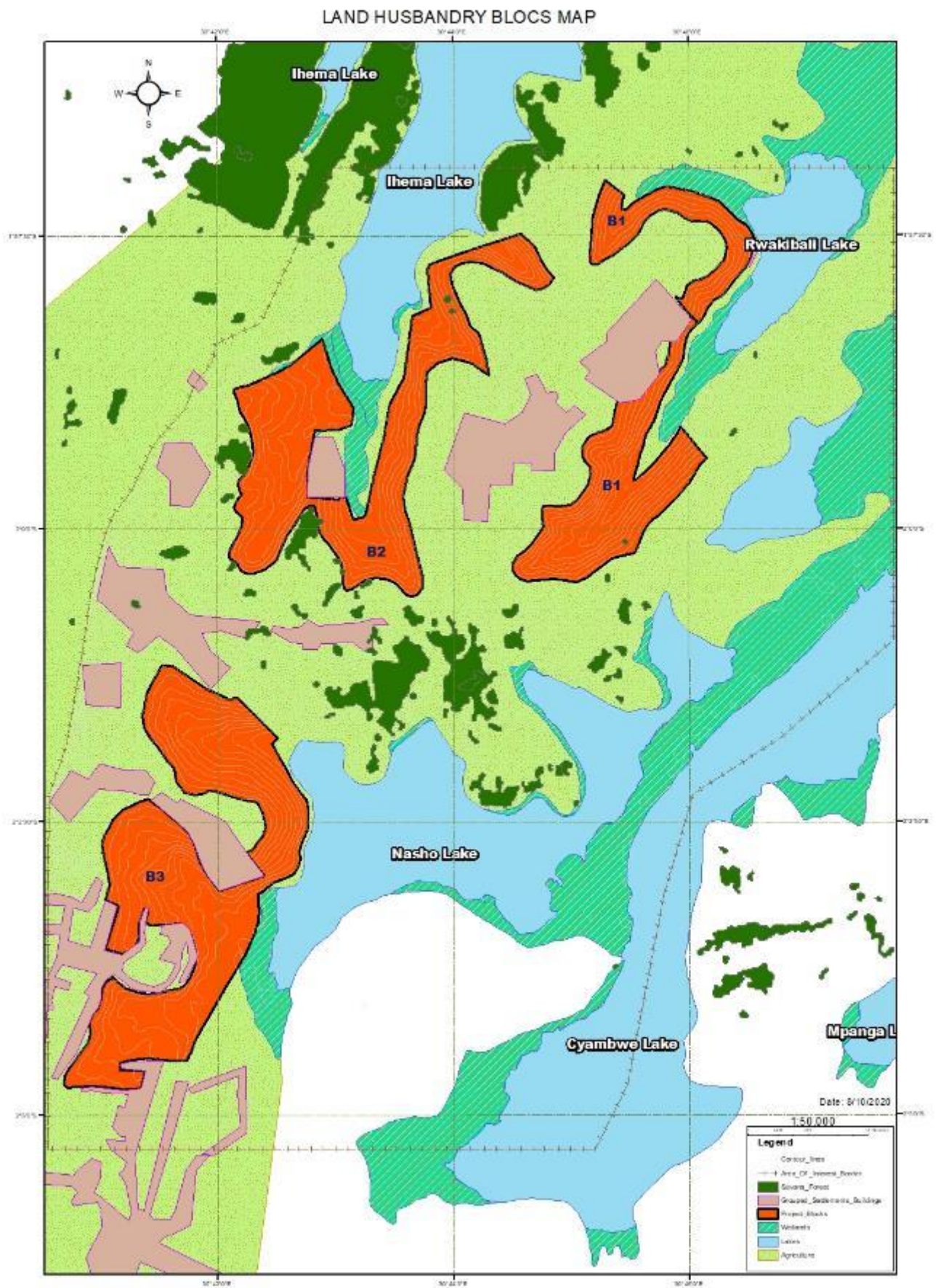


Figure 41: Land husbandry blocks
Sources: Adapted from Feasibility study, 2020

2.6.2.1. Command Area Catchment

Land husbandry technologies in the CAC were proposed to various slope categories (0-4%, 4-6% and 6-16%) as follows. The estimated area with 0-4%, 4-6% and 6-16% slope in the CAC will be about 714.2 ha, 1,431.43ha and 344.6 ha respectively.

(vi) Contour ploughing and Grass strip/ trash line

The contour ploughing and row planting along the contour line was designed for 0-4% slope because it is enough to obstruct the water movement. Grass strip and trash line were recommended on slope class of 4-6% to lay alternatively along the contour line in 10-meter interval of either the grass strip or the trash line so that every five meters' interval either the grass strip or the trash line could hinder the water movement within the sub-slope category. The width of Trash line and grass strip is recommended to be 1 meter and the density of the grass strip and the trash line will be 1 km/ ha each. The grass strip is advised to be managed properly so that, frequent cutting of the grass strip, through time, could develop into bund like elevated embankment to effectively obstruct the sheet erosion that may occur in this flat to gentle slope.

(vii) Anti-erosion trenches

The proposed technology for 6-16% slope category is the establishment of the trenches technique, also known as "Fanya juu". It consists of excavating ditches along the contour lines, making bunds with the excavated earth upstream with the purpose of creating progressive terraces. The recommended dimensions of the anti-erosion trenches are as follows: depth 0.5m, width 0.4m and 4m length or depth 0.5m, width 0.5m and 4m length depending upon the quantity of coming run off to be accommodated. Ditches are separated by a distance of 0.5m with 20cm below the soil level, playing a role of a check dam. These are positioned in a staggered fashion to prevent accumulation of water and then enhance the infiltration. Trenches are constructed in such a way the soil is evenly piled on the upper side of the trench to avoid collapsing and facilitate the plantation of grasses, shrubs and trees which help to stabilize the soil and prevent erosion.

(viii) Biological measures

The agroforestry species (timber trees and/or fruits and shrubs) and grasses should be planted along the embankments of ditches to stabilize them, with two rows of grasses separated by 50cmX50cm. The plantation should be done in staggered fashion in the way to cover properly the piled up soil. Agroforestry trees and shrubs should be planted on the upper side on the embankment, the spacing between timber trees should be 12m or 6m between fruit and timber trees (12m between two consecutive trees of the same type and 6m between fruits and timber tree) and shrubs spaced to 2m from each other. *Cedrela serrata*, *Maesopsis eminii*, *Grevilea robusta*, *Acacia* spp, Mango tree (*Mangifera indica*), *Avocado americana* are some of the tree component adapted to savannah conditions of Ndego area while *Senna* spp, *Calliandra* spp, *Leucaena* spp, etc should be used as shrubs.

For the quick stabilization of the soil on upper side of the ditches, the planting of grass species is 25 cm between plants and 25 cm between rows of plants. Two rows of grasses should be planted in staggered fashion to cover properly the soil. The grass species proposed include *Brachiaria* spp, *Panicum* spp and *Kakamega* spp.

(ix) Mulching and manure application

The mulching technique should also be applied to limit evapotranspiration, ensure the possible runoff that could invade the command area is controlled and improve physico-chemical properties of the soil. The organic manure can also be used. The mulch materials are decomposable plants and or crop residues. Thickness of the mulch is approximately 10 cm throughout the area. The fresh green-plant mulch is not left on the surface to dry before it is incorporated to the soil.

(x) Drainage systems

Though erosion is not a serious problem in the project area due to low rainfall and gentle slopes, drainage systems will be required for the protection of the site. The cut off drains are necessary to avoid runoff incidence and arrest the soil movement. They are recommended to be constructed in every 800-meter surface distance and be graded to 3-5%. A number of cut off drains are constructed in such a way that all are connected to the natural or artificial water ways. The water ways are expected to be constructed or reshaped not to have more than 15% slope against the contour line and also it requires checkdams to hinder the runoff

as well as to trap silt. It is compulsory to plant grass in the cutoff drains and water ways and manage it properly all along their length.

2.6.2.2. Command Area (CA)

The technologies recommended in the CA include the following:

(iii) Drainage systems

Surface drainage is very useful in removing excess water from land in a controlled manner and as quickly as possible, to an artificial drainage system or a natural watercourse. This should be done with no damage to the environment.

The design and location of the manmade drainage system should take into consideration the existing natural drainage network in both the command area catchment and command area. The drainage network from the command area catchment should match well with the drainage infrastructures of the command area.

Cut off drains are firstly located below the source of water which would invade agricultural lands (Houses, rocks, forests...); secondly, remaining cut off drains and manmade waterways are located considering the slope category. Each cut off drain, leads the water to the natural or manmade waterway. Manmade waterways are located at the end (Outlet) of cut off drains if these ones cannot convey excessive water in reasonable distances. Start lying out from the drainage divide and orient the cut-off-drains to both directions. Water ways are constructed from outlet to the tail end while the construction of cut off drains starts from the outlet where the cut-off-drain joins the waterway.

Both waterways and cut off drains are constructed in the form of inverted trapezoid with both sides sloping at 2:1 (V: H) ratio respectively; the average floor width is 40 cm. The minimum recommended depth of water channels after terracing is 50cm. Waterways are constructed with side pass for pedestrians. The check dams will be built across the floor of waterways and cutoff drains. Grasses will also be planted to stabilize the constructed drainage systems.

(iv) Land levelling

Levelling will be done in the command area on nearly level to gently sloping land (slope 0-4 %). The levelling has importance of facilitating irrigation. The ground irregularities should be removed and try to make the slope uniform.

The levelled land should be separated by the cut off drains spaced of 50m from one another. The cut off drains should be laid on 2% to 3% slope against the contour. Where the slope may not allow the above rule to be respected, it is better to try to orient the cut off drain perpendicularly to the ground slope in such way to avoid making an irrigable zone larger than 50m width cut off drain to cut off drain. The upper side of the cut off drains should be stabilized with trees, shrubs and grasses. The trees are spaced at 10 m while in between two consecutive tree shrubs are planted at 2 m spacing. The area between trees and shrubs should be covered by grasses. This grass – belt will contain the silt that is escaping through the tree and shrubs rows along the levelled land.

(v) Contour Buffer Strips

Contour buffer strips are strips of perennial vegetation alternated down the slope with wider cultivated strips that are farmed on the contour. Contour buffers strips are at least 50 cm at most one-meter width. Vegetation in strips consists of adapted species of grasses, trees and shrubs. They are applied on the average in 20m spacing to each other in 4 - 6% slopes. With frequent cutting and harvesting, the grass strip develops naturally into bund enough to effectively obstruct the sheet erosion that may occur in this flat to gentle slope.

(vi) Contour Bunds

Contour bunds are established to slow down the runoff water on 6-12% slope. Contour bund technique reduces water runoff and controls soil erosion through ridges made up of heap of soil that follow positions located at the same altitude. Those ridges should be covered with perennial grasses and stabilized by agroforestry trees and shrubs. The spacing between the bunds is made with Vertical Interval 1 meter.

(vii) Biological measures

The ditch or soil bunds embankments should be planted with two rows of grasses separated by 25cmX25cm. The plantation should be done in staggered fashion in the way to cover properly the soil.

(viii) Contour ploughing

Contour ploughing or contour farming or Contour ploughing is the farming practice of ploughing and or planting across a slope following its elevation contour lines. These contour lines create a water break which reduces the formation of rills and gullies during times of heavy water run-off; which is a major cause of soil erosion. The water break also allows more time for the water to settle into the soil. In contour ploughing, the ruts made by the ploughing run perpendicular rather than parallel to the slopes, generally resulting in furrows that curve around the land and are level.

2.6.3. Lime/travertine and compost application.

One of the most important conditions, for ensuring agricultural crops will grow, is the condition of the soil, including the pH balance. Soil pH affects the availability of plant nutrients. Lime is to be used for increasing the soil pH.

The optimal pH range for most plants is between 5.5 and 7.0; however, many plants have adapted to thrive at pH values outside this range. Results from laboratory analysis revealed that the soil pH of Ndego command area ranges between 4.3 and 8.5. The lime application is recommended on the pH ranging from 4.3 to 5.4. The lime to be applied is agricultural lime at the rate of 3 tons of lime (burnt lime) per hectare. The lime/travertine should cover the soil of some 5 – 10 cm depth. Preferably, apply burnt lime two weeks before sowing to maximize its effectiveness in reducing soil acidity and enhance nutrient uptakes by crops.

The quantity of good quality compost recommended is 10 tons per Ha. It must contain at least 0.4 % of N, 0.6 % of P and K nutrients. The compost to be used should be exhibiting more than 80% decomposition and friable. Make sure that the compost is applied and covered to avoid loss of its volatile nutrients.

3. LEGAL AND INSTITUTIONAL FRAMEWORK

The Legal and institutional framework evaluates the available laws, regulations, policies and institutions that guide the land acquisition and compensation, crop and assets compensation including mechanisms for conflict resolution and appeals. These legal frameworks provide applicable legal and administrative procedures including remedies available to displaced persons in the judicial process and the normal time frame for such procedures and available alternative dispute resolution mechanisms that may be relevant to the project. There are several enactments all governing land and transactions of land in the country. The laws and regulations relates to agencies responsible for implementing resettlement activities and guides on issues such as land, water and environment among others.

