AFRICAN DEVELOPMENT BANK GROUP

MINISTRY OF WATER AND ENVIRONMENT

Farm Income Enhancement and Forest Conservation Project II (FIEFOC)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED CONSTRUCTION OF DOHO II IRRIGATION SCHEME IN BUTALEJA DISTRICT

August, 2017

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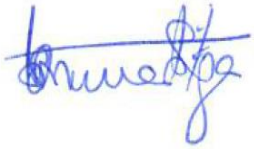
Muwanga Lammeck	**Team Member** Soil Impact Analysis and Waste Management Specialist	

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ACKNOWLEGEMENTS

The Environment and Social Impact Assessment team on the proposed construction of Doho II irrigation scheme in Butaleja district would like to thank all those who provided information that made it possible to prepare this ESIA Report. The team extends appreciation to the Ministry of Water and Environment (MWE) for initiating and facilitating the entire ESIA process. We also extend thanks to the technocrats of MAAIF, Butaleja district, local leadership of the three sub counties of Himutu, Mazimasa and Kachonga for immense contribution to the information which enabled successful conclusion of this work.

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List of Acronyms

AfDB	African Development Bank
BOQ	Bill Of Quantities
DAO	District Agriculture Officer
DEO	District Environment Officer
DWRD	Directorate Of Water Resources Development
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
FIEFOC	Farm Income Enhancement and Forest Conservation Project
GoU	Government of Uganda
MAAIF	Ministry Agriculture, Animal Industry and Fisheries
MGLSD	Ministry of Gender Labour and Social Development
MDGs	Millennium Development Goals
MWE	Ministry of Water and Environment
MFPED	Ministry of Finance Planning and Economic Development
OHS	Occupational Health and Safety Officer
PIU	Project Implementing Unit
PSO	Project Support Officer
UBOS	Uganda Bureau Of Statistics
WUAs	Water Users Associations

Executive Summary

The construction of the Doho II irrigation scheme is part of the government's plan to develop medium scale irrigations schemes of Doho, Ngenge and Mubuku II under Farm Income Enhancement and Forestry Conservation Project (FIEFOC II Project) with financial assistance from the African Development Bank (AfDB). The project is expected to ensure the sustainability of the irrigation scheme and increase agricultural production and thereby uplifting the livelihood of the local community who rely entirely of Doho irrigation scheme.

ES.1: Location of the project

The site is located in Himutu, Mazimasa and Kachonga sub-counties, Butaleja district at GPS coordinates A-0°55' 17.88182"N, 34°4'46.87105"E; B-0°55'26.26319N, 34°4'42.48725"E; C-0°55'44.51294"N, 34°4'29.27791"E; D-0°56'12.79255"N, 34°4'6.9425"E at an altitude of 1078 meters above sea level. The site is an agricultural setting area with extensive hectares of marshy land occupying fields of rice.

ES.2: Project Purpose

The FIEFOC-II aims at strengthening its commitment to providing necessary resources and inputs to enable farmers increase and manage valuable and profitable vegetation cover in local forest reserves, community forests, natural forests and degraded landscapes. The project will further support apiculture activities within selected watershed areas so that they contribute to conservation of forests and increase the quantity and quality of honey for immediate income generation.

The development goal of the project is to improve household incomes, food security, and availability of forestry products and services through sustainable natural resources management and agricultural enterprise development

The overall objective of the project is to improve farm incomes, rural livelihoods, and food security and contribute to poverty reduction through sustainable natural resources management and agricultural enterprise development.

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ES.3: Objective of the ESIA

The FIEFOC-II project activities will include the construction and use of irrigation infrastructures that may likely have significant environmental impacts such as loss of vegetation, soil erosion, pesticide use, wetland degradation and increase in waterborne diseases. These risks will be managed through implementation of mitigation measures well elaborated in site specific Environmental and Social Impact Assessment (ESIA).

In reference to the National legal requirement, the Third schedule of the National Environment Act. Cap 153 (1995) section 8(19) requires all agricultural development undergo an Environment Impact Assessment. Furthermore, in reference to the ESIA guidelines chapter 4; requires that if a project is likely to have adverse impacts whose mitigation measures are not readily available, a detailed impact assessment be conducted. Therefore the objective of this EIA report has been prepared in order to fulfill the above requirements.

The primary goal for preparing this ESIA is to define the projects' area of influence, the activities that shall be undertaken during the establishment and operations phase and to identify impacts arising from undertaking this project proposal. This Environmental and Social Impact Assessment has been written to provide a disclosure of the design for the project, beneficiaries and the implementing agencies. The specific objectives therefore include:-

1) Assess the potential environmental and social impacts of the project;
2) Outline proposed mitigation measures for adverse impacts, while proposing enhancements measures for positive impacts;
3) Specify monitoring requirements, and consultative and institutional measures in order to prevent, minimize, mitigate or compensate for adverse environmental and social impacts, and also to enhance the project's beneficial impacts;
4) Specify institutional arrangements, including appropriate roles and responsibilities for managing, reporting and monitoring environmental and social concerns of the project; and
5) Determine the other institutional requirements, including those related to training and capacity building needed to assist the Government of Uganda to strengthen its safeguard capacities within the Ministry of Water and Environment and at the district level.

ES.4: Policy, Legal and Institutional Framework

The policy, legal and institutional framework within which the EIA was conducted, National regulations are discussed along with African Development Bank's safeguard policies, relevant international agreements and conventions to which, Uganda is a party. Key

legislations governing the conduct of EIA in Uganda are the National Environmental Act (Cap 153) and the Environmental Impact Assessment Regulations (1998). The National Environmental Act established the National Environment Management Authority (NEMA), and entrusts it with responsibility to ensure compliance with the EIA process in planning and execution of agriculture projects.

ES.5: Relevant policies and regulations reviewed

a) The National Wetland Conservation and Management Policy;
b) The National Environment Management Policy, 1994;
c) The Plan for Modernization of Agriculture (PMA);
d) The National Water Policy, 1999;
e) The National Environment (Riverbanks, Lakeshores and Wetlands) regulations, 2000.

Legal framework

a) The Constitution of the Republic of Uganda, 1995;
b) The Occupational Safety and Health Act, 2006;
c) The Local Government Act, 1997;
d) The Land Act, Cap 227;
e) The Water Act, Cap 152;
f) The National Environment Act of 1995 Cap 153.

Institutional framework

a) The Ministry of Water and Environment (MWE)
b) The National Project Coordination Unit (PCU)
c) The National Environmental Management Agency (NEMA)
d) Butaleje District Local Government (BDLG)

AfDB Safeguard policies

a) OP/BP 1: Environmental and Social Assessment;
b) OP/BP 2: Involuntary Resettlement: Land acquisition, population displacement and compensation;
c) OP/BP 3: Biodiversity and ecosystem services;
d) OP/BP 4: Pollution prevention and control, hazardous and control, hazardous materials and resource efficiency;
e) OP/BP 5: Labour conditions, health and safety.

International Agreements

a) Stockholm Convention on Persistent Organic Pollutants (POPS);
b) Strategic Approach to International Chemicals Management (SAICM).

ES.6 Raised issues during consultations

Stakeholder		Raised issues	Actions
National Level	**Ministry of Water and Environment** (Department of Wetland Management) **Principle Wetlands officer** Barugahare Vincent 0774434969	✓ Integrated water management strategy should be considered key during project implementation. (Water catchment protection should be a prerequisite); ✓ The role of community development officers should be clearly streamlined; ✓ District political and technical officials should work hand in hand for the common goal of developing the scheme; ✓ There should be equity in accessing the scheme resources; ✓ Water reservoirs should be thought of in the designs; ✓ Boundaries on the ecological resources should be clear in order to avoid encroachment.	✓ Water users associations shall be formed to effectively manage the water catchment areas; ✓ The role of selected community development officers shall be clearly explained to the beneficiaries; ✓ Since the project is looking forward to enhancing farmers income, no politics should be brought on board during implementation; ✓ The dam shall be constructed to store water during dry spells; ✓ Specific tree species shall be planted in the boundaries of the river to avoid encroachment on the river banks.
District Level	**Political section** **Richard Waya** District Chairperson 0772453838	✓ Supervision of the scheme works by the district technical team; ✓ Empowering the community to own the project. ✓ Weak emphasis on	✓ All construction works at the scheme shall be keenly monitored by the selected district technocrats; ✓ Proper engagement of the community shall be mandatory since they

		environmental issues during construction works; ✓ Sanitation should be emphasized during construction and operation works; ✓ Creation of employment opportunities to the youth in the area; ✓ Compensation issues should be looked into prior to any construction works; ✓ Woodlots should be thought of to avoid further encroachment on forests; ✓ Integrated water management should be considered key during operation phase of the scheme; ✓ There should be quarterly joint meetings between the ministry and the district for smooth running of the scheme; ✓ Creation of buffer zones to avoid cultivation along the river banks.	are the direct beneficiaries of the project; ✓ Sanitary facilities shall be planned considering the number of people conducting their farming activities within the scheme; ✓ During construction works different job opportunities shall be created both for skilled and casual; ✓ Resettlement Action Plan (RAP) report shall iron out all issues related to compensation; ✓ Plans for planting trees shall be put forward under the guidance of the district forest officer; ✓ To avoid water shortage that are likely to spark off conflicts, there shall be formulation of water user groups; ✓ MAAIF and MWE as the lead government agencies shall spearhead quarterly joint meetings to check on the progress of the scheme.
	Higenyi Febiano Chairperson LIII-Himutu S/County	✓ The development is good for the area since there is high demand for infrastructures	✓ Road construction shall be a prerequisite in development of the scheme; ✓ More job opportunities