3.1. National Regulation related to resettlement

This part describes National institutional, legal and policy framework for resettlement requirements in Rwanda, applicable to the project as well as the international provisions that bear relevance to the implementation of this project.

- The Rwanda Constitution

The constitution is the supreme law of the land. Under Article 29 of the Rwanda constitution every citizen has a right to private property, whether personal or owned in association with others. Further it states private property, whether individually or collectively owned, is inviolable. However this right can be interfered with in case of public interest, in circumstances and procedures determined by law and subject to fair and prior compensation.

Article 30 stipulates that private ownership of land and other rights related to land are granted by the State. The constitution provides that a law should be in place to specify modalities of acquisition, transfer and use of land (expropriation law). The constitution also provides for a healthy and satisfying environment. In the same breath every person has the duty to protect, safeguard and promote the environment. The State shall protect the environment.

- **Expropriation Law for Public interest,**
- **Law n° 32/2015 of 11/06/2015 relating to expropriation in the public interest**

This law determines the procedures relating to expropriation of land in the interest of the public. The law stipulates that the government has the authority to carry out expropriation. However, the project, at any level, which intends to carry out acts of expropriation in the public interest, shall provide funds for inventory of assets of the person to be expropriated and compensation exercise. According to the law, no person shall hinder the implementation of the program of expropriation on pretext of self-centered justifications and no land owner shall oppose any underground or surface activity carried out on his or her land with an aim of public interest. In case it causes any loss to him or her, he or she shall receive just and fair compensation for it.

Eligibility for compensation is enshrined under the Rwandan constitution (article 29) and the expropriation law. The two laws regulate and give entitlement to those affected, whether or not they have written customary or formal tenure rights. The person to be expropriated is defined under article 2(7) of the expropriation law to mean any person or legal entity who is to have his or her private property transferred due to public interest, in which case they shall be legally entitled to payment of compensation.

There is no physical resettlement expected from the Ndego irrigation and land will be acquired at pumping station, main irrigation canals/pipes and water regulation reservoir. Further, loss of income is expected during land husbandry works. Given the low level of anticipated impacts, an abbreviated resettlement action Plan and livelihood restoration plan are the recommended social safeguards instruments.

- Law n° 43/2013 of 16/06/2013 governing land in Rwanda

The Organic Law No. 08/2005 Determining the use and management of Land in Rwanda of 2005 determines the use and management of land in Rwanda. It also institutes the principles that are to be respected on land legal rights accepted on any land in the country as well as all other appendages whether natural or artificial.

According to the Law, Land in Rwanda is categorized into two: Individual land and Public land. The latter is subdivided into two categories: the state land in public domain and the state land in private domain. State land in public domain includes national land reserves for environment conservation; land over which administration building are erected, statedam, land containing lakes, rivers, stream and springs. State land in private domain include swamps that may be productive in terms of agriculture, vacant land with no owner, land purchased by the State, donation, land acquired through expropriation and land occupied by state owned forests. Land in Rwanda is predominantly individual land.

The law gives the owner of land full rights to exploit his or her land in accordance with the existing laws and regulations. The law also provides for expropriation through article 56 which stipulates that land expropriation can be undertaken if it's for public interest. Article 29 of the law states that swamp land belongs to the state and no person can use the reason that he or she has spent a long time with it to justify the definitive takeover of the land. The definition of the swamp in this case, is not very clear and the law gives the Minister in charge authority to identify and determine these swamps, use structures and boundaries.

- Law establishing and organizing the Real Property Valuation Profession in Rwanda

Law No.17/2010 of 2010 Establishing and Organizing the Real Property Valuation Profession provides conditions for registration of land valuers in Rwanda and. The law also allows the Government to conduct valuation when mandated by their government institutions. Articles 27, 29, 30 and 31 of the law deals with valuation methods. These articles stipulate that price for the real property shall be close or equal to the market value. The valuation could also compare land values country wide. Where sufficient comparable prices are not available to determine the value of improved land, the replacement cost approach shall be used to determine the value of improvements to land by taking real property as a reference. The law also allows the use of international methods not covered in the law after approval from the Institute of Valuers council. This law is in conflict with the ministerial order on determining land prices in and outside Kigali which sets reference prices of land.

- Ministerial Order Determining the Structure of Lands Registers

Ministerial Order No. 001/2006 of 2006 Determines the Structure of Lands Registers, the Responsibilities and Functioning of the District Land Bureau The responsibilities of the land bureau include among others to implement land registration and manage land and update, safely keep records of land registers and monitor and approve activities pertaining to valuation of land, other immovable property and demarcate and approve

land cadastral. This Order does not apply to land specified in articles 12, 14, 15 and 72 of the Organic Land Law No.8/2005 of 14/07/2005 determining the use and management of Land in Rwanda

- Ministerial Order Determining Modalities of Land Registration

Annex 3 of the ministerial No. 002/2008 of 2008 Determining Modalities of Land Registration provides for dispute resolutions procedures and some provisions related to the cell adjudication committee. Articles 17, 20, 22, and 23 provide the process for resolving disputes. Article 17 grants parties to a dispute, the right to take that dispute to the mediation committee. That article also provides that where a dispute arose during demarcation and adjudication but, with the assistance of the CAC, the parties were able to resolve the dispute, the parties are bound by that agreement, and may not later attempt to raise the issue. Article 20 provides procedures for the cell adjudication committee when hearing disputes, including that the hearing is open to the public and announced eight days in advance, among other requirements. Articles 22 and 23 govern the lodging and processing of objections and corrections during a 60-day period. The CAC is comprised of all five members of the cell land committee and five members of the particular umudugudu where demarcation and adjudication is taking place. The cell executive secretary acts as the CAC secretary, although he or she has no voting rights. This order can be used to resolve resettlement conflict at the sub project area.

3.2. Categories of lands in Rwanda

The Organic Land Law No 08/2005 of 14/7/2005 amended in 2013 categorizes land via two criteria: (1) Land Use and (2) Land Ownership. Land Use (Article 9) is split into two categories: urban lands and rural lands. Urban lands are defined as lands confined within the legal boundaries of towns and municipalities as well as lands in suburbs and collective settlements of towns and municipalities. Any other land is rural land.

Land ownership is divided into the following categories: individual owned lands and State lands (whether urban or rural). Article 11 provides that individual land is comprised of land acquired through custom, written law, acquisition from competent authorities, purchase, gift, exchange and sharing. State lands are further categorized into two sub-categories: public domains and private State owned lands (Articles 12 and 13). State land for public domain comprises land reserved for public use, for use by organs of state services or for environmental protection. Private state owned land consists of all other state owned land not considered to be part of public domain.

- Land tenure legal provisions in Rwanda

The Organic Land Law also provides two types of formal land tenure: full ownership/ freehold and long term leasehold. Following the privatization 09/04/2007 of State owned lands, very few land users currently hold either type of land tenure. This means that PAPs will receive compensation for individual land owned unlike in the past where land was communally owned (customary) or state owned. Therefore, the Organic Land Law recognizes existing rights, whether written or unwritten, under both civil law and customary practices through new national land tenure arrangements. Efforts are being made under the Law (Article 7) to formalize land ownership, especially those acquired through customary means. For instance, rural populations with customary/indigenous land rights are being encouraged to register their land through decentralized land institutions like the District Land Bureau, Sector Land Committees and Cell Land Committees (Ministerial Order N° 001/2006 of 26/09/2006 determining the structure of Land Registers, the responsibilities and the functioning of the District Land Bureau). All types of land tenure must be in compliance with the designated land use and environmental protection measures as outlined in the Land Use Master Plan..

- Private lands

According to Article 10 of new land law of June 2013, Private individual land shall comprise land acquired through custom or written law. That land has been granted definitely by competent authorities or acquired by purchase, donation, inheritance, succession, ascending sharing, and exchange or through sharing. This Law offers equal protection to rights over land resulting from all channels stipulated in the preceding paragraph.

- Property laws

Laws on property are found in various legal texts of Rwanda including the Rwandan Constitution which recognizes every person's right to private property (Article 29). Consequently, private property, whether individually or collectively owned is inviolable. Exceptionally, the right to property may be overruled in the case of public interest. In these cases, circumstances and procedures are determined by the law and subject to fair and prior compensation (Article 29).

In addition, the present Organic Land Law sets a legal framework for property law under articles 5 and 6 which provides for full ownership of land and permits any person that owns land (either through custom or otherwise), to be in conformity with the provisions of this law. It is important to observe however that full ownership of land is only granted upon acquisition of a land title issued by the general land registrar authority. Once the efforts to provide proper land tenure documentation are completed, ownership of land without proper documents such as land title will not be deemed lawful land ownership and thus in event of circumstances like expropriation, one will not be able to benefit from a fair and just compensation package.

- Eligibility to Expropriation

Eligibility for compensation is enshrined under the Rwandan constitution (Article 29) and the Expropriation Law. The two laws regulate and give entitlement to those affected, whether or not they have written customary or formal tenure rights. The person to be expropriated is defined under article 2(7) of the Expropriation Law to mean any person or legal entity who is to have his or her private property transferred due to public interest, in which case they shall be legally entitled to payment of compensation.

- Compensation entitlement

In case an individual suffers any loss, Article 3 of the Expropriation Law stipulates that he or she should receive just compensation for it, although it is not clear what comprises fair and just compensation, this being left to the judgment of independent valuers. Article 4 of this law also stipulates that any project which results in the need for expropriation for public interest shall provide for all just compensation in its budget. Through mutual arrangement, both parties can determine the mode of payment. Article 22 (2) of the of the Expropriation Law provides that through an agreement between the person to expropriate and the one to be expropriated, just compensation may either be monetary, alternative land or a building equivalent as long as either option equates to fair and just monetary compensation. In case the determination of ‘just’ compensation exceeds in value the alternative land given to the expropriated person, the difference will be paid to the expropriated person.

- Land Assets Classification and valuation

A land holder whose holding has been expropriated shall be entitled to payment of compensation for land and other assets, plus compensation relating to all activities resulting in any improvement to the land. Land and other assets are classified into two categories: movable and immovable assets, both of which are eligible for compensation. For movable assets, compensation relates to inconveniences and other transition costs caused in the process of relocation. Immovable assets include: crops, forests, any building or other activity aimed at efficient use of the land, the value of land, and the activities thereon that belong to the person expropriated.

The valuation is made considering the size, nature and location of land as well as the prevailing market price. The amount of compensation for property is determined on the basis of the replacement cost of the property. Prior to the 2005 Organic Land Law, as all land was State owned, buying and selling of land was not permitted. Following the recent restructuring of Land legislation, people now have the right to claim ownership and trade in newly-privatized lands. However, the decrees supporting this aspect of the 2005 Organic Land Law are not yet fully implemented, and awareness is currently perceived to be low among the population such that appropriate market prices for land have yet to be established.

3.3. IFAD policies related to resettlement

IFAD is committed to mainstreaming environmental and social safeguards and climate change solutions in its operations. It has adopted the Social, Environment and Climate Assessment Procedures (SECAP) in 2017. The SECAP endeavors to ensure that IFAD’s goal of enabling poor rural people to improve their food and nutrition security, increase their incomes and strengthen their resilience, particularly to climate change, is done in an environmentally and socially responsible manner. The procedures set the minimum standards for the assessment of social, environmental and climate change risks of IFAD funded projects which apply throughout the project cycle.

IFAD triggers the following safeguards policies (minimum standards): (i) Environmental and Social Impact Assessment, (ii) Natural Habitats, (iii) Involuntary Resettlement, (iv) Indigenous Peoples, (v) Pest Management, (vi) Physical cultural resources, (vii) Safety of Dams, and (viii) Accountability and Grievance systems.

3.3.1. Policy on Improving Access to Land and Tenure Security

The IFAD land policy provides a conceptual framework for the relationship between land issues and rural poverty, and identifies the major implications of this relationship for IFAD's work. The policy acknowledges the complexity and dynamics of evolving rural realities and articulates guiding principles for mainstreaming land issues in the Fund's main operational instruments and processes. It also provides a framework for the subsequent development of operational guidelines and decision tools. The main principles of the policy are:

- Align with national priorities and support to poverty reduction strategies;
- Adhere to the "do-no-harm" principle at all times;
- Appreciate the diversity and dynamic nature of existing agrarian structures and tenure systems;
- Support the centrality of the empowerment of poor rural people and the organizations that represent them;
- Forge complementary partnerships with like-minded actors;
- Focus on the gender dimension of land rights;
- Adhere to the principle of free, prior and informed consent;
- Support to production services and market linkages to maximize the positive effects of access to land and tenure security.
- Anchored in this policy are the tenets of Free Prior and Informed Consent (FPIC).

3.3.2. Policy on Disclosure of Documents, 2010

IFAD's Policy on the Disclosure of Documents enables project design documents to be disclosed prior to the Executive Board session at which the project is to be considered. The Consultation also directed the Executive Board to review policy provisions with regard to the disclosure of previously undisclosed documents. Under IFAD's current disclosure policy, the following documents are disclosed to the public at the same time that they are made available to Executive Board representatives and Governors:

- All documents submitted to the Governing Council (including its Replenishment Consultations);
- All documents submitted to the Executive Board (including the Evaluation Committee);
- Information/status notes on projects being developed for presentation to the Executive Board following internal approval of the inception memorandum;
- Agreements for loans and grants once they are signed and effective;
- Amendments to loan and grant agreements once signed and countersigned;
- Previously undisclosed documents that are eligible for disclosure under the current policy (upon request or as necessary)

3.3.3. Gender Equality and Women's Empowerment Policy, 2012

IFAD's Gender Policy goal is to deepen the impact and strengthen the sustainability of IFAD-supported development initiatives, in order to increase IFAD's impact on gender equality and strengthen women's empowerment in poor rural areas. The Policy has three strategic objectives:

- Strategic objective 1: Promote economic empowerment to enable rural women and men to have equal opportunity to participate in, and benefit from, profitable economic activities.
- Strategic objective 2: Enable women and men to have equal voice and influence in rural institutions and organizations.
- Strategic objective 3: Achieve a more equitable balance in workloads and in the sharing of economic and social benefits between women and men.

To achieve these objectives, the Policy outlines five action areas aiming to:

- Systematically address gender equality and women's empowerment issues in IFAD-supported country programmes and projects;
- Improve IFAD contributions to advocacy, partnerships and knowledge management on gender equality;
- Strengthen capacity of partners to address gender issues in agriculture and rural development;
- Develop corporate approaches and procedures with IFAD that support gender and diversity; and;
- Ensure IFAD's corporate human and financial resources, and monitoring and accountability systems fully support gender equality and women's empowerment.

3.3.4. Targeting Policy

IFAD's mandate defines its "target group" as rural people living in poverty and experiencing food insecurity in developing countries. Within this broad group, IFAD proactively strives to reach extremely poor people (as defined by MDG 1) who have the potential to take advantage of improved access to assets and opportunities for agricultural production and rural income-generating activities. IFAD's Targeting Policy focuses on improving livelihoods through: ensuring national and international resources are used effectively, policy support is dedicated to rural and agricultural development; encouraging local and national governments to focus on enabling the rural poor to improve their livelihoods; economically and socially empowering rural poor; and encouraging national ownership of interventions. The Policy's guiding principles are to:

- Focus on rural people who are living in poverty and experiencing food insecurity, and who are able to take advantage of the opportunities to be offered;
- Expand outreach to proactively include those who have fewer assets and opportunities, in particular extremely poor people;
- Include marginalized groups, such as minorities and indigenous peoples, and address their specific needs;
- Address gender differences and have a special focus on women within all identified target groups – for reasons of equity, effectiveness and impact – with particular attention to women heads of household, who are often especially disadvantaged;
- Recognize that relative wealth or poverty can change rapidly due to external shocks and that this vulnerability needs to be addressed;
- Clearly identify at the programme or project design stage who the intended target groups are and why, and consistently apply these categories, during implementation, in monitoring and evaluation (internal and external) of targeting performance;
- Identify and work with like-minded partners at local, country, regional and international levels to develop a shared understanding of both the dynamics of rural poverty in different contexts and successful targeted approaches;
- Pilot and share learning on successful approaches to targeting hard-to-reach groups; and
- Build innovative and complementary partnerships with actors that can reach target groups that IFAD cannot reach with the instruments at its disposal

3.4. Institutional Framework

In Rwanda, there is no specific institutional arrangement in regards to resettlement activities. The institutional framework for environmental and Social management is currently enshrined in the Organic Law determining the modalities of protection, conservation and promotion of the environment in Rwanda, published in the Official Gazette RWA N° 9 of the 1st May 2005, particularly in its chapter III relating to the establishment of the institutions, the 2013 land law and 2007 expropriation law.

3.4.1. Rwanda Agriculture Board (RAB)

RAB will play essential role in the successful implementation of the project. RAB is entrusted with the implementation of agriculture and livestock policies and plans. The vision of RAB is to improve food security and livelihoods of all Rwandans by transforming agriculture from subsistence into modern farming through generating research and extension innovations that generate sustainable crop, animal husbandry and natural resource management. RAB has the mission of developing agriculture and animal husbandry through their reform, and using modern methods in crop and animal production, research, agricultural extension, education and training of farmers in new technologies. Key responsibilities of RAB include the implement the national policy of agriculture and animal husbandry, contribution in determining policy in agriculture, animal husbandry, agricultural and animal husbandry research and technology and to provide farmers and consumers of agricultural products with information, techniques and services meant for improving their profession and supplying the internal market with increased and quality production thereby raising their agricultural and animal husbandry incomes.

3.4.2. Rwanda Environment Management Authority (REMA)

REMA was established in 2004 to act as the implementation organ of environment related policies and laws in Rwanda. Under supervision of the Ministry of Environment, from the Law n°63/2013 of 27/08/2013 determining the mission, organization and functioning of Rwanda Environment Management Authority

(REMA), REMA has the legal mandate for national environmental protection, conservation, promotion and overall management, including advisory to the government on all matters pertinent to the environment and climate change. Key responsibilities of REMA are as follows:

- Advise the Government on policies, strategies and legislation related to the management of the environment as well as the implementation of environment related international conventions, whenever deemed necessary;
- Conduct thorough inspection of environmental management in order to prepare a report on the status of environment in Rwanda that shall be published every two (2) years;
- Put in place measures designed to prevent climate change and cope with its impacts;
- Conduct studies, research, investigations and other relevant activities in the field of environment and publish the findings;
- Closely monitor and assess development programs to ensure compliance with the laws on environment during their preparation and implementation;
- Participate in the preparation of activities strategies designed to prevent risks and other phenomena which may cause environmental degradation and propose remedial measures;
- Provide, where it is necessary, advice and technical support to individuals or entities engaged in natural resources management and environmental conservation;
- Prepare, publish and disseminate education materials relating to guidelines and laws relating to environmental management and protection and reduce environmental degradation risks;
- Monitor and supervise impact assessment, environmental audit, strategic environmental assessment and any other environmental study. REMA may authorize in writing, any other person to analyze and approve these studies. The EIA review has been delegated to Rwanda Development Board.

3.4.3. Rwanda Land Management and Use Authority (RLMUA)

RLMUA is responsible for putting in place and operationalizing an efficient system of land administration, use and management that secures land ownership, promotes investment in land for socio-economic development and poverty reduction. Responsibilities of RLMUA are:

- Put in place mechanisms which procure security of land tenure for the promotion of investments in land.
- Promote proper allocation of land, and proper use of land resources, according to their potential.
- Avoid the splitting up of plots, and to promote their regrouping in order to bring about optimum production.
- Establish mechanisms which facilitate an optimum exploitation of land, targeting the social-economic development of the country.
- Orient land management towards a more profitable and sustainable production, by making good choices among methods of land development.
- Develop methods that protect land resources from various types of land degradation.
- Establish institutional frameworks which enable land to become more valuable in the economy or at the market.
- Promote research as well as the education of the public on all aspects concerning land tenure, management, and transactions.
- Establish order and discipline in the allocation of land, as well as in land transactions in order to control the pressure on land, inappropriate development, speculation and trafficking of land.
- Involve and sensitize the public at all levels in order to ensure protection of the environment and good management of the land.

3.4.4. Kayonza district and its sectors

Generally, decentralized entities are responsible for the implementation of laws, policies, strategies, objectives and programmes relating to protection, conservation and promotion of the environment in Rwanda. Article 61 of environmental law states that in the framework of conservation and protection of the environment, decentralized entities are particularly responsible for:

- ensuring activities related to better management of land, especially controlling soil erosion and tap rain water;
- afforestation, protection and proper management of forests;
- efficient management of rivers, lakes, sources of water and underground water;
- efficient management and effective use of swamps;

- Protection and proper management of reserved areas, historical sites, endangered animal and plant species.

Local Governments including Kayonza and Ndego sector are tasked to perform the following functions:

- At the request of RDB, review Project Briefs so as to advise on Terms of Reference,
- Provide information or advice to developers and ESIA Experts when consulted during ESIA process,
- At the request of RDB, review ESIA reports and provide comments to RDB,
- Assist RDB in organizing public hearings,
- Host public hearings,
- Host individual consultations,
- Gather written comments from public and transmit them to RDB.
- Facilitate the land acquisition process through Land bureau office;
- Plan and complaints resolutions.

4. PROJECT AFFECTED PERSONS AND RESETTLEMENT IMPLICATIONS

4.1. Eligibility criteria for various categories of PAPs

This section sets out eligibility criteria, which are necessary to determine who will be eligible for resettlement and benefits, and to discourage inflow of ineligible people.

4.1.1. Principles

The involuntary taking of land resulting in relocation or loss of shelter; and loss of assets or access to assets or loss of source of income or means of livelihood, whether or not the PAPs must move to another location or not. Meaningful consultations with the affected persons, local authorities and community leaders will therefore allow for establishment of criteria by which displaced persons will be deemed eligible for compensation and other resettlement assistance. Affected people eligible for compensation and resettlement in three groups as shown below.

- a) Those who have formal rights to land including customary/communal land, traditional and religious rights recognized under Rwandan Law.
- b) Those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets provided that such claims are recognized under the laws of Rwanda or become recognized through a process identified in the resettlement plan.
- c) Those who have no recognizable legal right or claim to the land they are occupying, using or getting their livelihood from before the cut of date.

4.1.2. Resettlement impacts

So far, the location of some project components such as borrow pits, quarry, postharvest and access roads have not yet identified. However, it is clear that the construction of irrigation infrastructures (BS and canals networks) and post-harvest facilities, some crops, trees and land will be affected. Based on current design 122 households will be affected by losing lands, trees and perennial crops where pumping stations, water balance storage and pressure pipeline will be constructed.

- At water, balancing storage 37 households will lose permanently their land and will need compensation.
- In pressure Pipe pipeline it is expected that small strips of land will be affected and 65 households were identified;
- At pumping station, 8 private plots and two government plots were identified as affected.

In addition, the command area was delineated on agriculture lands with both seasonal and perennial crops including woodlots. During the construction phase especially during land husbandry work, landowners will be requested not to use their land for a given period to free the area reserved for land husbandry works and construction of irrigation and post-harvest facilities. This implies that some farmers lose the produce that they could have obtained in that particular missed season; hence, a loss in home income and in most cases domestic food. It also affects targets of crop production set by local government officials for their respective district sectors.

Table 10: Resettlement Impacts associated with Ndego irrigation schemes

Type of Loss	No of PAPs	Eligibility Criteria	Entitlement
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Type of Loss	No of PAPs	Eligibility Criteria	Entitlement
Loss of private lands on water balance reservoir	37	Owners of land where regulation reservoir will be constructed	Cash compensation for loss of land
Loss of private lands along pressures pipes	65	Owners of land along main pressure canals	Cash compensation for loss of land
Loss of lands at water pumping stations	9	Current users of lands at pumping station sites	Cash compensation for loss of land
Loss of perennial trees and food crops	Not identified	Various rights and interest holders Share croppers and Lessees	Cash compensation for loss of perennial crops
Vulnerable people	Not identified	Older, handicapped, marginal and others	Employment during construction and technical training
Loss of income during land husbandry	Not yet identified	Land owners	Cash for work as source of income

Source: Filed survey

Furthermore, during field survey few grazing area were observed inside command area with some cattle sheds. With the establishment of irrigation system, grazing in these areas will not be possible and the project management will discuss with owners on the possibility of relocating grazing areas outside the command area and cattle sheds will be compensated. The next tables show the number of grazing area and cattle shed identified in command areas of three blocks.

Table11: Grazing plots and Cattle sheds identified in Command areas

Name of block	No. of Cattle-shed	No. of Grazing Plots
Kibare	21	23
Ihema	5	6
Nasho	13	9

Source: BESST LTD Field Survey, 2020

In addition, to the above grazing areas and cattle sheds the next below provides an indication of resettlement and compensation associated with the proposed project. It is, therefore, recommended to prepare and implement a resettlement plan before project implementation. It's worth to note that there is no physical resettlement expected give that all people in project are living in grouped settlements and these areas are out

4.1.3. Entitlement Matrix

PAPs entitlement matrix is provided in Table 3 below it provides an indication of resettlement and compensation measures to restore livelihoods impacted by the loss of land, crops and other structures. It is important to pay special consideration to vulnerable people, for instance, giving them high priority to be employed as project labors.