	0782848354	facilities like internal roads within the rice fields; ✓ The proposed irrigation scheme activities will create more job opportunities to the people in the area. More so, the scheme will boost production of rice; ✓ People working at the scheme will be equipped with skills regarding rice growing thus building their capacity; ✓ The revenues collected should partly help in developing the area within the jurisdiction of the development.	shall be created both for skilled and unskilled labour force and several groups will acquire skills; ✓ High yielding varieties of rice shall be introduced at the scheme.
	Malwa Augustine District Councillor-Mazimasa S/County 0782614939	✓ Employment should prioritize the youth when sourcing the labour during construction activities; ✓ Establishment of irrigation scheme will also, solve the rampant youth unemployment problem in the area; ✓ The revenues collected should partly help in developing the area within the jurisdiction of the project the district as a whole; ✓ There should be a good working relationship between	✓ To avoid high cost incurred while providing logistics to workers during construction works, the constructor shall source labour from the surrounding communities; ✓ The district planning unit shall look into the issues of revenue collected and planning for the irrigation scheme community; ✓ Emphasis shall be put on cooperation to boost the irrigation scheme.

		the implementing unit and the farmers as well as the Butaleja district.	
	Technical section **Were Lamula** District Natural Resources Officer-Butaleja 0782608259	✓ Maintenance of canals should be effected; ✓ Sensitization of the community about the dangers of poor farming practices at the scheme; ✓ Ecotourism should be planned at the proposed dam; ✓ Tree planting to protect the river banks at least 10-12 metres; ✓ Regulation on the use of fertilizers and other chemicals.	✓ De-silting of the canals shall be prioritized at least twice a month; ✓ Community sensitization shall be mandatory if the government id to maintain smooth running of the scheme; ✓ The district technical people shall look into the issues of ecotourism at the proposed dam; ✓ One of the priority under FIEFOC II is tree planting therefore this shall be implemented; ✓ It shall be the role of the district agriculture officer to train farmers on better techniques of fertilizer application.
	Tom Wandera Environment Officer-Butaleja 0781421432	✓ Construction of the dam to store water in the dry seasons; ✓ Collaboration in the management of the water catchment for equal benefit of both upstream and downstream users; ✓ The implementing Ministry should intervene in solving the emerging conflicts of water through	✓ The water reservoir shall be constructed to sort out the issues of water shortage during dry spells; ✓ Water user groups shall be formed to strengthen water management in the scheme; ✓ The district agriculture officer shall train the farmers better techniques of fertilizer application.

		formulation of water user groups in different sections of Doho irrigation scheme; ✓ Minimize increased use of fertilizers.	
	Banamwita Charles Joshua District Forest Officer-Butaleja 0752501993	✓ The proposed rice growing at the scheme should be integrated with fishing activity as a new innovation; ✓ The Project Support Officer should train farmers around the proposed site and this will improve on their production; ✓ There is need for a project Implementation Unit to come up with a strategy of controlling floods which are prominent during heavy rains; ✓ The proposed irrigation scheme will boost the market for rice and other products in the area; ✓ The scheme will increase on government revenue through paying taxes; ✓ The project will change the face of the area thus improving its standards.	
	Wasose Richard District Water Officer-Butaleja	✓ Alternative source of water such as underground water abstraction should be	✓ District water officer in liaison with the project implementing ministry shall work hand in hand

	0782030226	thought of; ✓ If possible other crops should be introduced at the scheme other than rice which demands a lot of water; ✓ The proposed infrastructure under FIEFOC II should be effectively managed; ✓ Institutionalization during implementation of this project.	on the issue of alternative water source; ✓ Since the project is focusing on enhancing farmers income, suitable crops shall be thought of by the district production officer after thorough consultation with other technocrats; ✓ The roles of each institution shall be streamlined to avoid overlaps.
Local Community		During consultation the community acknowledged the following: ✓ Increased rice yields once the project is well implemented thus improving their living standards; ✓ Improved roads and other built structures within the scheme; ✓ Creation of Job opportunities during proposed construction works; ✓ The introduction of FIEFOC II project is likely to increased conflict over water use since much water will be needed to feed the scheme and yet all farmers depend entirely on river Manafua whose volumes drastically reduce during dry seasons; ✓ There is fear that after modernization of the scheme the	✓ Different rice varieties shall be introduced at the scheme to boost farmers harvests; ✓ Road construction work is part of FIEFOC II project, therefore new roads shall be constructed; ✓ New jobs shall be created in both casual and skilled labour force; ✓ Construction of water reserves and formation of Water users associations shall reduce of the conflicts.

	government might take full control and yet the land belongs to the community.	

ES.7 Key Findings

This Environmental and Social Impact Statement (ESIS), therefore, presents the findings of the Environmental Impact and Social Assessment (ESIA), and includes an overview of the project activities, predicted environmental impacts, the suggested mitigation measures addressing identified adverse impacts, the project alternatives that were considered, socio-economic concerns and associated costed Environment Monitoring Plan for the implementation of the ESMP.

Anticipated Positive Environmental and Social Impacts

1) Improved water for productive uses;
2) Increased agricultural acreage and productivity;
3) Increased job opportunities;
4) Environmental protection;
5) Market creation;
6) Opportunity for training and skills acquisition.

In spite of high benefits associated with the project as listed above, there is a number of significant negative environmental, health and safety impacts which the study has found to be associated with construction, operation and decommissioning of the irrigation scheme project and, therefore, which must be taken into account before project commencement. The impacts are as summarized in below:-

Anticipated Negative Environmental and Social Impacts

1) Oil spillage resulting in soil and water contamination
2) Air and noise pollution
3) Soil Erosion
4) Occupational health hazards
5) Impact on local infrastructure
6) Influx of people
7) Resource use conflict
8) Loss of soil fertility from monoculture and use of inorganic fertilizers
9) Water pollution
10) Water logging and salinization

11)Water conflicts as a result of irrigation scheme improvement
12)Vandalism of Irrigation infrastructure
13)Increased spread of Water related diseases

ES.8: Conclusions

The issues/impacts have been assessed and described in detail to gain an adequate understanding of possible environmental effects of the proposed project – from design to decommissioning, in order to formulate mitigation measures in response to negative aspects which will emerge. The Environmental Management Plan (EMP) provides a way forward for implementation of the identified mitigation measures. The EMP should be implemented as a prerequisite for a positive record of decision by the appropriate authorities.

The Environmental Monitoring Plan provides parameters to be monitored and responsibility. While the consultant is aware that each monitoring aspect need to have a separate budget line, for small projects which are remotely located this does not make economic sense. The consultant is recommending that the Project Proponent assigns the Environmental officer to undertake the monitoring of the mitigation measures for the project through its existence. This is the way the proponent will achieve sustainable project implementation at reduced cost for undertaking the monitoring.

Given the nature and location of the development, the conclusion is that the potential impacts associated with the proposed development are of a nature and extent that can be reduced, limited and eliminated by the application of appropriate mitigation measures.

ES.9: Recommendations

MWE should work closely with local authorities and other government agencies to ensure benefits of the irrigation scheme are enhanced by sensitizing farmers on good irrigation practices, promoting water and soil conservation, build capacity of WUAs for operations and maintenance of the scheme, establishing demonstration plots/blocks, constructing access roads, enabling increased access to collateral, markets, value addition facilities, improvements to safe water and sanitation coverage.

Based on the assessment done, the Consultant is of the opinion that most of the potential environmental impacts identified can be mitigated. The proposed environmental management plan and environmental monitoring plan if implemented will safeguard the integrity of the environment

1.0 Introduction

1.1 Background of the study

Uganda's economy is forecasted to grow at a rate of approximately 5.6% (UBOS, 2014), and could maintain an upward trajectory into the near future, as oil investments and the large infrastructure programs boost construction activities. Uganda's population is estimated to be 34.9 million (2014 population census) and is growing at roughly 3.2 per cent per year, one of the world's highest rates. Uganda has made important progress towards meeting the Millennium Development Goals (MDGs), especially with respect to income poverty, gender equality and women empowerment, reducing child mortality, ensuring environmental sustainability and developing a global partnership for development. A key challenge to accelerating progress towards middle income status and promote shared prosperity is to raise productivity in sectors where most people are employed or move people from low to higher productivity activities.