Table 12: Resettlement Impacts

Type of Loss	No of PAPs	Eligibility Criteria	Entitlement
Loss of private lands on water balance reservoir	37	Owners of land where regulation reservoir will be constructed	Cash compensation for loss of land
Loss of private lands along pressures pipes	65	Owners of land along main pressure canals	Cash compensation for loss of land
Loss of lands at water pumping stations	9	Current users of lands at pumping station sites	Cash compensation for loss of land
Loss of perennial trees and food crops	Not identified	Various rights and interest holders Share croppers and Lessees	Cash compensation for loss of perennial crops
Vulnerable people	Not identified	Older, handicapped, marginal and others	Employment during construction and technical training
Loss of income during land husbandry	Not yet identified	Land owners	Cash for work as source of income

Source: Filed survey

Table 13: Entitlement Matrix for Various Categories of PAPs

Land and Asset Acquired	Type of Impact	Entitled Person	Compensation/Entitlement/ benefits
Agricultural	No displacement:	Farmer/ title	Cash compensation for affected land equivalent to

Land and Asset Acquired	Type of Impact	Entitled Person	Compensation/Entitlement/ benefits
land	Cash compensation for affected land equivalent to market Value Less than 20% of land holding affected, The remaining land remains economically viable.	holder	replacement cost. The replacement method of valuation of assets that helps determine the amount sufficient to replace lost assets and cover transaction costs shall be applied
		Tenant/ lease holder	Cash compensation for the harvest of the affected land equivalent to average market value of last 3 years, or market value of the crop for the remaining period of tenancy/ lease agreement, whichever is greater.
	Displacement: More than 20% of land holding lost or less than 20% of land holding lost but remaining land not economically viable	Farmer/ Title holder	<ul style="list-style-type: none"> - Land for land replacement where feasible, or compensation in cash for the entire landholding according to PAP's choice. - Land for land replacement will be in terms of a new parcel of land of equivalent size and productivity with a secure tenure status at an available location which is acceptable to the PAP. Transfer of the land to the PAP shall be free of taxes, registration & other costs. - Relocation assistance (costs of shifting + assistance in re-establishing economic trees + allowance up to a maximum of 12 months while short- term crops mature)
		Tenant/ Lease holder	<ul style="list-style-type: none"> - Cash compensation equivalent to average of last 3 years' market value for the mature and harvested crop, or market value of the crop for the remaining period of tenancy/ lease agreement, whichever is greater. - Relocation assistance (costs of shifting + assistance in re-establishing economic trees + allowance up to a maximum of 12 months while short- term crops mature; - Relocation assistance (costs of shifting + allowance).
Commercial Land	No displacement: Land used for business partially affected, limited loss	Title holder/ Business owner	<ul style="list-style-type: none"> - Cash compensation for affected land - Opportunity cost compensation equivalent to 5% of net annual income based on tax records for previous year (or tax records from comparable business, or estimates where such records do not exist).
		Business owner is lease holder	<ul style="list-style-type: none"> - Opportunity cost compensation equivalent to 10% of net annual income based on tax records for previous year (or tax records from comparable business, or estimates where such records do not exist)
Residential Land	Land used for residence partially affected, limited loss, and the remaining land remains viable for present use.	Title holder	<ul style="list-style-type: none"> - Cash compensation for affected land
		Rental/lease holder	<ul style="list-style-type: none"> - Cash compensation equivalent to 10% of lease/ rental fee for the remaining period of rental/ lease agreement (written or verbal)
Standing crops	Crops affected by land acquisition or temporary acquisition or easement	PAP (whether owner, tenant, or squatter)	<ul style="list-style-type: none"> - Where possible and does not delay to much the project implementation, affected person will be given time to harvest their crops, - Where this cannot be done, cash compensation equivalent to market value for the mature and harvested crop.
Trees	Trees lost	Title holder	<ul style="list-style-type: none"> - Cash compensation based on type, age and productive value of affected trees plus 10% premium
Temporary Acquisition	Temporary acquisition	PAP(whether owner, tenant, or squatter)	<ul style="list-style-type: none"> - Cash compensation at replacement cost for any assets affected (e. g. boundary wall demolished, trees removed)
Special assistance		Vulnerable groups/Person	<p>Options for vulnerable people will varies depending on their specific circumstance and their socio-economic situation and this may include but not limited to:</p> <ul style="list-style-type: none"> - Training for income generation activities; - Connection to electricity at reduced cost; - Assistance in land registration if their land is affected, - Priority in employment etc;

4.1.4. Cut-off date

Compensation eligibility will be limited by a cut-off date which should be date of commencement of the census survey of PAPs. The precise cut-off date will be publicly announced by the local leaders in advance and the census of PAPs and assets inventory will commence immediately following this announcement.

4.2. Assets inventory and valuation methods

This section describes the methods to be used in valuing assets that will be eligible for compensation consistent with either Rwandan laws or policies or IFAD. Law No.17/2010 of 2010 establishes and organizes the Real Property Valuation Profession in Rwanda. It provides the registration of land valuers in Rwanda and conditions for registration. The law also allows the Government to conduct valuation when mandated by their government institutions. Articles 27, 29, 30 and 31 of the law deal with valuation methods and stipulate that the price for the real property shall be close or equal to the market value. Land values could also be compared country wide. Where comparable prices are not available to determine the value of improved land, the replacement cost approach shall be used to determine the value of improvements to land by taking real property as a reference. The law also allows the use of international methods not covered by the law after approval of the Institute of Valuers.

4.2.1. Valuation methods

Valuation methods recognized under valuation law in Rwanda include:

- **Use of Standard Valuation Tables**

The implementation of the proposed project will be done in all 30 districts and it is anticipated that a relatively large number of small-scale asset valuations will need to be carried out during the course of the project. It would therefore be cumbersome and inefficient to deploy an individual valuation expert in each and every case. Therefore, it is recommended that the independent value is hired to provide the list of properties value and this list will be used by district to calculate the compensation package for affected people when the need arises. The compensation rates / valuation tables would be developed using legally acceptable valuation procedures accepted by both the Government of Rwanda and World Bank for purposes of fairness and consistency. The approach will consider replacement costs and types and levels of compensation under the Rwanda law. Valuation of lost assets will be made at their replacement cost.

- **Comparison of Land/Property Values Countrywide**

In case there are no compensation rates, the Valuer shall compare prices by referring to the prices recently assigned to a real property that is similar or comparable to the real property subject to valuation. Where comparable prices are not available for land in a particular area, the Valuer may use comparable prices of similarly classified land from other areas of the country

- **Replacement Cost Approach**

The replacement cost approach is based on the premise that the costs of replacing productive assets is based on damages caused by project operations. These costs are taken as a minimum estimate of the value of measures that will reduce the damage or improve on on-site management practices and thereby prevent damage. The approach involves direct replacement of expropriated assets and covers an amount that is sufficient for asset replacement, moving expenses and other transaction costs.

- **Gross Current Replacement Cost**

Gross Current Replacement Cost (GCRC) is defined as the estimated cost of erecting a new building having the same gross external area as that of the existing one, with the same site works and services and on a similar piece of land.

- **Other methods**

Rates from Contractors: When rate schedules do not exist or are out of date, recent quotations by contractors for similar types of construction in the vicinity of the project can be used for calculating replacement costs. In projects offering the options of cash compensation or alternative accommodation, the construction cost estimates for alternative accommodation could be used for calculating cash compensation payable.

It is recommended that the replacement Cost is used as valuation methods and results can be used to prepare standardised valuation tables. This is because the Replacement cost valuation methods is

recommended by ESS5 and recognised by valuation law in Rwanda. Standardized table will ease the valuation process given that small scale valuation site are scattered in different places.

4.2.2. Calculation of compensation by assets

The following methods of calculation should be adopted for the preparation of the aforementioned standardized asset valuation tables and/or the application of specific case by case valuations in the case of projects that have significant impacts.

- **Compensation for Land**

Compensation for land is aimed at providing a farmer whose land is acquired and used for project purposes, with compensation for land labour and crop loss. For this reason, and for transparency, land is defined as an area or homestead (i) in cultivation, (ii) being prepared for cultivation, or (iii) cultivated during the last agricultural season. This definition recognizes the farmer's labour as the biggest investment he/she makes in producing a crop which is higher than all other inputs such as seed and fertilizer. As a result, compensation relating to land will cover the market price of labour invested as well as the market price of the crop lost.

- **Land Measurement**

For purposes of measuring land, the unit of measurement would be that which is used and understood by the affected farmers and if a traditional unit of measure exists in the rural areas, that unit should be used. If a traditional unit of measurement does not exist in a particular area, then it is recommended that land should be measured in meters or any other internationally accepted unit of measurement. However, in such an event, the unit that is being used must be explained to the affected farmers/users and must somehow be related to easily recognizable land features that the communities are familiar with, such as using location of trees, stumps, etc as immovable pegs. The most important concern of this exercise is to ensure that the affected person is able to verify using his/her own standards/units of measurement, the size of land that is being lost. This will ensure transparency in the system and will thus avoid subsequent accusations of wrong measurements or miscalculation of areas. A farmer should know how much land he/she is losing, in terms of size and the replacement land must be at least of that same size and comparable value as land lost.

- **Calculation of Crops Compensation Rate**

The current prices for cash crops will be determined and all crops will be valued using a single rate considering the crop at mature age. This rate incorporates the value of crops and the value of the labour invested in preparing new land. Determining compensation using a single rate creates transparency because anyone can measure the area of land for which compensation is due and multiply that by a single rate known to all. This approach also allows assignment of values to previous year's land (land in which a farmer has already invested labour) and land that have been planted but crops have not germinated. Further, it avoids contention over crop density and quality of mixed cropping.

The value of the labour invested in preparing agricultural land will be compensated at the average wage in the community for the same period of time. The rate used for land compensation should be updated to reflect values at the time compensation is paid. Table 5 below, derives a total value for a one-hectare land from the value of the crops on the land and the value of labour invested in preparing a replacement land.

Table 14: Example of method to be used to determine a monetary compensation rate for land*

Item Compensated	Basis of Value	Rwandese Francs/ha
	Average of the highest 2007 official and market survey land prices per ha of staple food crops (maize, rice etc.), plus cash crops (e.g. sugar cane, corn).	
	Labour costs of preparing a replacement land.	
Total	Replacement value of crops plus labour.	

(Rwandan Francs payments will be revised to reflect crop values and labour rates in effect at the time of compensation). This example assumes a one-hectare land. Crop values will be determined on:

- A combination of staple foods and cash crops. The 80/20 ratio of land that a farmer typically has in food crops and cash crops is used to determine the chances s/he would lose food crop rather than a cash crop income.
- The value of stable crops to be taken as the highest market price (over 3 years) reached during the year, in recognition of the following factors:

- Although most farmers grow staple crops mainly for home consumption, they always have the option of selling these crops to take advantage of the market.
- Farmers most often purchase cereals when they have run out, during drought when prices are high. Compensating at a lower value might put the individual or household at risk.
- On average, the highest price of staple food yields a high per hectare value reimburses for the vegetables and other foods that are commonly inter-cropped with staples, but are almost impossible to measure for compensation.
- The labour cost for preparing replacement land is calculated on what it would cost a farmer to create a replacement land. This value is found by adding together the average costs of clearing, ploughing, sowing, weeding twice, and harvesting the crop.

- **Compensation for vegetable gardens**

Until a replacement garden starts to bear, the family displaced (economically or physically), will have to purchase vegetables in the market for daily use. The replacement costs therefore, will be calculated based on the average amount that an average town dweller spends on buying these items for one year from the local market.

- **Compensation for horticultural, floricultural and fruit trees**

Banana and Mango trees are featured here below as two examples of the set of primary fruit trees that are likely to be found in project targeted area and are estimated to account for a significant amount of all fruit bearing trees. They are primarily important as a source of:

- Subsistence food for families
- Cash produce that contribute to the export economy
- Petty market income in some areas, and
- Shade (in the case of mango trees).

For banana trees, they have a relatively much shorter productive life, normally, than mango trees. For species, banana trees will not bear fruit more than once. Therefore, compensation for banana trees would be compensated at the full market rates for bananas harvested in that year and for another year. The second year payment is for the replacement cost of planting a new tree, looking after it and harvesting it which could all be done in one year. Therefore, the farmer should have restored his pre-project position by the end of the second year. This example of bananas is an example for trees/plants that have a relatively short life.

As defined in this policy, individuals will be compensated for wild trees which are located in their land. Wild productive trees belong to the community when they occur in the bush as opposed to fallow land. These trees will be compensated for under the umbrella of the community compensation.

4.2.3. Preparation of Asset Inventory and PAPs identification

In order to prepare for compensation and other resettlement benefits, it is imperative that a comprehensive asset and affected persons inventory in the designated areas for the different project components is done. The inventory will specify the different assets, properties affected in each plot of land and their owners. The Land Valuation Bureau which is the entity responsible for undertaking valuation of assets will be responsible for the valuation exercise and will therefore provide independent valuation experts. The valuation document will indicate when the affected person will be notified, and that the inventory will not be official until a second signed copy, verified by project supervisory staff, is returned to the affected person. At this time, a copy of the grievance procedure will also be given to the affected person as stated in the grievance redress mechanism. The valuation experts will work hand in hand with the local leaders of the area.

4.2.4. Forms of Compensation

Individual and household compensation will be made in cash, in kind, and/or through assistance. The type of compensation will be an individual choice although every effort will be made to instil the importance and preference of accepting in kind compensation if the loss amounts to more than 20% of the total loss of subsistence assets. Compensation payments raises issues regarding inflation, security and timing that must be considered. One purpose of providing in-kind compensation is to reduce inflationary pressure on the cost of goods and services. Local inflation may still occur and thus market prices will be monitored within the time period that compensation is being made to allow for adjustments in compensation values. The issue of

security, especially for people who will be receiving cash compensation payments should to be addressed by the local administration. The RPF has provided an entitlement matrix that shows type of compensation for each category.

4.2.5. Procedures for delivery of compensation

It is recommended that compensation be made through reputable local banks. This will ensure security of the PAPs money especially for those receiving large sums. Forms acknowledging receipt of the compensation packages shall be signed by each PAP.

5. PUBLIC CONSULTATION AND STAKEHOLDERS ENGAGEMENT

5.5. Overview

Public consultation and stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts. Stakeholder engagement is an on-going process that involves the following elements; stakeholder analysis and planning, disclosure and dissemination of information, consultation and participation, grievance mechanism and on-going reporting to affected communities.

5.6. Purpose

- To prepare communities on potential emergency scenarios that could be caused by the project and can affect the community.
- To build a trusting relationship with the affected communities and other interested stakeholders based on a transparent and timely supply of information and open dialogue.
- To ensure effective engagement with local communities and other key stakeholders throughout all phases of the project.
- To actively build and maintain productive working relationships, based on principles of transparency, accountability, accuracy, trust, respect and mutual interests with affected communities and other stakeholders.

5.7. Public consultations and participation

As part of the project consultations, efforts were made to consult with the decision making official at central level as well as a number of local authorities, to determine their thoughts, opinions and feedback on the impact of proposed Ndego project. Information and comments collected from the public early in the study process were of use. Local communities especially farmers who are currently using command area and Command area catchment were also consulted to give them the opportunity to express their views and concerns. As part of the process, they were also provided with relevant and sufficient information on the project prior to its start - up.

5.7.1. Stakeholders

Discussions with decision making bodies, key stakeholders, sector institutions and specialist experts were made on the very concepts and nature of the proposed project, giving emphasis on levels of public participation, role of key stakeholders and joint contributions of these actors to the success of the project. In addition, the scope of the proposed project and possible means of maximizing local communities' social, economic and environmental benefits from the project implementation were underlined. Key stakeholders and authorities with whom consultations made at the project study areas were:

Table 15: Category of Consulted People

Category	Institution/desired person	Issue to discuss
RAB	Environmental Specialist	Environmental requirement
	Social safeguards specialist	Resettlement Requirement
	Project Engineer	Projects design
	Irrigation engineer	Water requirement and proposed irrigation option
	Project agronomist	Farmers organization, crop suitability and crop selection
	Feasibility and design team	Project design and options
Regulatory and standards	Rwanda Environment Management Authority (REMA)	Environmental and social requirements

Category	Institution/desired person	Issue to discuss
authorities		
	Ministry of Environment	Environment and water quality requirements
	Rwanda Water Board	Water quality, water abstraction permitting
	Rwanda Land use and Management Authority	Land ownership and Resettlement
	Rwanda Development Board	EIA process
Kayanza District	District agronomist	Crop selection, farming practices
	Land administration	Land registration, valuation and ownership transfer
	District environment officer	Environmental and social monitoring at local level
Ndego sector	Land manger	Land registration, valuation and ownership transfer
	Agronomist/ veterinary	Crop selection, farming practices
Community	Current users of targeted area including Hinga wize, Bramin, Musambi Project and other users	Project appreciation, crop selection, project, proposed mitigation measures, sustainability, crop selection etc.

5.7.2. Public participation – methods and process

Due to restrictions imposed by COVID-19, where by public gathering were not allowed one to one interview, conference call and phone calls were only consultation approaches used.

5.8. Consultative meeting held with stakeholders during ESIA preparation

Different meeting was organized by the study team from the earliest stage of project planning to present to all stakeholders the proposed project. In addition to public consultation meeting with project beneficiaries or project-affected persons, the study team held technical meeting and one to one meeting with stakeholders as well. Meetings and consultation continued throughout the study period.

5.8.1. Project Introductory meeting

The initial consultation meeting was held on May 13th, 2020) at the SPIU offices. The meeting was attended by lead consultant and project team involved in feasibility study and ESIA study including SPIU environment and Climate Change Specialist, SPIU Social Safeguards Specialist, project Manager and irrigation engineer. The purpose of the meeting was to introduce project team agree on project ESIA timeline and plan for scoping mission as well as implications of COVID-restrictions.

Table 16: Issues and answers recorded during initial consultation meeting

Item	Summary of discussion	Conclusion
Project Schedule	The meeting discussed the project schedule based on the contract signed by between RAB and BESST LTD. It was noted that, the contract was signed on March 28, 2020 and the duration was six month. Due to COVID-19 and restriction to travel between provinces the Consultant was not able to submit the inception report as it was not possible to visit the site	It was agreed that RA will request a special authorization for the consultant to visit the site and the consultant will prepare and submit an inception report on May 22 nd , 2020 Further, the inception report will include a revised study schedule
Project team	The Consultant confirmed the availability of ESIA team including Team Leader, Socio-economic Expert, Agronomist, Hydrologist, Ecologist and GIS expert.	It was agreed that the consultant will work closely with the designated project manager and study team from client side
Project documents	The meeting discussed available projects documents that will help the consultant to conduct the ESIA	It was agreed that the client will provide the consultant with the Feasibility study and project shape file and other relevant documents

Source: BESST Ltd, 2020

The meeting was attended by:

For the consultant

- Théogène Habakubaho, ESIA team Leader

For the client:

- Usabyimbabazi Madeleine, Environmental and Climate change Specialist and Client project manager
- Muligande Benjamin, Social safeguards Specialist;
- MUCYO PAPIAS, Senior Irrigation Engineer, Ag. Irrigation Program Leader
- Dr. SIRIKARE N. Sylvere (KIIWP Focal Person
- Ndagijimana Andre, Project Specialist

5.8.2. Presentation and Validation of inception report

After the submission of inception report, the consultant presented to stakeholders in order to get comments and views on the proposed methodology and study schedule. Due to COVID-19 restrictions, the validation was conducted via conference call and was attended by Consultancy team, client team, Specialist from Rwanda Environment Management Authority (REMA) and Rwanda Development Board (RDB)/EIA department. The next table present participant to the meeting

Table 17: Consultation at inception report

Names	Institutions	Position	Contact
Usabyimbabazi Madeleine	RAB/SPIU	Environmental and Climate change Specialist and Client project manager	madousa2020@yahoo.fr
Muligande Benjamin,	RAB/SPIU	Social safeguards Specialist;	muligandeben2007@gmail.com
Dr. SIRIKARE N. Sylvere	RAB/SPIU	KIWP Focal Person	sylvere.sirikare@rab.gov.rw
Ndagijimana Andre,	RAB/SPIU	Project Specialist	ndagabruce@gmail.com
Theogene Habakubaho	BESST LTD	ESIA team Leader	htheogene@yahoo.fr
Nshimiyimana Fabien	BESST LTD	Hydrologist	nshimiyefabien@gmail.com
Ruzibiza Marcel	BESST LTD	Agronomist and land Husbandry specialist	mruribiza1980@gmail.com
Nzamuambaho Etienne	BESST LTD	Survey and GIS Expert	etienne2020@gmail.com
Ngaboyamahina Théogène	REMA	Environment Inspection and regulation officer	tngabo@rema.gov.rw
Jacqueline Musoni	RDB	Environment Review Specialist	jacqueline.musoni@rdb.rw

Source: BESST LTD, 2020

After the presentation made by ESIA team leader, participants was given an opportunity to provide comments and ask questions. The inception report was validated and the consultant was requested to incorporate comments provided and submit a revised inception report and proceed with detailed ESIA study. Comments provided includes:

- To provide a detailed information on how the baseline data/information on biophysical & social economic condition of the project area will be collected;
- To expand the list of key stakeholders to be consulted and incorporate other development partners who have the activities within the scheme and or adjacent to the scheme (such as USAID Project_Hinga wize, Bramin, etc)
- It was recommended to provide a brief introduction to the key features of Ndego irrigation development project
- It was recommended to consider description of the aquatic life of the 2 lakes (which are targeted as key source of water for this project)
- It recommended that the ESMPs of the 3 irrigation scheme in Ndego should be separated and be site specific
- It was recommended to ensure a close consultation with the local communities in order to ensure sustainability (especially existing farmers organizations in that area)
- It was recommended that lake Ihema should be removed among the three sources of water under the final inception report given that the water permit was not granted
- It was recommended to provide additional information to the provided scoping matrix in order to provide justification to why some impacts are expected to be positive or negative or neutral vis a vis the features of the schemes as well as the location of the key irrigation infrastructures vis as the existing biophysical and socio-economic condition (information should be provided from the preliminary site visit)
 - ✓ Under RAP section: it was recommended to provide a list of all socio-economic activities that are likely to be affected by the project in addition to providing a list of all peoples who are likely to be affected by the project development.

5.8.3. Consultation with official at central and local level

In addition to the public consultation meeting, the consultant team conducted one to one interviews with different official to discuss the projects and collect their views, concern and recommendation. Consultation conducted also allowed the team to collect different data and information related to the projects like existing laws, standards and policies helped. Below are the key stakeholders consulted.

- Ministry of Agriculture and animal Resources: Environmental and Social safeguards Specialist for World Bank Funded Projects ;
- Ministry of Environment, Water Pollution Control Expert
- Rwanda Environment Management Authority(REMA): In charge of pollution control
- Rwanda Development Board RDB: Environmental Review Specialist.
- Rwanda agriculture Board: Project team involved in ESIA and feasibility study for Ndego Irrigation schemes
- Kayonza District agronomist
- Kayonza Land administration officer
- Kayonza District environment officer
- Ndego sector Land manager
- Ndego Sector Agronomist
- Hinga wize, Bramin, Musambi Project and other users; and
- BRAMIN management

Full list of Consulted people at technical level is provided in Annex 1

• **Key issues identified during consultations at central level include:**

- Pollution of water bodies during construction and from non-point sources during project implementation, soil erosion, sedimentation of river due to excavation around the river, Possibility of loss of property , crops and trees, disturbance of water table, loss of biodiversity.
- Likelihood of delays in compensation of PAPs, which could escalate into disputes, Execution period, employment for their citizen, cost and accessibility of potable water waste management and disposal, Source of construction material, health insurance; connectivity to the existing network, cost of land acquisition and eligibility criteria.;
- Possibility of low wages to local workers during construction works;
- Payment of water fees;
- Roles and responsibilities in implementation and monitoring of ESMP/RAP;

5.8.4. Consultation at community level

Public participation and community consultation has been taken up as an integral part of social and environmental assessment process of the project. Consultation was used as a tool to inform project affected people, beneficiaries and stakeholders about the proposed activities both before and after the development decisions are made. It assisted in identification of the problems associated with the project as well as the needs of the population likely to be impacted. This participatory process helped in reducing the public resistance to change and enabled the participation of the local people in the decision making process. Initial Public consultation has been carried out in the project areas with the objectives of minimizing probable adverse impacts of the project and to achieve speedy implementation of the project through bringing in awareness among the community on the benefits of the project.

As the consultation was held under restriction imposed by COVID-19, local community was conducted in form of interview and small group of 3-5 people. The full list of all consulted people at community level is presented in Annex 2.