Agriculture remains Uganda's most important sector in terms of employment. In FY 2012/13, the sector provided employment to about 66% of the country's working population. Officially, almost three quarters (72%) of the agricultural workforce are women. The sector is also a major source of raw materials used in the local processing industries. In the export sector, agriculture contributes about 40% of total goods exported. Indeed, agriculture has a high potential for poverty reduction and bringing about inclusive growth. However, the performance of the sector has been dismal over the past decades, mainly due to low productivity, lack of long-term credit, inadequate access to information and technology, overlapping land rights, low levels of investment, post-harvest losses, and poorly targeted input subsidy schemes.

It is against this background that the Farm Income Enhancement and Forest Conservation project was framed to boost agricultural productivity and enhance food security through sustainable natural resources management and agricultural enterprises development at Doho II irrigation scheme in Himutu, Mazimasa and Kachonga sub counties, Butaleja district.

1.2 Project Rationale and Justification

The National Development Plan II (NDP II) 2015/16-2019/20, which has been designated by GoU as the second of a series of six 5-year NDPs to translate the country's Vision 2040 into action, is the overall development strategy for Uganda. The NDP's core objectives are to increase household income; generate employment; develop the infrastructure; increase access to quality social services; promote science and technology; and develop human capital which FIEFOC is consistent with. The Project's activities, notably, construction of

irrigation infrastructure and promotion of value addition to enhance household incomes, are also consistent with the Agricultural Sector Development Strategy and Investment Plan (DSIP) 2010, Gender Policy Brief for Uganda's Agriculture Sector (2012), the Rural Development Strategy (RDS) of the Ministry of Finance, Planning and Economic Development (MoFPED), the Local Government Sector Investment Plan (LGSIP) Investment Strategy 6, Local Economic Development), the Uganda Forestry Policy, and the Uganda Climate Change Policy.

The Project is in line with the Bank's Ten Year Strategy (TYS) as it relates to inclusive growth and food security through the involvement of youth and women in skills development and entrepreneurship. The Project is also consistent with the Bank's CSP (2011-2015) with its two pillars focusing on (i) the development and rehabilitation of critical economic infrastructure and increased agricultural productivity; and (ii) improving capacity skills development for poverty reduction, both of which are well aligned to the NDPII. FIEFOC-II was identified by the CSP as one of the key investment projects to be supported by the Bank under its first pillar mentioned above. In addition, the Project is aligned with the Bank's draft Agriculture and Agribusiness Strategy 2015-2020, the Gender Strategy (2014-2018), the Bank's Climate Change Action Plan (CCAP, 2011-2015).

The Bank has gained good experience under FIEFOC-I in implementation of irrigated agriculture and has also accumulated vast experience through the implementation of other agricultural infrastructure projects. The first phase of FIEFOC has rehabilitated three irrigation schemes Doho, Mubuku, and Agoro irrigation scheme with a total area of about 3000ha now benefiting more than 6,800 farm families. It has also supported communities and households to work together to manage watersheds, enabled households to participate in tree planting and beekeeping activities. Building on the achievements of the first phase, FIEFOC-II project design will hinge on a community-based development, with the districts, sub-counties and communities as focus of implementation, and the private sector as main service providers. The project will direct its efforts towards using small-scale irrigation facilities and improved soil fertility management practices, to produce and market high value crops. It will also address deforestation, climate variability and change, and problems of natural resources degradation with the catchment area.

1.3 Purpose and Scope of Environmental Impact Assessment

The National Environment Act, Cap. 153 introduced the requirement for an Environmental Impact Assessment tool into the Laws of Uganda. Section 19 (3) of the National Environment Act, Cap. 153 requires that all projects that may, are likely to or will have significant impacts on the environment be subjected to EIA so that adverse impacts can be eliminated or mitigated. On the other hand, the FIEFOC-II Project is being implemented at Doho irrigation scheme inthree Sub Counties of Himutu, Mazimasa, Kachonga, and it will

include construction of irrigation infrastructures which are likely to pose significant environmental and social impacts locally. Hence, the Environmental and Social Impact Assessment (ESIA) is crucial to ensure that social and environmental impacts, and risks identified in the study are effectively managed during the construction and operations of the Farm Income Enhancement and Forest Conservation II project. More importantly, the ESIA will ensure that the FIEFOC-II Project complies with applicable Uganda environmental and social legal requirements, as well as the African Development Bank's Safeguards policies and procedures.

1.4 Objective of the ESIA

The FIEFOC-II project activities will include the construction and use of irrigation infrastructures that is likely have significant environmental impacts such as loss of vegetation, soil erosion, pesticide use, wetland degradation and increase in waterborne diseases. These risks will be managed through implementation of mitigation measures well elaborated in site specific Environmental and Social Impact Assessment (ESIA).

In reference to the National legal requirement, the Third schedule of the National Environment Act. Cap 153 (1995) section 8(19) requires all agricultural development undergo an Environment Impact Assessment. Furthermore, in reference to the ESIA guidelines chapter 4; requires that if a project is likely to have adverse impacts whose mitigation measures are not readily available, a detailed impact assessment be conducted. Therefore the objective of this EIA report has been prepared in order to fulfill the above requirements.

The primary goal for preparing this ESIA is to define the projects' area of influence, the activities that shall be undertaken during the establishment and operations phase and to identify impacts arising from undertaking this project proposal. This Environmental and Social Impact Assessment has been written to provide a disclosure of the design for the project, beneficiaries and the implementing agencies. The specific objectives therefore include:-

1) Assess the potential environmental and social impacts of the project;
2) Outline proposed mitigation measures for adverse impacts, while proposing enhancements measures for positive impacts;
3) Specify monitoring requirements, and consultative and institutional measures in order to prevent, minimize, mitigate or compensate for adverse environmental and social impacts, and also to enhance the project's beneficial impacts;
4) Specify institutional arrangements, including appropriate roles and responsibilities for managing, reporting and monitoring environmental and social concerns of the project; and

5) Determine the other institutional requirements, including those related to training and capacity building needed to assist the Government of Uganda to strengthen its safeguard capacities within the Ministry of Water and Environment and at the district level.

1.5 ESIA Process for Uganda

The ESIA process followed the legal procedures as contained in Environmental Impact Assessment manual for Uganda, 2002. The flow chart in Figure 1-1 summarizes the process.