Table 18: Key outcome of consultation at community level

No	Question/comments	Answers provided by consultant
Consultative meeting in Kibare		
1	How are we going to know the value of our properties?	RAB in collaboration with Kayonza district will hire an independent valuer who will agree with assets owner the compensation value.
2	When the project implementation will start so that we can plan for our agriculture activities?	As of now, we are still at feasibility study that will be followed by detailed design. Once design are completed, the community will be informed about implementation schedules
3	Will the project gives us the jobs or it will use machines?	Though some activities will require the use of machines, other works will be performed by people and affected people will be

		given priority.
4	What are the mechanisms that are you putting in place to ensure that local are provided with jobs?	First of all, locals will be provided with information on time but also during the preparation of construction contract RAB shall emphasize the use of local resident in construction work where possible.
5	We are using Kibare for cattle water, what will happened once the lake is being used for irrigation	All water users are considered in feasibility and water allocation will be done in consideration of users.
6	Is there any impacts on fishing activities in the lac Kibare?	There can be impacts if water is over abstraction, however, the determination of amount of water abstracted will consider fish farming requirements.
7	What will happen for income loss during land husbandry works?	Farmers will be involved in works and will have get income from employment to cover losses.
8	We are having water shortage in the area and we are using lake water. Does project plan to support the local community in getting water for domestic use.	The project will work with other institution to addressed this issues by exploring possibility of having water points for cattle and for domestic use?
9	What are measures in place to avoid conflict over water use?	Water Users Association will be formed as well as Grievance redress mechanism
Consultative meeting Ihema		
1	Sometimes the fees paid as compensation is not enough to buy another land. What are you planning to address this issue?	There will be compensation for land owners and Special attention will be taken on these who are going to lose government land. RAB will hire and independent valuer to provide the replacement cost. For the person who disagrees with the value assignment to his/her property appealing measures are provided.
2	When are we going to get results of your data collection?	This exercise is the initial identification of assets and PAPs and results will be included in RAP report which will be made public. However a final asset valuation will be conducted and every PAP will sign on the valuation form after verification of his attest and its value
3	Can we know exactly where different infrastructure will be installed?	During detailed design, reference point will be established and people will be informed
5	Will farmers allowed to continue to use the land located after full water level?	Yes, but a buffer of 20 m will be required for dam protect. Farmers who have land in these meter will receive compensation
6	One PAPs wanted to know the size of his land that will be taken.	All affected land has been identified but once detailed design is completed an assets inventory will be made and everyone informed about results.
Consultative meeting in Nasho		
1	Will our land be taken without compensation?	Private land will be compensated
2.	What kind of compensation will you give us?	Compensation measures will be provided based on eligibility criteria and the nature of Impact and the compensation may include land for land compensation or monetary compensation. Especially for crops and trees.
3	When shall the construction start?	The final date for construction is not yet fixed but when fixed people will be communicated
4	We cannot be against public interest but, but what are the support are we going to receive from the government?	Compensation will be provided to the affected people and job opportunities will be provided during construction.
5	How many seasons are we going to miss during land husbandry works	The number of season to be missed will be known after final design study and construction schedules. However reference made to other similar number of missed season range between 2 and 4
6	Is there any compensation for the income loss during construction?	The income losses during construction have been estimated and means of compensation shall be proposed in the RAP including jobs during construction and other possible assistance to be agreed between RAB and farmers
7	People who are doing small irrigation now will be considered in the design.	All users are considered

6. IMPLEMENTATION ARRANGEMENTS

Ndego irrigation schemes RAP]will be implemented by different stakeholders from national level to site level. This is to ensure that laws and regulations are respected and livelihoods of affected persons are improved or restored the previous status.

6.1. National Level Implementing Institutions

6.1.1. RAB/SPIU for IFAD funded projects

For better implementation Ndego irrigation schemes RAP, RAB will assign the RAP implementation and coordination to IFAD SPIU . The role of the designated SPIU will be to implement the RAP, coordination of monitoring activities maintenance of monitoring information, building the capacity of other stakeholders in collection and analysis of monitoring data. The social safeguard Specialists of SPIU will be the focal point RAPs implementation and will liaise with other stakeholders to executive RAP.

The Coordination of SPIU will ensure that the procedures and requirements of the Rwandan laws and IFAD environmental and Social Policies are complied with. A key role will be to implement the RAP and other resettlement-related activities and to ensure that all procedures have been adhered to and that there is consistency in approach between sub-projects activities. It will also undertake the main monitoring and evaluation role of resettlement activities during and post implementation.

6.1.2. RLMUA

RLMUA through its department of Land administration and Mapping is the organ responsible for overall management and coordination of all activities related to land administration, land use planning and management in Rwanda. The role of RLMUA in RAP process will be to advise on matters related to land ownership and expropriation. District land bureau in close collaboration with project staff will check and approve surveys, various maps and approve land surveys carried out during the RAP exercise.

6.1.3. REMA

REMA was established in 2004 to act as the implementation organ of environment-related policy and laws in Rwanda. REMA is also tasked to coordinate different environmental protection activities undertaken by environmental promotion agencies; to promote the integration of environmental issues in development policies, projects, plans and programmes; to coordinate implementation of Government policies and decisions taken by the Board of Directors and ensure the integration of environmental issues in national plan among concerned departments and institutions within the Government; to advise the Government with regard to the legislation and other measures relating to environmental management or implementation of conventions, treaties and international agreements relevant to the field of environment as and when necessary; to make proposals to the Government in the field of environmental policies and strategies; etc. In Regards to the implementation of this RPF, REMA will ensure that all policies and regulations related to resettlement are observed and advise on the better way to implement RAPs. This will be done together with environmental monitoring.

6.2. District Level Implementing Institutions

6.2.1. Kayonza District

As indicated in section 3.6, the Land Office is a district based institution authorized by law to manage land. The DLBs will be responsible for ensuring activities undertaken comply with the National and District level Land Use Master Plans. They will assess the validity of land tenure rights of affected persons and eventually provide the land use permit for the new activity proposed by the sub- project. In addition they will be responsible for ensuring effective grievance mechanisms are in place. They will also be used in the design of the RAP as much as possible in order to ensure that community buy in is present at an early stage hence reducing disputed or grievances. Their activities will be monitored by the District authority.

The District Land Offices will play a major role in RAP implementation by:

- Issue construction permits and monitor compliance with construction plans
- Monitor and approve activities pertaining to valuation of land and other immovable property;
- Demarcate and approve land cadastral;
- Establishing project level Resettlement and Compensation Committees at Sector/ Cell level;
- Clarifying the policies and operational guidelines of these Resettlement and Compensation Committees;
- Review and approve valuation report done by independent Valuer and ensure that are in compliance with valuation, expropriation and land laws.
- Coordinating and supervising implementation by Resettlement and Compensation Committees

6.2.2. District resettlement committee

The Kayonza district will work closely with the designated SPIU in the implementation of this RAP. A team that includes a civil Engineer, District Land Bureau officer, Social Safeguards specialist (provided by designated SPIU), executive secretaries of Ndego sector affected sectors and PAPs representatives will be responsible for resettlement and ensure that the RAP is properly applied across all relevant subprojects. Its initial role will be to undertake screening and assessment of potential subprojects. The team will be supported by the project Social Safeguards team based at project headquarters.

6.2.3. Resettlement Committees at site level

Based on Rwanda's decentralization governance and project nature, the responsibility for the development and implementation of the RAPs will be at district and site level. Once resettlement requirements, affected assets and affected persons has been identified via the census process, District Land Bureau representatives will be responsible for electing members of a sub-project Resettlement and Compensation Committee. This committee will be constituted for the sole purpose of RAP implementation arrangements, and will operate at District level and site level. It is proposed to be coordinated by the District Land Bureau, due to the executive powers of the DLB.

This committee will plan for, coordinate and monitor resettlement, compensation and relocation activities, as well as supervise compensation payments to the recipient PAPs. A large part of their responsibility will be consultation with potential PAPs.

It is recommended to have site resettlement committee at each block and the Site Resettlement and Compensation Committee would comprise the following:

- Representative from Sectors preferably the land manager
- Representative of four cells that are affected
- Representative from the District Development Committee;
- Representative from any other key sector office involved in the resettlement process;
- Key stakeholder's representative from the implementing organization;
- Two representatives of PAP by cells (equal gender representation); and

The Resettlement and Compensation Committee would have responsibility for:

- Verifying PAPs
- Validate inventories of paps and affected assets;
- Allocate land, where required, to permanently paps;
- Monitor the disbursement of funds;
- Guide and monitor the implementation of relocation;
- Coordinate activities between the various organizations involved in relocation;
- Facilitate conflict resolution and addressing grievances; and
- Provide support and assistance to vulnerable groups including widows, orphans, and the old persons among others).

This committee should meet on a regular basis (as determined by the needs of the project) to ensure that resettlement activities are appropriately designed and executed. It is recommended that a representative be elected to act as the District Project Coordination officer who would act as the key contact with PAPs and therefore facilitate implementation of consultation, public participation and grievance mechanisms.

6.2.4. Mediators/Abunzi

At the Cell, there are in place mediators (abunzi) whose work is to hear disputes, especially land disputes. The abundzi, or mediation committees, have mandatory jurisdiction over land disputes involving amounts less than three million RwF, which means over most land disputes. The Abunzi also have mandatory jurisdiction over succession and boundary disputes involving less than three million Rwanda Francs. The abundzi will be used in the Ngoma 22 sub project as the first stop for resolving disputes and grievances following land acquisition. They will be involved in the compensation process from the beginning to the end. They will also be used in the design of the RAPs as much as possible in order to ensure that community buy in is present at an early stage hence reducing disputed or grievances.

6.2.5. Project Affected Persons

This group of people will also help identify community projects that will lead to the uplifting of the lives as well as share in Ndego irrigation project . PAPs will also participate in planning and implementing resettlement programs.

Table 19: Summary of Institutional Responsibilities RAP implementation

Institutions	Responsibilities
RAB	<ul style="list-style-type: none"> - Collation of information regarding Ndego irrigation project , including RAP documentation. - Review and approval of Resettlement related documentation from all subprojects(screening forms, RAP reports etc) to ensure consistency and compliance with regulations; - Overall monitoring and evaluation of resettlement implementation (i.e., annual audits and review of sub-project level monitoring undertaken by District authorities), ensuring that RAPs are implemented in accordance with regulations
Designated SPIU	<ul style="list-style-type: none"> - Initiate the resettlement process identify resettlement and compensation requirements - Preparation and signature of Compensation Grant agreement with the District - To establish Resettlement and Compensation Committee in consultation with District Land Bureau - Have a representation in sub-project Resettlement and Compensation Committee - Provision of capacity building and technical support relating to resettlement and compensation activities; - Ensure funds allocated appropriately, according to RAP.
RLMUA	<ul style="list-style-type: none"> - To advise on matters related to land ownership and expropriation Exercise. - To participate in verification of land ownership and land titles
District	<ul style="list-style-type: none"> - Verify land owners from records of land register - Issue construction permits and monitor compliance with construction plans - Monitor and approve activities pertaining to valuation of land and other immovable property - Approve land expropriated land surveys - Work in collaboration with the Sub- Project Resettlement and Compensation Committees to ensure that 'fair and just' compensation is reached in accordance with the law and the requirements of this RAP. - To identify resettlement site in any physical resettlement is required - To coordinate the land for land compensation and land redistribution
District Resettlement Committee	<ul style="list-style-type: none"> - Verifying PAPs - Validate inventories of PAPs and affected assets; - Allocate land, where required, to permanently affected households - Facilitate conflict resolution and addressing grievances - Guide and monitor the implementation of relocation
Site resettlement Committee	<ul style="list-style-type: none"> - Help in creating awareness on expropriation process - Monitor the implementation of community resettlement work closely with environment protection committees to monitor the use of marshlands and reserved areas; - Conflicts resolution - Help in land demarcation confirm holders of land rights during land resettlement process, help in the resettling of the displaced in the community, participate in the identification of community settlement sites, identify and list escheat land, and serve as witnesses in compensation and resettlement
Mediators/ Abunzi	<ul style="list-style-type: none"> - Resolving disputes - Provide grievances mechanism following land acquisition. - Help in designing resettlement programs at the community level to ensure community buy in.
Project Affected Persons	<ul style="list-style-type: none"> - Be present when the land survey and inventory is being carried out - Provides all required information in regards to resettlement activities - Participate in compensation and livelihood activities

6.3. Grievance Redress Mechanism

The District of Kayonza is an acknowledged institution for which the PAPs have been made aware of as avenues for expressing discontent and disapproval to the resettlement and compensation process. Article 26 of the Expropriation Law of 2015 provides complaints procedures for individuals dissatisfied with the value of their compensation. The Law stipulates that dissatisfied persons have a period of 30 days after project approval decision has been taken to appeal (Article 19).

Grievance procedures are required to ensure that PAPs are able to lodge complaints or concerns, without cost, and with the assurance of a timely and satisfactory resolution of the issue. The procedures also ensure that the entitlements are effectively transferred to the intended beneficiaries. Stakeholders will be informed of the intention to implement the grievance mechanism, and the procedure will be communicated at the time that the RAPs are finalized. Grievances may arise from members of communities who are dissatisfied with eligibility criteria use, community planning and resettlement measures, actual implementation or compensation.

6.3.1. GRM process

The overall process of grievance is as follows:

- During the initial stages of the valuation process, the affected persons will be given copies of grievance procedures as a guide on how to handle the grievances.
- The process of grievance redress will start with registration of the grievances to be addressed for reference, and to enable progress updates of the cases.
- The project will use a local mechanism, which includes resettlement committees, peers and local leaders of the affected people. These will ensure equity across cases, eliminate nuisance claims and satisfy legitimate claimants at low cost.
- The response time will depend on the issue to be addressed but it should be addressed with efficiency.
- Compensation will be paid to individual PAPs only after a written consent of the PAPs, including both husband and wife.

6.3.2. GRM procedures

The aggrieved person should file his/ her grievance, relating to any issue associated with the resettlement process or compensation, in writing to the subproject Resettlement and Compensation Committee. The grievance note should be signed and dated by the aggrieved person.