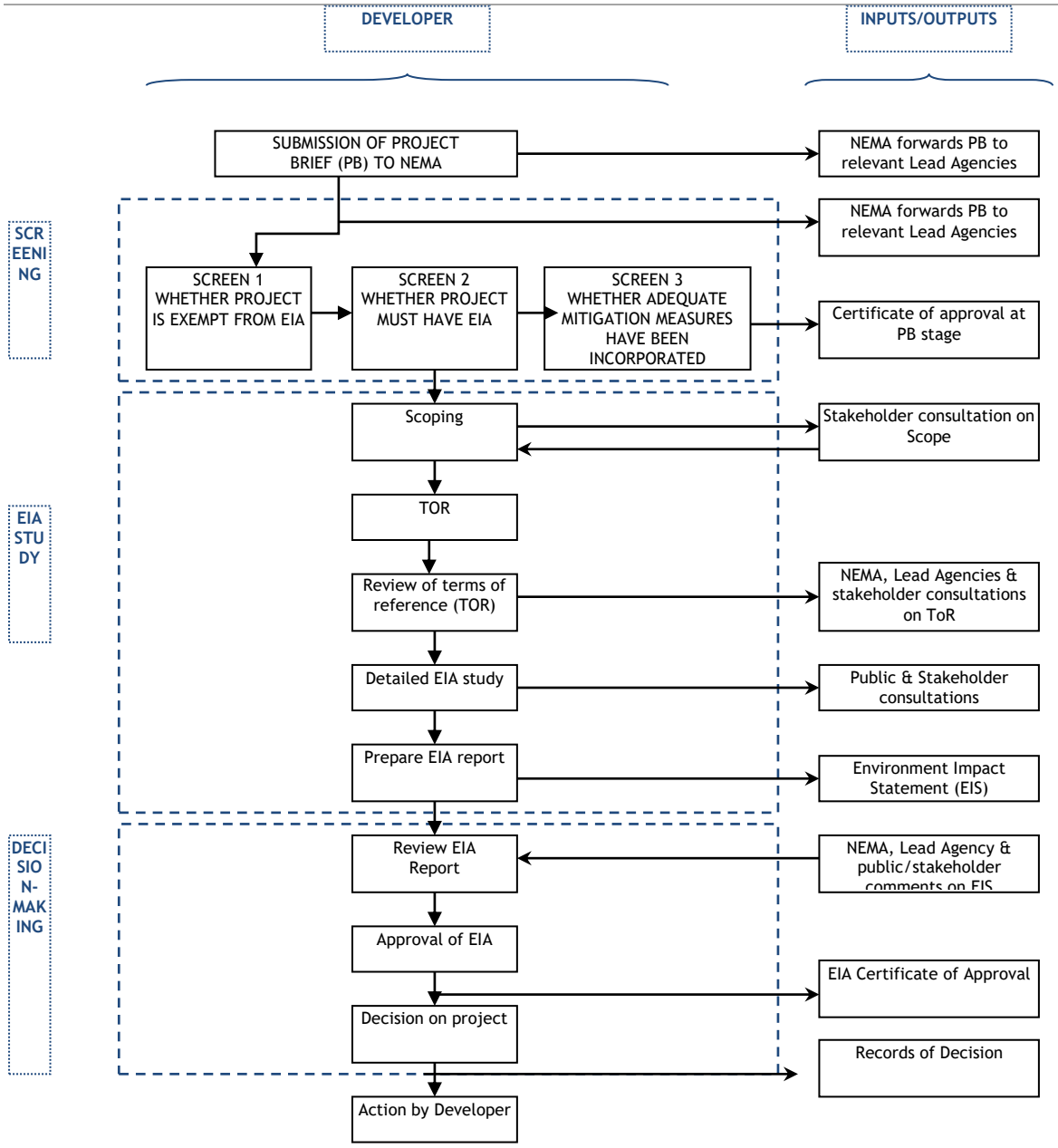

Figure 1-1: EIA Process in Uganda

2 Methodology and approach

2.1 Literature

The literature was reviewed to obtain an outlook on the need to construct and improve the proposed irrigation scheme, potentials and current conditions favouring the existence of the scheme. Also of importance was the primary and secondary baseline information of the proposed project area, the regulatory and institutional context relevant to the project, and environment. Review has also been made, of EIA studies and experiences related to irrigation projects that have been undertaken in Butaleja, mostly especially those previously done in FIEFOC-I project.

2.2 Field surveys

Field surveys included transect walks around the proposed site to undergo construction, to determine availability and spatial location of utilities, topography, site geo-physical environment to determine drainage patterns, and collecting baseline information as well as making an inventory of activities in the neighbourhood that are likely to be affected and conducting public consultations with communities within the jurisdiction of the proposed project. The studies were also used to identify the state of the environment in the area and to facilitate description of the receptor system and analyze its fate with respect to development of the project.

The range of specialist studies undertaken during the EIA phase was informed by the issues identified in the feasibility study. The specialist studies and experts used were determined by the nature of the project and applied in the process of the study accordingly. Particularly agronomist was involved with an aim to give substantive technical input regarding the nature of the project in relation to the proposed environment. Also the water engineer responsible for the scheme designs provided information which has been reflected in the formulation of the report. In addition, a sociologist was involved during the socio-economic study entailing consultation and disclosure of the project.

2.3 Consultations

Consultations with stakeholders particularly the neighbours to the proposed project, relevant government agencies (MWE) and; local authorities including but not limited to the Butaleja Natural resources officer, water engineer, Environment and Forestry officers and; the sub county officials were consulted. The mode of consultation was formal and informal interviews to ensure public participation in the Environmental Assessment study as recommended by the National Environmental Act, Cap.153, EIA Regulations 1998, and Conduct of Environmental Practitioners Regulations, 2001. The aim of these consultations was to seek the views of those likely to be affected by the proposed activity, publicize the

intended project, its anticipated effects and benefits and identify and take note of environmental concerns and views of the stakeholders at an early stage so that appropriate mitigations are incorporated into the final implementation of the project.

2.4 Impacts Evaluation

The next step was to undertake evaluation of the various significant impacts likely to be associated with the proposed project in order to integrate remedial measures in the project development and operation, and this included:-

i) Description and evaluation of the magnitude of potential environmental impacts resulting from the proposed irrigation scheme infrastructure development, and proposing appropriate mitigation measures;
ii) Development of an Environment Management and Monitoring Plan for implementation by the contractor during all development phases of the irrigation project.

The significances of the impacts were determined through a synthesis of the criteria as shown below:

Probability of occurrence: This describes the likelihood of the impact actually occurring. It can be;

Improbable: The possibility of the impact occurring is very low, due to the circumstances, design or experience.

Probable: There is a probability that the impact will occur to the extent that provision must be made thereof.

Highly Probable: It is most likely that the impact will occur at some stage of the development regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

Duration: This defines the lifetime/persistence of the impact on the subject environment as;

Temporary: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases (< 1 year).

Short term: The impact will last up to the end of the phases, where after it will be negated (1 – 3 years).

Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter (3 – 5 years).

Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient (> 5years).

Spatial Extent /Scale: evaluates the area of occurrence/influence by the impact on the subject environment

Site specific: The impacted area extends only as far as the proposed site up to a distance within 1km radius of the site.

Local: The impact could affect the whole, or a measurable portion of the nearby environment including the neighbouring residential areas up to a distance within 5km radius.

Regional: The impact could affect a large area as far as regional level (above 5km).

Magnitude/ Severity: the quantifiable effects of impacts on the environment. Does the impact destroy the environment, or alter its function.

Low: The impact alters the affected environment in such a way that natural processes are not affected.

Medium: The affected environment is altered, but functions and processes continue in a modified way.

High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Overall impact Significance: This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. Using a combination of the above criteria, the overall importance of the impact is assigned a rating of **Severe, Substantial, Moderate, Minor, and Negligible** as described in the table 2.1 below.

Table 2.1: Criteria for rating impact significance

Impact Rating	Description of Impact
Severe	i) Highly noticeable, irreparable effect upon the environment;

	ii) Significant, widespread and permanent loss of resource; iii) Major contribution to a known global environmental problem with demonstrable effects; iv) Causing mortality to individuals of a species classified as globally or regionally endangered; v) Major expedience of water/air quality and noise guidelines representing threat to human health in long and short term, causing widespread nuisance both on and off site.
Substantial	i) Highly noticeable effects on the environment, difficult to reverse; ii) Widespread degradation of resources restricting potential for further usage; iii) Significant contribution to a known global environmental problem when compared with the industry world-wide; iv) Sub-lethal effects upon a globally or regionally endangered species compromising reproductive fitness and/or resulting in long-term disruption/disturbance to normal behaviour; v) Air quality/noise approaching occupational exposure limits. Water quality parameters approaching maximum stipulated values; vi) Periodic widespread nuisance both on and off site.
Moderate	i) Noticeable effects on the environment, reversible over the long term; ii) Localised degradation of resources restricting potential for further usage; iii) Sub-lethal effects upon a globally or regionally endangered species with no effect on reproductive fitness and/or resulting in disruption/disturbance to normal behaviour but returning to normal in the medium term; iv) Elevated contribution to global air pollution problem partly due to preventable releases; v) Frequent breaches of water/air quality and noise guidelines; vi) Causing localised nuisance both on and off site.
Minor	i) Noticeable effects on the environment, but returning naturally to original state in the medium term; ii) Slight local degradation of resources but not jeopardising further usage; iii) Disruption/disturbance to normal behaviour of a globally or regionally endangered species returning to normal in the short term; iv) Small contribution to global air problem through unavoidable

	releases; v) Elevation in ambient water/air pollutant levels greater than 50% of guidelines; vi) Infrequent localised nuisance.
Negligible	i) No noticeable or limited local effect upon the environment, rapidly returning to original state by natural action; ii) Unlikely to affect resources to noticeable degree; iii) No noticeable effects on globally or regionally endangered species; iv) No significant contribution to global air pollution problem; v) Minor elevation in ambient water/air pollutant levels well below guidelines; vi) No reported nuisance effects.

2.3 Structure of the Report

The structure of the report is in conformity with both NEMA and the EIA guidelines 1998. Therefore, the main chapters of EIA report are as follows:-

Chapter 1: Background
Chapter 2: Methodology and Approach
Chapter 3: Project Description
Chapter 4: Policy, Legal and Institutional Framework
Chapter 5: Environment and Socio-Economic Baseline
Chapter 6: Stakeholder Consultation and Disclosure
Chapter 7: Grievance Redress Mechanism
Chapter 8: Impact Analysis and Punitive measures
Chapter 9: Analysis of Alternatives
Chapter 10: Environmental, Social Management and Monitoring Plan
Chapter 11: Conclusion and Recommendations

3 Projects description

The project targets commercial production and marketing of rice. This will be achieved using modern farming methods such as mechanization, water harvesting and irrigation.

3.1 Site location

The site is located in Himutu, Mazimasa and Kachonga sub-counties, Butaleja district at GPS coordinates: A-0°55′ 17.88182″N, 34°4′46.87105″E; B-0°55′26.26319N, 34°4′42.48725″E; C-0°55′44.51294″N, 34°4′29.27791″E; D-0°56′12.79255″N, 34°4′6.9425″E at an altitude of 1078 meters above sea level. The site is an agricultural setting area with extensive hectares of marshy land occupying fields of rice.

Figure 3-1: Google map for the proposed irrigation scheme site

The proposed Doho II extension is bordered by the existing Doho irrigation scheme at its southern border and the River Manafwa forms the northern border.

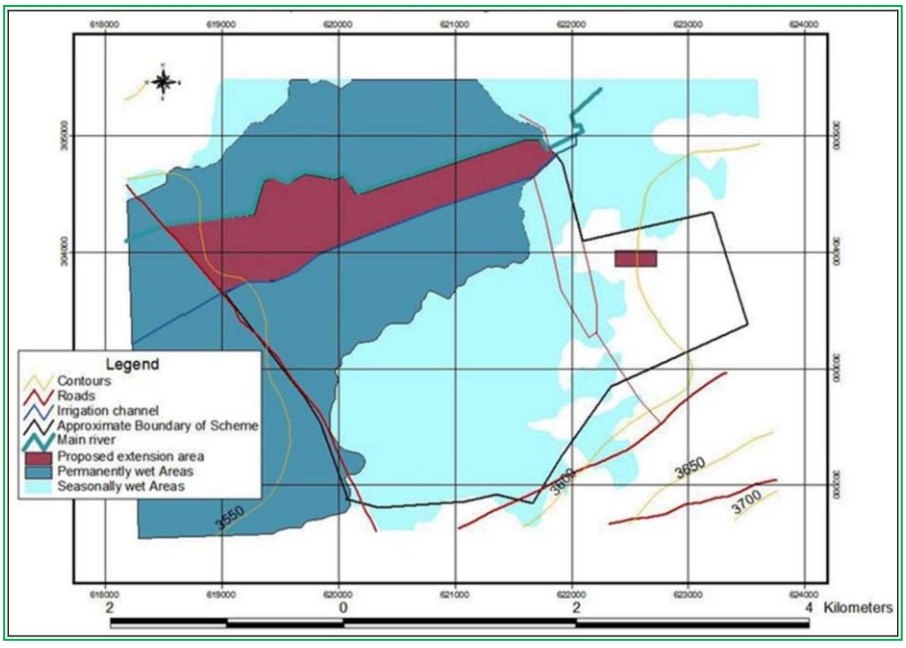

Figure 3-2: Proposed Doho Irrigation Scheme

Manafwa River borders the area proposed for the extension making it an area that will be easily and sufficiently irrigated. The extension is also within the permanently wet areas

(Uganda Biomass Shape Files). The proposed extension area is already under rice and the scheme is aimed at improving on the sufficiency of the water supply.

Figure 3-3: Photographs showing the surrounding environs of the proposed irrigation scheme




3.2 IRRIGATION AND DRAINAGE SYSTEM LAYOUT AND DESIGN

3.2.1 Irrigation system

Command area of Doho Irrigation Project has Gross command area of 1030 ha, while net area which can be irrigated with current design is 817 ha. The area was divided into two blocks those will be irrigated through MC- 1 with design capacity of 1.8m ^{3}/sec (12hr), and two secondary canals SC-1 and SC-2 with design capacity of 0.66m^3/sec (12hr) and 0.825m^3/sec (12hr) respectively. From the total 1.8m^3/sec the remaining 0.315 m^3/sec will be released to the traditionally irrigated land with approximate area of 250 ha that cannot be commanded by the current design. MC-1 has a total length of 2.504 km from Luwoba diversion.

In view of suitable climatic conditions, paddy crop is planned to be cultivated throughout the year. Therefore a continuous supply of water is required to irrigate the rice fields in different parts of the project area. Paddy will be at different growing stages in different parts of the project area. In wet season, the irrigation system will run continuously as there is no constraint of water availability in Manafwa River. However, due to no major constraint in water availability all canals i.e. the main canal, the secondary and tertiary canals will run for 12 hours and field canals may have to run in rotation.

3.2.2 Flow Control Methods

Conveyance and distribution of irrigation water to farms can be controlled by two principal methods i.e.; upstream control and downstream control. Sometimes combination of these two methods is also used.

3.2.3 Upstream Control

In this case, a predetermined amount of water is supplied to a canal from the head of the main canal. The amount of discharge delivered into the channel is determined based on the drawn up irrigation programme. The branch canals and distributaries are then fed according to the demand.

Hydraulic structures for a system with upstream control are simple with comparatively less cost. The structures are designed to maintain a constant and pre-fixed upstream water level. In this system, the discharge remains practically constant during the operation. This method of control is used when the availability of the water is limited at least during a part of the year. In the case of low flow or demand, rotational running of distributary canals is practiced and water may be supplied in turn.

3.2.4 Downstream Control

If the supply available at the diversion headwork is always greater than the demand and no restriction are imposed on the withdrawal from canals and each user is allowed to regulate his/her own supply. The effect of withdrawals is transmitted step by step to the head of the system by automatic regulators. Then the overall supply to the network is adjusted to suit the cumulative demand. The system is complex with high investment cost.

3.2.5 Recommended Practice for the Project

Upstream control has been adopted for the design of the irrigation system of the Project. The main, secondary and tertiary canals will run continuously during peak demand and water will be distributed according to the pre-determined requirements of the area to be irrigated. Head regulators have been provided on the intake structures for regulating flows and cross regulators for maintaining designed water level and adjust the supplies if required. In this way all the canals will be regulated by an upstream control. During periods of low demands, the field canals will be run by rotation.

3.2.6 Tertiary Canal Unit

Farm channel is the smallest irrigation channel for delivering water to the farm. The typical water tertiary unit has eight farm channels to supply water to farms after receiving water from secondary canal. Each farm has farm drain on one end of the farm to drain the excess water and discharge to tertiary drain. Design discharge of tertiary and field channel is selected keeping in view of the handling capacity of the individual farmer. Generally it is difficult to handle discharge more than 60 l/s by a single farmer. Therefore the discharge field channel has been adopted as 55 l/s.

Peak 10-daily irrigation requirements rate for rice crop at watercourse head has been estimated as 2.4l/s/ha. Considering the capacity of watercourse as 55 l/s, the area to be irrigated by a tertiary is 25 ha.

Farm roads of 6 m wide have been provided all around the tertiary unit for the movement of machinery and transport of goods and services. In addition, 4 m wide road has been provided inside the farm unit. The length of the farm channel has been limited to 500 m for ease of maintenance and operation requirements.

3.3 DESIGN OF IRRIGATION CANALS

3.3.1 Design Discharges

Design discharges at various levels i.e.; field, tertiary, secondary and at main canal head have been calculated by multiplying the command area of respective channel with design discharge rate and by adding losses besides system rotation was taken under consideration.

3.3.2 Hydraulic Design of Canals

Due to seepage losses and scarcity of water in the project area during dry season, the irrigation channels have been recommended to be lined to save water. For Main and Secondary Canal concrete lining has been proposed over an impermeable geomembrane. Sub-surface drainage system under the canal lining has also been provided in the entire extensive clayey reaches. For tertiary and field canals unlined earth canal was recommended. For design of canal sections Manning's formula has been used.

$$Q = A/n\ R\ S$$

Where	**Q**	**=**	**Discharge in m /sec**
	n	**=**	**Manning's n**
	R	**=**	**Hydraulic radius**
	S	**=**	**Longitudinal slope**
	A	**=**	**Cross sectional area**

Manning's "n" of 0.018 for concrete and 0.025 for earth canal sections has been adopted. The canal longitudinal slopes have been selected to ensure that flow velocities remain within the acceptable limits.

3.3.3 Water Levels

Farm elevations/levels of each farm have been calculated on the basis of topographic survey keeping minimum cut to avoid removal of top humus layer. Water depth of 0.01 m is required in the paddy field. Additionally 0.01 m has been kept to cater for variation of land

leveling within the farm. Therefore, +0.02 m water head above the farm level has been adopted for command of the farm channel.

Field channel of 300 m long with longitudinal slope of 0.001 will require additional head of 0.3 m. taking head loss in the farm turnout as 0.10 m total head form field to u/s of farm turnout is 0.4m. Accordingly the water levels in upstream direction i.e.; at head of tertiary, secondary and main canal have been calculated on the basis of longitudinal slope of the channels and adding head losses at various structures.

Additional head of 0.1 m for variation of land leveling within the farm has been taken in the present conditions, when the limited spot levels of the farm are available. During construction stage, detailed levels are available then the variation of leveling in the field can be adopted as 0.05 m instead of 0.1m.