The SPIU social safeguards officer and the Resettlement and Compensation Committee will consult to determine the validity of claims. If valid, the Committee will notify the complainant and s/he will be assisted. The Resettlement and Compensation Committee will respond within 14 days during which time any meetings and discussions to be held with the aggrieved person will be conducted. If the grievance relates to valuation of assets, a second or even a third valuation will be undertaken, until it is accepted by both parties. These should be undertaken by separate independent valuers than the person who carried out the initial valuation.

If the aggrieved person does not receive a response or is not satisfied with the outcome within the agreed time, s/he may lodge his/her grievance to the relevant Municipal Administration such as the District Land Bureau, also mandated to help resolve such matters. If requested, or deemed necessary by the subproject Committee, the District Project Coordination officer will assist the aggrieved person in this matter.

The relevant Local Administration will then attempt to resolve the problem (through dialogue and negotiation) within 30 days of the complaint being lodged. If no agreement is reached at this stage, then the complaint is dealt with through the local courts (Abunzi) where possible. Where matters cannot be resolved through local routes, the grievance will be referred to higher authorities at the national level. The Resettlement and Compensation Committee will provide assistance at all stages to the aggrieved person to facilitate resolution of their complaint and ensure that the matter is addressed in the optimal way possible.

If administrative ways of grievance redress is not enough to address the complaint, then the aggrieved person may refer to judicial system. Based on the nature of complaints, the process will start from mediators for assets below 3 millions Rwandan francs and if the value is more than three million, the process will start from intermediate courts, High court and to supreme court.

6.3.3. Grievance Log

The District land Bureau will ensure that each complaint has an individual reference number, and is appropriately tracked and recorded actions are completed. The log will contain record of the person responsible for an individual complaint, and records dates for the following events:

- Date the complaint was reported;
- Date the Grievance Log was added onto the project database;
- Date information on proposed corrective action sent to complainant (if appropriate);
- The date the complaint was closed out; and
- Date response was sent to complainant.
- The District Project Coordination officer will be responsible for:
- Providing the sub-project Resettlement and Compensation Committee with a weekly report detailing the number and status of complaints;
- Any outstanding issues to be addressed; and
- Monthly reports, including analysis of the type of complaints, levels of complaints, actions to reduce complaints and initiator of such action.

6.4. Monitoring

The objective of the monitoring and evaluation process will be to determine whether PAPs have been paid in full and before implementation of the subproject, and people who were affected by the subproject have been affected in such a way that they are now living a higher standard than before, living at the same standard as before, or they are actually poorer than before. The arrangements for monitoring the resettlement and compensation activities will fit into the overall monitoring program of the entire project, which will fall under the overall responsibility of the RAB.

6.4.1. Monitoring Indicators

A number of indicators would be used in order to determine the status of affected people (land being used compared to before, standard of house compared to before, level of participation in project activities compared to before, how many kids in school compared to before, health standards, etc). Therefore, the resettlement and compensation plans will set two major socio-economic goals by which to evaluate its success: Affected individuals, households, and communities are able to maintain their pre-project standard of living, and even improve on it; and the local communities remain supportive of the project.

In terms of the resettlement process, the following indicators could be used to understand the success of the measures identified and the working of the relevant parties in implementation the RAP:

- Percentage of individuals selecting cash or a combination of cash and in-kind compensation;
- The number of contentious cases as a percentage of the total cases;
- The number of grievances and time and quality of resolution;
- Number of impacted locals employed by the civil works contractors; and
- General relations between the project and the local communities.

These will be determined through the following activities:

- Questionnaire data will be entered into a database for comparative analysis at all levels of local government;
- Each individual will have a compensation dossier recording his or her initial situation, all subsequent project use of assets/improvements, and compensation agreed upon and received.
- The District authorities will maintain a complete database on every individual impacted by the sub-project land use requirements including relocation/resettlement and compensation, land impacts or damages; and the SPIU should prepare Resettlement Completion Reports for each RAP, in addition to other regular monitoring reports.
- Resettlement and Compensation Committee will facilitate coordination of information collation activities (such as surveys, supervising documentation) in accordance with procedures put in place.

- RAB will provide training, technical support and funds to ensure that this happens. In order to assess whether these goals are met, the resettlement and compensation plans will indicate parameters to be monitored, institute monitoring milestones and provide resources necessary to carry out the monitoring activities.

6.4.2. Monitoring of RAP Implementation

Local Government Authorities from district level will assist in compiling basic information from the project, and convey this information to the SPIU, on a quarterly basis. They will compile the following statistics:-

- Number of households and individuals physically or economically displaced by each sub-project;
- Length of time from sub-project identification to payment of compensation to PAPs;
- Timing of compensation in relation to commencement of physical works;
- Amount of compensation paid to each PAP household (if in cash), or the nature of compensation (if in kind);
- Number of people raising grievances in relation to project; and
- Number of unresolved grievances.

Table 20: Sample Format for Monitoring

Work	Planned total	in	Progress quantity	in	Progress percentage	in
Announcement to the affected people						
Cost estimation for resettlement						
Consultation meeting						
Revise of the resettlement plan and signing based on the feedback at the consultation meeting						
Compensation in cash						
Compensation by land						
Social supports such as job training						
Number of unresolved grievances.						

RAB will scrutinize these statistics in order to determine whether the resettlement planning arrangements as set out in this RAP are being adhered to. The project team will alert RAB, if there appears to be any discrepancies. RAB will directly monitor compensation and loss of wages. Financial records will be maintained by the district land bureau to permit calculation of the final cost of resettlement and compensation per individual or household. The indicators that will be used to monitor implementation of the RAP include.

- Outstanding compensation contracts not completed before next agricultural season
- Projects unable to settle compensation after two years
- Grievances recognized as legitimate out of all complaints lodged

Financial records will be maintained by Project team to permit calculation of the final cost of resettlement and compensation per individual or household.

6.4.3. Storage of PAPS details

Each PAP household will be provided with a signed report recording his or her initial situation, all subsequent project use of assets and compensation agreed upon and received. At the same time, before compensation all household heads representing the PAPs will be required to provide passport size photographs. The Local Authority and project management team will maintain a complete database on every individual impacted by the project land use requirements including relocation, resettlement and compensation, land impacts or damages.

Each recipient of compensation will have a record containing individual bio-data, number of household dependents and amount of land available to the individual or household when the report is opened. Additional information to be acquired for individuals eligible for resettlement and/or compensation include the level of income and of production, inventory of material assets and improvements in land and debts. Each time land is

used by a sub-project; the report will be updated to determine if the individual or household is being affected to the point of economic non-viability and eligibility for compensation or its alternatives.

6.4.4. Socio-economic Monitoring

The purpose of socio-economic monitoring is to ensure that PAPs are compensated and recovering on time. During implementation of each subproject RAP, an assessment will be undertaken on payment of compensation, restoration of income delivery of resettlement objectives. Monitoring of living standards will continue following resettlement.

A number of indicators will be used to determine the status of affected people and appropriate parameters and verifiable indicators will be used to Measure the resettlement and compensation plans performance. For this sub-project with adverse social impacts, a monitoring and evaluation plan of the mitigation measures will be established. As part of the preparation of each RAP, a household survey will be conducted of all PAPs, prior to physical or economic displacement, and this will provide baseline data against which to monitor the performance of the RAP.

6.5. Cost estimation

Based on the impacts described earlier, this section present the budget estimates according to the aforementioned valuation methodologies and unit value rates. The estimated budget for RAP is summarized in next table.

Table 21: Cost Estimation for Compensation

No	Impact Description	Qty	Unit cost (Rwf)	Total (RWF)
1	Loss of Land at water balance reservoir, pumping station and canals	5ha	2400/m2	80,000,000
3	Loss of Trees	2,670	10,000	60,000,000
	Sub-total of compensation			140,000,000
4	Training of officers involved at local level for grievance settlement and so on	1 set	5,000,000	5,000,000
5	Final census survey and valuation	1 set	LS	20,000,000
	Sub-Total (25,000,000
	Total			165,000,000

Table 22: Estimated Monitoring Cost

Activity	Indicator	Qty	Unit cost (RWF)	Total Cost (RWF)
Meeting for set up resettlement committees	Established committee	3	100,000	3,000,000
Meeting for displaying PAPs asset.	Meeting	3	100,000	3,000,000
Follow up compensation process	Meeting	5	100,000	5,000,000
Meetings for grievance redress	Meetings/grievance resolved	12	100,000	1,200,000
Sub –total				12,200,000
Contingency (10%)				1,200,000
Total				13,400,000

7. RAP DISCLOSURE

The RAB will disclose final Resettlement Action plan by making copies available at its head office and in District coordination offices in Kayonza Districts. It will also make copies available to the local government's agencies, the Environmental Protection Agency and other stakeholders of the Ndego project. The RAP will be disclosed to RAB website and the Government of Rwanda will also authorize IFAD to disclose the final RAP electronically. A completion report of the entire resettlement process for this project will be prepared and will include a hand over certificate which will ostensibly provide a verification of when the compensation and assistance were undertaken and to whom these services were provided as well as to indicate that indeed all the compensation has been delivered.

This report will be prepared and submitted to IFAD 6 months after the end of compensation payment by the District of Kayonza. The RAP implementation report should include (but not be limited to) the following information:

- Background of the RAP preparation including a description of the project activities, scope of impacts, number of affected persons, and estimate budget.
- Update of its implementation with actual numbers of displaced persons by segments, compensation paid, issues/complaints raised and solutions provided
- Complains status
- Early assessment of the impacts of resettlement and compensation on affected categories at the time of the report production.
- Total sum disbursed
- Lessons learned from the RAP implementation
- Suggested annexes:
 - List of people affected as per the RAP report
 - List of people compensated during implementation

Annex 1: List of people to be affected at water pumping station

No	Cell	Village	UPI	Area/m2	NAME	ID
1	Byimana	Busasamana	5/04/08/01/2314	512560.78	MUJAWAMARIYA Cecile	1196770003548030
2	Isangano	Gafunzo	5/04/08/02/388	11173.87	NYIRAMINANI Vencencie	1194870023575020
3	Isangano	Kagoma	5/04/08/02/1819	22101.68	NTAKIRUTIMANA Etienne	1197380075064040
3	Isangano	Kibare	5/04/08/02/2664	802.06	KABOYI Flodouard	1194380004447060
4	Isangano	Kibare	5/04/08/02/2663	3830.17	BAMBUZIMPAMVU Innocent	1197580043230040
5	Isangano	Kibare	5/04/08/02/3111	5373.98		
6	Isangano	Kanyinya	5/04/08/02/3137	67.13	NTEZIRYAYO Theogene	1196480058484060
7	Isangano	Kanyinya	5/04/08/02/3144	717.16	NIYORUREMA Gaspard	1197980106045060
8	Isangano	No village	5/04/08/02/2722	670.61	NIYOMUGABO Philippe	1198480156450050
9	Isangano	Kibare	5/04/08/02/1521	21907.88		

Annex 2: List of people to be affected by water balance reservoir

No	UPI	Cell	Village	Area/m2	NAME	ID
1	5/04/08/01/836	Byimana	Kabeza	4652.59	DUSABAMAHORO Leonidas	1198680150819090
2	5/04/08/01/757	Byimana	Kabeza	8182.22	MUKARUKAKA LAURENCE	1195770043332010
3	5/04/08/01/814	Byimana	Kabeza	10637.85	ENGLISE(MUSILMAN)	148/11du 01/12/2005
4	5/04/08/01/816	Byimana	Kabeza	8983.32	UWAMAHORO Esperance	1197570043566000
5	5/04/08/01/835	Byimana	Kabeza	10426.77		
6	5/04/08/01/811	Byimana	Kabeza	9107.71	DUKUZUMUREMYI Juvenal	1197480081965050
7	5/04/08/01/850	Byimana	Kabeza	2555.20		
8	5/04/08/01/812	Byimana	Kabeza	10131.58	YIRIRWAHANDI Hirary	1198680150824040
9	5/04/08/01/815	Byimana	Kabeza	9298.58	UZAKUNDA	1199280121247070
10	5/04/08/02/132	Isangano	Kagese	8881.95	NSANZUMUHIRE Joseph	1196980058898020
11	5/04/08/02/477	Isangano	Kagese	8696.26	NAHONYIRIMPUHWE Celestin	1196380055978000
12	5/04/08/02/852	Byimana	Kabeza	7897.94	MANIRAREBA Jean	1198580151346040
13	5/04/08/02/1365	Isangano	Kanyinya	12312.70	NAHAYO Pierre	1197980106038040
14	5/04/08/02/813	Byimana	Kabeza	13348.89	KANYANDEKWE Felecien	1195580040751090
15	5/04/08/02/133	Isangano	Kagese	40187.20		
16	5/04/08/02/408	Isangano	Kagese	10878.76	KARANGWA Joseph	1195180023964020
17	5/04/08/02/1362	Isangano	Kanyinya	11376.74	NSANZIMANA Claver	1198280160294030
18	5/04/08/02/368	Isangano	Kanyinya	10528.44	BIJAMWA Emmanuel	1196580028606110
19	5/04/08/02/363	Isangano	Kanyinya	9347.75	NGEZAHAYO August	1197980105994030
20	5/04/08/02/615	Isangano	Kamahoro	2249.23	BAZIRA Leonidas	1194980023235090
21	5/04/08/02/369	Isangano	Kanyinya	9103.88	RWASIBO Martin	1196880065254020
22	5/04/08/02/755	Byimana	Kabeza	4629.82	RWAGASORE Jonathan	1197680082415050
23	5/04/08/02/837	Byimana	Kabeza	7348.78	GATO Speciose	1195770043316080
24	5/04/08/02/422	Isangano	Kagese	7566.84	NSENGIYUMVA Protails	1197780088404010
25	5/0408021361	Isangano	Kanyinya	9337.36	NYIRANDIRAHISHA Bonefride	1194270026200000
26	50408021364	Isangano	Kanyinya	12040.46	NTEZIRYAYO Theogene	1196480058484060
27	5040802613	Isangano	Kamahoro	15036.13	BIGIRUMWAMI Alex	1196080059117040.00
28	5040803550	Karambi	Musenyi	21853.26	SEMASENGE Innocent	1196780054868010.00
29	50408032613	Karambi	Kamabuye	12920.33	NDAYISENGA Jonas	1195880050724060
30	50408032628	Karambi	Kamabuye	956.76	MINANI Sylvestre	1197980106052090
31	50408032629	Karambi	Kamabuye	7756.70	BUZINDU Gratien	1195780043364040