3.3.4 Canal and Embankment Cross Sections

The proposed typical cross section of the main and secondary canal and other irrigation canals are shown in Fig. 3-4 and Fig. 3-5 respectively.

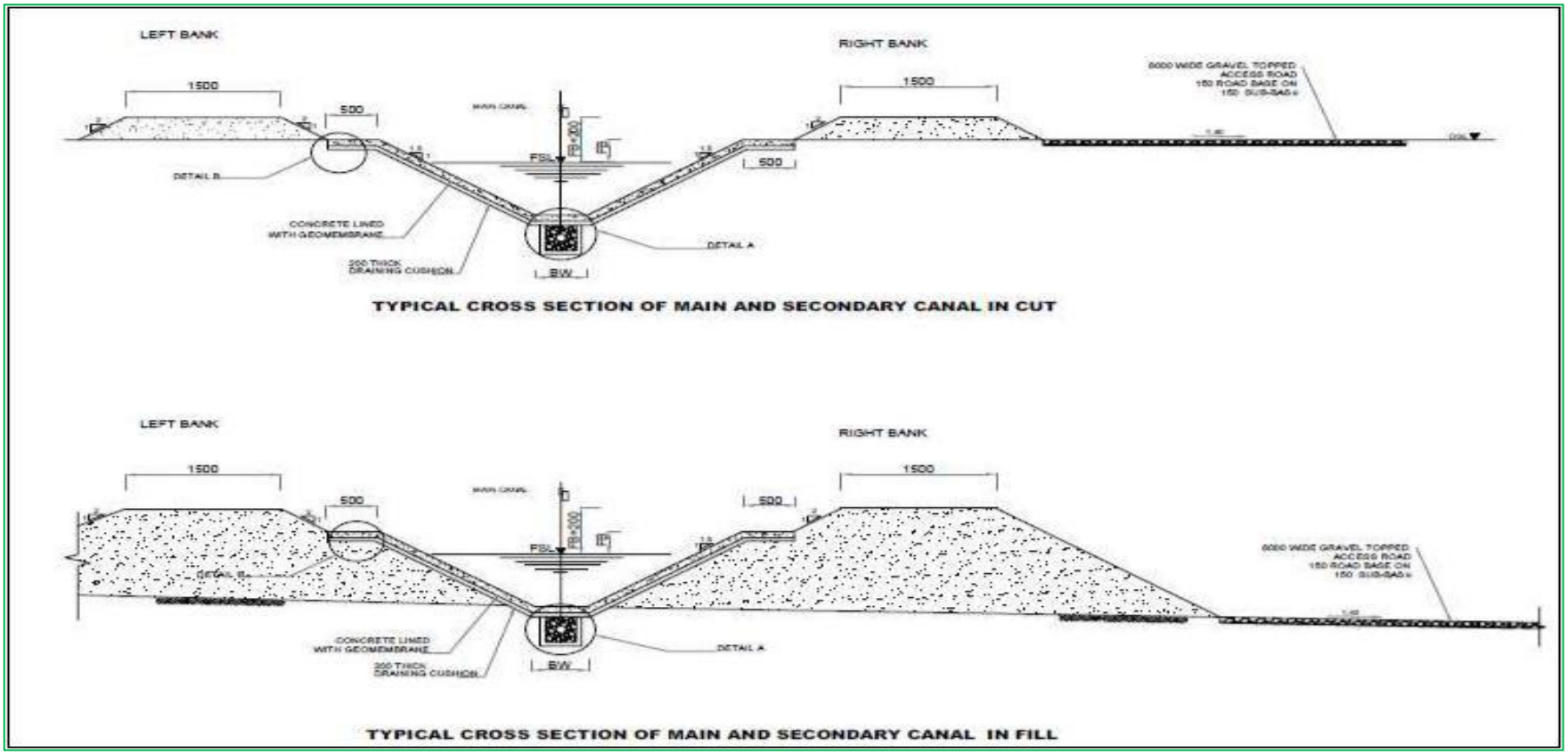

Figure 3-4: Typical Main and Secondary Canal Cross Section

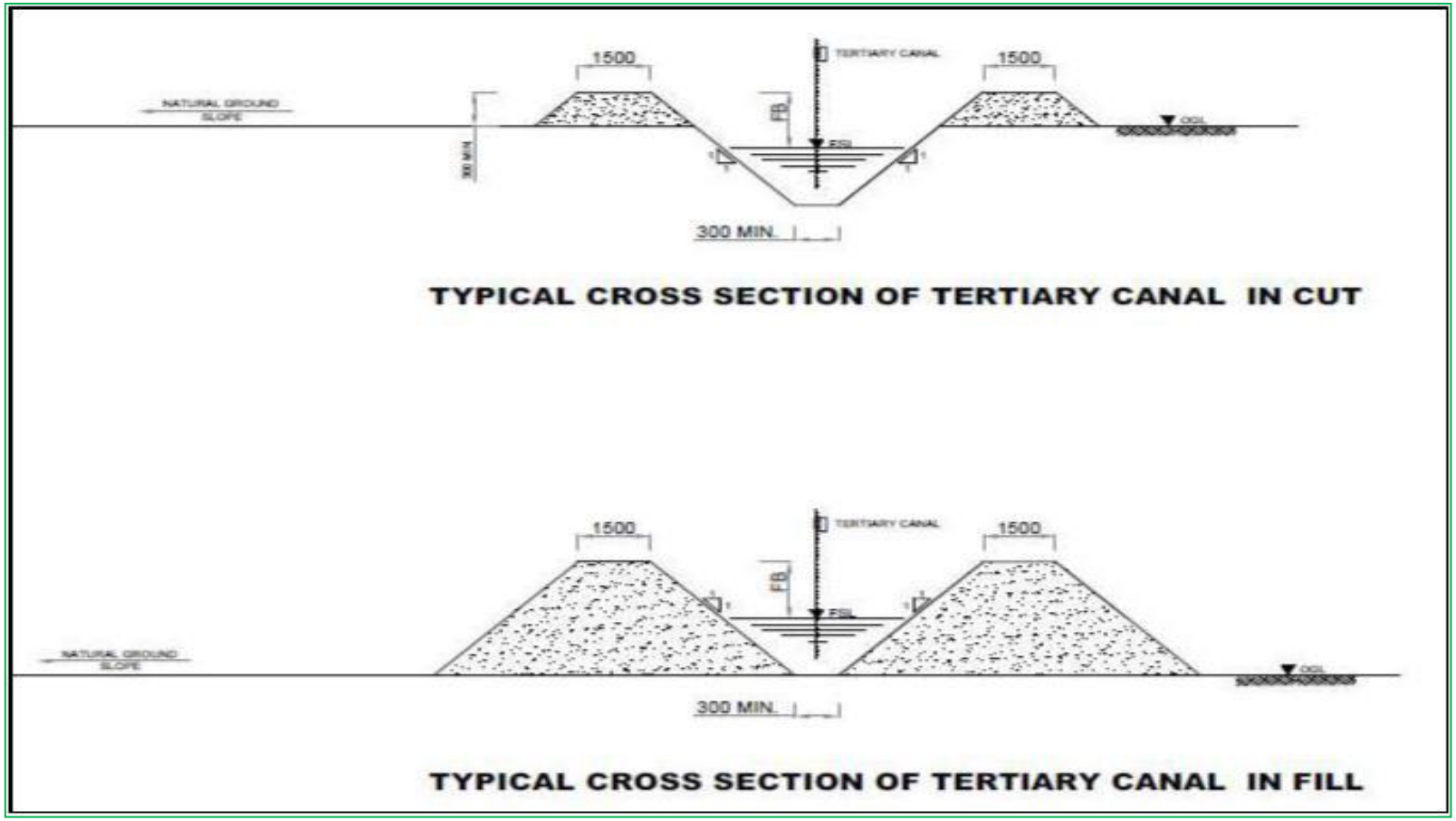

Fig.3-5: Typical cross section of tertiary canal in fill

Side Slope

Canal Side Slopes vary from 1H: 1V to 1.5H: 1V based on the geotechnical investigation as discussed in the preceding chapters.

Free Board

The following values of free board for lined and earthen section are adopted according to USBR formula.

Table 3-1: Recommended Lined and Unlined Free Board

Discharge, Q		Freeboard	
	(m^3/sec)	Lined (m)	Unlined (m)
≤ 0.25		0.15	0.2
0.25 < Q ≤ 0.55		0.15	0.25
0.55 < Q ≤ 1.10		0.15	0.3
1.10 < Q ≤ 1.70		0.2	0.3
1.70 < Q ≤ 2.25		0.2	0.35
2.25 < Q ≤ 2.75		0.2	0.4
2.75 < Q ≤ 4.25		0.25	0.4

Bed Width and Flow Depth (b/d) Ratio

The following values of b/d have been adopted for the different discharges.