32	50408031317	Karambi	Ihema	9574.97	MINANI Sylvestre	1197980106052090
33	50408032612	Karambi	Kamabuye	25220.07	UKWIBISHAKA Sauveur	1196780069927000
34	50408032086	Karambi	Remera	20712.39	KAMUZINZI Emmanuel	1196480073054070
35	50408032625	Karambi	Kamabuye	8590.00	MUNYANZIZA Vincent	1197080022335020
36	50408032606	Karambi	Kamabuye	16030.23	NSENGIMANA Callixte	1196680022030090
37	50408032627	Karambi	Kamabuye	7559.68	HATANGIMBABAZI Jonathan	1197680082500010

Annex 3: List of people to be affected by pressure pipes

No	UPI	Cell	Village	AREA/m ²	NAME	ID
1	5/04/08/02/810	Isangano	Kamahoro	5420.71		1196680054276090
2	5/04/08/02/177	Isangano	Kagese	9957.97	MAJYAMBERE Pascal	1197680082440000
3	5/04/08/02/806	Isangano	Kamahoro	914.62	VUMIRIYA Samusoni	1196480058471010
4	5/04/08/02/807	Isangano	Kamahoro	695.50	MUKARWEMA Petronile	1195270041004000
5	50408021817	Isangano	Kagoma	4917.69	SINARINZI Innocent	1199280067541030
6	5040802394	Isangano	Gafunzo	1291.29	MAZIMPAKA Joel	1198680056325030
7	5040802610	Isangano	Kamahoro	10290.04	RWEMERIKIJE Boniface	1197680075826060
8	50408022642	Isangano	Kagoma	1524.04	NTAWUBIRAGA Josephine	1197070072837000
9	5040802797	Isangano	Kamahoro	17080.37		
10	50408021821	Isangano	Kagoma	8752.67	MBONABUCYA Theophire	1198280160260020
11	50408023126	Isangano	Kibare	5392.16		
12	5040802379	Isangano	Gafunzo	5012.83	MINANI Jean Baptiste	1198080133764020
13	50408022441	Isangano	Kamahoro	4254.31	SIBOMANA Donatien	1198480156309000
14	5040802128	Isangano	Kagese	37902.16	BARABWIRIZA Jean Claude	
15	5040802389	Isangano	Gafunzo	9139.42	BARABWIRIZA Jean Claude	1197780088350010
16	5040802396	Isangano	Gafunzo	11408.25	MUNYAZIKWIYE Jean Baptiste	1198280160282070
17	50408021818	Isangano	Kagoma	11062.63	SIBOMANA Vianny	1198380141870040
18	5040802805	Isangano	Kamahoro	6741.00	NTAKIRUTIMANA Etienne	1197380075064040
19	5040802147	Isangano	Kagese	2065.04	SINAMENYE Emmanuel	1198780147439040
20	5040802808	Isangano	Kamahoro	1631.75	NYIRAHABIMANA Jeanne	1197570080531090
21	50408022641	Isangano	Kibare	6898.26	UMAZEKABIRI Cyliverien	1196280063306090
22	5040802377	Isangano	Gafunzo	4965.65	MINANI Jean Baptiste	1198080133764020
23	5040802390	Isangano	Gafunzo	10969.64	MUKANDAYISENGA Vestine	1198070133746020
24	5040802391	Isangano	Gafunzo	10817.88	NSENGIMANA FERDINAND	1197680082475070
25	50408022430	Isangano	Kamahoro	222.46	NIRAHIRA Laurent	1196080059116060
26	50408021820	Isangano	Kagoma	21340.32	UWIRAGIYE Francois	1196880065242050
27	5040802616	Isangano	Kamahoro	2749.51	MAGABE Thadee	1194880023570070
28	5040802146	Isangano	Kagese	7331.77	MUKEZANGANGO Juvenal	1198180124975070
29	50408032115	Karambi	Remera	10942.91	MUKAMUGEMA Anathalie	1194470015460010
30	5040803600	Karambi	Musenyi	17972.83	TWIZEYIMANA Jean Damascene	1198280160304030
31	50408032614	Karambi	Kamabuye	16701.95	SERUBANZA Boniface	1197080072823060
32	5040802176	Isangano	Kagese	8497.69	BAPFAGUHEKA Donath	1196980058858070
33	5040802182	Isangano	Kagese	11456.80	RUDAHUSHA Heroni	1197780088406080
34	5040802153	Isangano	Kagese	3641.73	SINABURAGA Simon	1198080133760070
35	5040802606	Isangano	Kamahoro	5682.31	NIYONZIMA Thomas	1196680054301030

36	50408021816	Isangano	Kagoma	3942.50	HASHAKIMANA Viateur	1198280160346050
37	5040802604	Isangano	Kamahoro	10182.35	NTIBARIKURE	1197080072835020
38	50408032083	Karambi	Remera	21419.63	NYIRANTUYE Jean	1197580080573010
39	5040802603	Isangano	Kamahoro	21775.37	MUGEMANTAGARA Phocas	1197480081954080
40	50408022643	Isangano	Kagoma	1391.48	AHISHAKIYE Annonciatta	1195170023962050
41	5040802393	Isangano	Gafunzo	2915.91	NIYONZIMA Thomas	1196680054301030
42	5040802154	Isangano	Kagese	7518.92	MUSHIMIYIMANA Vincent	1197780036102030
43	5040802137	Isangano	Kagese	2384.78	KAYITESA Tharcisse	1197580080548090
44	5040803598	Karambi	Musenyi	15473.22	AYINKAMIYE Beathe	1198170124949060
45	50408032080	Karambi	Remera	11840.02	NIYONZIMA Thomas	1196680054301030
46	50408032084	Karambi	Remera	20225.54	MUKANDAMAGE Virginie	1196370013459020
47	50408032618	Karambi	Kamabuye	13530.68	NYIRAGIRANEZA Selapie	1196870065257080
48	50408032620	Karambi	Kamabuye	8495.08	NIYOMUKIZA EUGENE	1197180058992110
49	50408032113	Karambi	Remera	15363.25	KWIZERA Uzziel	1198080130508090
50	50408032959	Karambi	Remera	8526.43		
51	50408032114	Karambi	Remera	10157.70	NGIRINSHUTI Elias	1199280067498090
52	5040803599	Karambi	Musenyi	16006.32	NSENGIYUMVA Janvier	1198080133757090
53	50408032088	Karambi	Remera	19690.61	RIBANJE Evariste	1195480037835090
54	50408032065	Karambi	Remera	16922.35	NDIZIHIWE Cleophas	1198680150823050
55	50408032616	Karambi	Kamabuye	7449.73	NYIRAGIRANEZA SELAPIE	1196870065257080
56	5040802152	Isangano	Kagese	7575.15	NIYIBIZI Sylvestre	1197280077369020
57	50408032067	Karambi	Remera	15719.06		
58	50408032054	Karambi	Remera	424.63	IYAKAREMYE Saverien	1198480156277060
59	50408032079	Karambi	Remera	9861.19		
60	50408032055	Karambi	Remera	421.01	NYIRAMINANI Claudine	1198270160256060
61	50408032066	Karambi	Remera	7604.55	NIYORUREMA Gaspard	1197980106045060
62	50408032070	Karambi	Remera	10558.96	MAJYAMBERE Fulgence	1198980203178000
63	50408032087	Karambi	Remera	20177.15		
64	50408032112	Karambi	Remera	14926.14	URIMUBENSHI Gustave	1199380066449040
65	5040803549	Karambi	Musenyi	20554.13	MURISA Samuel	1198080133807040

Annex 4: Proposed Socio Economic and Land Asset Inventory Forms**1. Socio-economic Household Datasheet of PAPs**

Name of interviewer ID Code		signature
Name of supervisor ID Code		(after verification of interview)

Cell Name		Number of Concession in Village (GPS Coordinates)	
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Date:

Day Month Year

Name of Head of Extended Family	
Number of Nuclear Families in Extended Residential Group (including household of head of extended family)	

Name	Relationship to head of family	Sex		Place of birth	Age	Marital Status	Residence Tenure	Religion	Education Level	Income Earner		Economic activities	
		M	F							Yes	No	Primary	Secondary
1.													
2.													
3.													
4.													

Relation to Head of Family

1 HOH; 2 Spouse of Hoh; 3 Child of HoH; 4 Spouse of child of HoH; 5 Grandchild of HoH; 6 Parent of HoH; 9 Other (specify); 0 No answer

Marital Status 1 Married 2 Widowed; 3 Divorced; 4 Unmarried; 0 No answer

Residential status 1PRP (Permanent Resident) 2 RA (Resident Absent) 3 Member of non-resident HH; 4 Visitor; 9 other (specify); 0 No answer

Occupations

Principle Occupation

Farmer 2 Shepherd; 3 household; 4 Merchant; 5 Religious leader; 6 Artisan; 7 Transport; 8 Unemployed; 9 Other (specify); 0 No answer

Secondary Occupations

Educational Level 1 Illiterate; 2 Three years or less; 3 Primary School; 4 Secondary school ; 5 Technical School; 6 Religious School; 0 No Answer

Religion 1 Christian (Specify denomination); 2 Muslim; 9 Other (specify); 0 No Answer

2. Land asset inventory for Project Affected People

Village; Date;

Cell;

Survey No.	Name of HH Head	No of persons in Household	Total land holding of Household (m2)	Land to be acquired(m2)	Land use Type*	Loss of % total	Loss of assets	Loss of crops	Loss of other assets	Other losses
							Structures permanent (m2); Structures temporary	Fruit trees lost type and number; Agricultural land lost(m2) Other(specify)	e.g. graveyards, wells etc(type & no)	Residence rented; Business lost; Income loss

*Land types are as follows (please fill in the types of land for Rwanda)

3. Entitlements of Project Affected People

Sector date

Cell

Survey No.	Name of Head of Household	Compensation for Land	Compensation for Structures	Compensation for crops and trees	Compensation for other assets and losses(e.g. graveyards, wells, businesses, etc)	Total (USD)
		Quantity(m2) Unit Price(USD) per m2 Entitlement (USD)	Quantity(m2) Unit Price(USD) per m2 Entitlement (USD)	Quantity Unit Unit Price(USD) Entitlement (USD)	Quantity Unit Unit Price(USD) Entitlement (USD)	

Annex 5: Sample Grievance Redress Form

Grievance Form		
Grievance Number		Copies to forward to:
Name of the recorder		(Original) Receiver Party
District/ Sector/Cell		(Copy)- Responsible Party
Date		
INFORMATION ABOUT GRIEVANCE		
Define The Grievance		
INFORMATION ABOUT THE COMPLAINANT		Forms of Receive
Name-Surname		Phone line
Address		Community/Information meetings
Village/ Cell		Mail
Sector/ District		Informal
Signature of Complainant		Other

Details of Grievance

6.Incidents Regarding	7.Resettlement Process (specify)	8.EmDPCOy ment and	9.Construction Camp and Community Relations	10.Other (specify)
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Expropriation and Compensation (Specify)		recruitment (Specify)	Nuisance from dust Nuisance from noise Vibrations due to explosions Misconduct of the project personal/worker Complaint follow up Other	
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Grievances Close Out Form

Grievance Number:.....

Define immediate action required:.....

Define long term action required (if necessary).....

Corrective action taken	Due date

Responsible Party

Notes: This part will be filled in and signed by the complainant when he/she receives the compensation or file is closed out

Complainant:.....
Name and Signature.....
Date
Representative of Responsible Party
Title, Name and Signature.....
Date:.....