Table 3-2: Recommended b/d Ratio for lined canals

Discharge, Q (m^3/sec)	b/d
0 – 25.5	1.0 – 1.1

25.5 - 28	1.1 – 1.2

Minimum Radius of Curves

All possible efforts have been made to keep the channel straight. Where it is not possible to keep the channel straight due to any reason, minimum radius of curvature has been calculated using the following formula:

$$r = 3\ W \text{ (meter)}$$

Where

W is the water surface width of the channel in meters.

Hydraulic Gradient, Bank Width and Service Road

Outer slopes of canal banks have been adopted in the light of stability of slopes and to maintain the seepage phreatic surface at least 0.3m within the toe of the embankment for canals in fill. The hydraulic gradient for the project canals has been estimated as 1 in 6.

Service Roads

For the Main canal, and any Secondary canals service roads of 8.0 m wide on the top of canal bank have been provided. 6.0 m wide road has been provided to connect the unit centers. 4.0 m wide road has also been provided in the center of each Field unit.

3.3.5 Irrigation System Layout Plan

The layout of the irrigation system for the project has been prepared on the basis of onsite topographic survey conducted. The layout has been planned to meet the following basic planning criteria of:-

i) Providing irrigation facility to maximum area with minimum channel lengths;
ii) Aligning major channels centrally on the ridges for maximum command on both sides;
iii) Ensuring minimum cut/fill requirements;
iv) Minimum need of crossing natural depressions/water ways;
v) Channel alignments are selected as to avoid the channel section being in excessive fill;
vi) Tertiary canals would be so aligned to fit into the adopted size of field unit.

In general, the entire 817 ha, has been divided into 15 tertiary units, in which each unit will cover approximately 25~50 ha. Each unit has been further divided into farm units having 3.0~4.0 ha each. Units have been made for good management of paddy cultivation. Layout plan of the Doho irrigation system is shown in Figure 3-6 below.

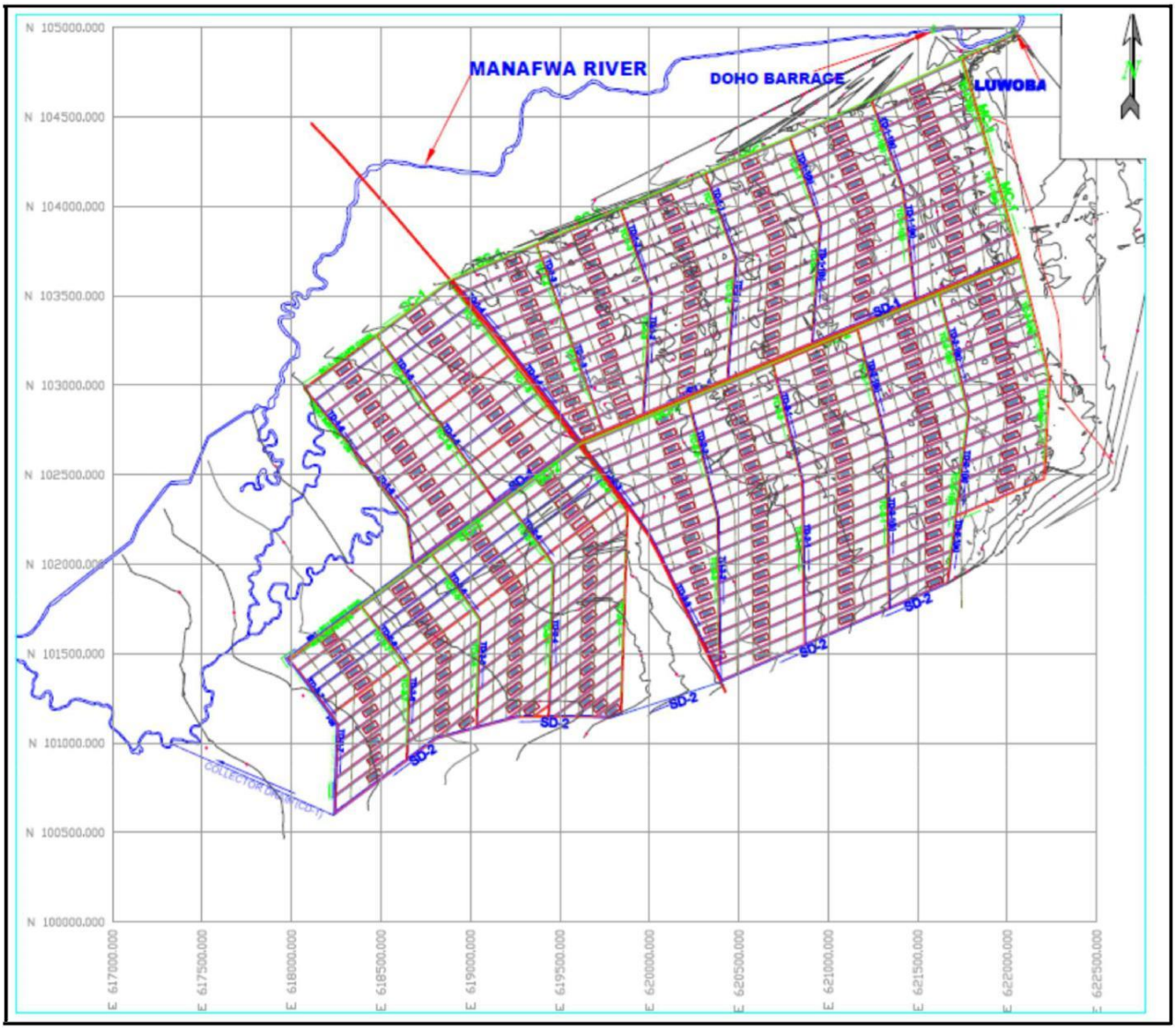

Figure 3-6: Doho Irrigation System

3.4 DRAINAGE SYSTEM

Rice crop requires a certain depth of water to be maintained in the field for best crop production. As such water standing in the field does not have any harmful effect provided the rice plant is not submerged. However, when the rice seedlings are young are liable to damage in rainy season, due to accumulation of runoff from rainfall superimposed on the already depth of standing water. Further to enable harvesting of the existing rice crop and make preparation of next rice crop, standing water from the fields have to be evacuated.

Therefore objective of the proposed surface drainage system is not only to remove excess runoff from rainfall from rice field but also to remove the excess irrigation surplus from the rice fields. As the rise in water table is not expected, therefore, only surface drainage is recommended for the project area.

For proper drainage, estimation is required for the quantity of water to be removed in a specific time period such that damage to the crops can be avoided or limited. The quantity of water accumulated depends upon characteristics of rainfall and the catchment area, while the required time in which the accumulated water must be removed depends upon the tolerance of crops to be grown in the area. Rice is the only crop for the DIP (Doho Irrigation Project); therefore design capacity of drainage system has been fixed on the basis of this crop.

3.4.1 Design Capacity of Drains

Considering the surface runoff and irrigation surplus as contributing source, design capacity of the drains has been calculated. The design capacity of the drains is based on the following parameters:

Frequency analysis of one day and two day maximum rainfall for Tororo station was carried out for selection of design rainfall;
Rainfall of 1 in 5 year return period has been used for calculating design capacity of the drains. However the drainage structures were designed 1.5 times the design discharge capacity of the drainage channel;
U.S. Soil Conservation Service Curve Number Method has been used for estimating direct runoff volume which is based on soil and cover condition of the catchment;
The design discharge rate computed by curve number method for determining the design capacity of the drains.

The discharges of the collector drains, secondary drains and tertiary drains have been computed by multiplying design discharge rate with the contributing area at the point of interest.

3.4.2 Water Levels

Generally water levels in the farm drains have been kept minimum at least 0.2m below the farm level to allow free discharge of excess water from farms into the farm drain. The water levels in the collector, secondary and tertiary drains have been fixed by the water levels at the outfall of the farm drains into tertiary drains inflowing into the secondary drains and which in turn inflow into the collector drains. Ultimate disposal of drainage water by gravity has been planned to be in the creeks of Manafwa River through outfall drains. Adjustments in water levels have been made depending upon the governing water level at their outfalls.

3.4.3 Longitudinal Slope

The slopes of the drains have been fixed keeping in view the following considerations:

i) Topography of the area;
ii) The velocity of the water increases with the water slope which will reduce the weed growth and reduce maintenance requirements;
iii) Depth of the drainage network.

3.4.4 Hydraulics of Open Drains

The open drains carry free surface flow. Although there are quite a few relationships available for designing this type of channels, Manning's equation has been considered to yield good results. The Manning's equation is

$$V=1/n\ R^{2/3}\ S^{1/2}$$

Where: V= velocity in meter/second

n= Manning's roughness coefficient of the channel

R= hydraulic radius in m, which is the area divided by the wetted perimeter S= hydraulic gradient, which is longitudinal slope of the channel.

3.4.5 Manning's Roughness Coefficient "n

The value of Manning's 'n' has been based on the condition which is expected to prevail some years after the construction of the drains as with the passage of time weed growth and deterioration of the drain increases the resistance to flow. Therefore, a value of 'n' as 0.025 has been adopted for the design.

3.4.6 Design Velocity

The velocity in the drains shall be non-scouring and non-silting. The maximum permissible velocity for an open drain depends upon the texture of the soil through which the drain passes.

Table 3-3: Recommended Velocity

Soil type	Velocity
Clay	1.22
Sandy Loam	0.76
Fine Sands	0.46

Source: *United States Bureau of Reclamation (USBR) Drainage Manual First Edition (1978)*

Topography of the area is the major factor in setting the longitudinal slope of the drain, which in turn determines the velocity in the channel. The topography of the area is relatively flat. The bed slopes have been selected to follow the general topography of the area to avoid excessive cut and fill however, a minimum adopted slope is 1 in 1000 and the resulting velocities have been checked in order to remain within the above prescribed limits.

3.4.7 Side Slope

Drain side slopes are determined by the stability of the soils through which the drain is constructed and by the maintenance method that will used be for its maintenance of the drains. The depth of cut in surface drains is expected to be in the range of 0.35 m to 2 m. keeping in view the soils of the project area it is proposed to design the drains for 1H: 1V side slope.

3.4.8 Drain Section

Approximately bed width to depth ratio of 1:1.0 has been adopted in the design. The minimum bed width will be 0.3 m. The proposed cross section of the farm drains is smaller which suits to the farmer's implements for construction and will not hinder normal farming operations. Other parameters as bank height, bank width, berm width, side slope etc. are shown in the typical sections of the drains.

3.4.9 Radius of Curves

Keeping in view the topography of the area and velocity in the drains, the minimum radius of curves for drains has been calculated using formula:

$$r = 3\ W$$

Where W is the water surface width of the channel in meters

Where a drain runs alongside a surfaced road, the radius of curve is controlled by the minimum radius required by the road.

3.4.10 Drainage Layout

Surface drains are designed to remove not only the surface runoff from rainfall but also tail escape discharge, excess rainfall and irrigation surplus from water watercourse units at early growth period, when the seedlings are young and prior to harvesting. During early growth period seedlings are liable to be submerged in case of heavy rainfall and need drainage. Fields must be at the field capacity at the time of harvesting so that the machinery can move and clear the land for timely sowing of next crop.

3.5 DESIGN FLOODS

For Doho project flood frequency analysis approach was used to determine the annual peak flow of the site. Flood frequency analysis considered the annual peak flows at site for all the years. The method gives the magnitude of peak flood at the desired recurrence interval or return period. So it is carried out in order to obtain estimate of the 1,000 years return period flood peak at the project diversion point. Table 3-4, present the frequency analysis results of different frequency analysis distributions and the results gain by Log-Pearson III is preferred due to its best fitting for this project.

Table 3-4: Flood frequency analysis in different frequency distribution for Doho River

Return period	Extreme Value I	Gamble	Log-Normal	Log-Pearson III
2	33.30	49.18	44.06	51.78
5	55.32	77.60	71.07	76.21
10	69.90	94.01	91.27	90.49
20	83.89	108.40	112.20	103.66
25	88.33	112.74	119.16	107.78
50	101.99	125.53	141.55	120.35
100	115.56	137.50	165.26	132.74
200	129.07	148.86	190.42	145.05
500	146.90	163.15	226.10	161.24
1000	160.38	173.53	255.04	173.47

3.6 FLOOD MODELING

The Doho Irrigation Project is considered as one of the most promising areas for rice production. The preliminary study of the flood protection works mainly focused on the identification of flood problems and forwarding alternative possible solutions with regard to the proposed schemes.

The Watershed Concepts hydrologic and hydraulic analysis of the Manafwa watershed was performed in order to investigate various alternatives to lessen the effects of flooding at the irrigation area. The stream reaches that were studied by detailed methods are listed in Table 3-5.

Table 3-5: Stream Reaches Studied by Detailed Methods

Stream Name	Upstream Limit	Downstream Limit	Length (Km)
Manafwa	-	D/S of Command Area	18.3

3.7 HYDRAULIC DESIGN

Different types of structures are essential in any irrigation and drainage system to effectively and efficiently convey, regulate and drain the flows and to protect the system from storm runoff damage. For this project, the hydraulic structures have been categorized as conveyance, regulating and protective structures. The conveyance structures include all the inline canal structures like water crossing, falls, road culverts. The regulating structures are cross regulators, head regulators on main and secondary canals; pond inlet, outlet and spillway structures on the night storages. The structures dividing the flow in secondary, tertiary and Field canals though regulate the flow in a broader sense but have been termed as flow division structures. These structures can also be used as flow measurement structures provided ratings curves are developed for ease of operation. The protective structures which externally protect the canal from storm water have been referred as interceptor drain and the structures which internally safeguard the canal from the excess canal have been named as escape structures.

This section briefly describes the approach used for the design of these structures.

3.7.1 Design of main and secondary canals

Manning's formula has been used for the design of lined main and secondary canal. The various parameters adopted for the design are described hereunder. All analysis and design have been affected in S.I. units.

3.7.2 Values of Manning's Roughness Co-efficient "n"

The coefficient of roughness "n" for the lined canal has been adopted as 0.018 for aged concrete.

3.7.3 Decision of Lining Main and Secondary Canals

The decision of lining of the main canal is based on the character of the material forming the canal cross section. More the permeability of the material, the more justifiable is the decision of lining. Based on the geotechnical investigation, the main canal has been divided into following four reaches on the basis of measured permeability values:

Table 3-6: Permeability values of Main canal (MC-1)

Description	Location	Soil Type	Average Permeability
		Fine grained brown	Coefficient k (cm/s)
All Reach	km 0+000 to km 0+676	MUD	$2.2x10^{-4}$

Based upon permeability data alone, canal lining would have been required in all reaches. Nevertheless, the final decision on canal lining was taken in a special design meeting held on March 16 -17, 2016 at Ministry of Water and Environment; by taking into account the hydraulic efficiency of lined and unlined section as well as the relative cost and risk trade-off. It was decided that lining would be of plain concrete and geo-membrane shall also be provided along with longitudinal drainage under the canal on the basis of investigations. The more details regarding geotechnical investigation and provision of drainage under the canal can be found in the chapter on Geotechnical Investigations.

The thickness of the lining has been fixed as per recommendations of U.S. Bureau of Reclamation. For the Main and Secondary canals having discharge up to 14.75 cumecs, the thickness of plain concrete lining has been kept as 75 mm. To avoid the cracks in the lining, the joints at appropriate distance have been provided in line with the recommendations of U.S. Bureau of Reclamation.

3.7.4 Discharge Capacities

The design capacities of the main canal, branches, distributaries, minors and watercourses have been determined on the basis of crop water requirements for the rice plus losses in the reaches. The details on the design capacities of irrigation canals are well detailed above.

3.7.5 Freeboard

Freeboard for the lined main and secondary canal has been adopted on the basis of guidelines provided by U.S. Bureau of Reclamation for different ranges of design discharges. The table 3-7 below shows freeboard for lined and unlined parts of the canal prism derived from these guidelines is as under:

Table 3-7: Recommended Freeboard for Lined and Unlined Canals

Discharges	Height of Bank above FSL	Free board	
		Lined	Unlined

< 0.25	0.35	0.15	0.20
0.25 < Q < 0.55	0.40	0.15	0.25
0.55 < Q < 1.10	0.45	0.15	0.30
1.10 < Q < 1.70	0.50	0.20	0.30
1.70 < Q < 2.25	0.55	0.20	0.35
2.25 < Q < 2.75	0.60	0.20	0.40

3.7.6 Side Slope

A slope of 1V:1.5H has been found safe for main/secondary canals on water side of the canal. It has been evaluated that slopes of 1V:1.5H can safely be adopted of outer slopes of the canal for embankment having heights up to 4.0 m. For a very few cases where embankments height exceeds 4.0 m, either the slope needs to be flattened or the benching of slope should be considered.

3.7.7 Minimum Radius of Curvature

The minimum radius of curvature for canals constructed in less erosive soils, as recommended by FAO (1988) has been adopted as 5 and 8 times the water surface width in the canal; the lower limit being applicable for canals conveying less than 5 cumecs. A radius of curvature equal to 7 times the water surface width has been adopted for main and secondary canals.

3.7.8 Bed-Width Ratio

The irrigation canals design parameters like bed slope and geometry have been fixed in such a way that the bed to width ratio is maintained to achieve a hydraulic more efficient and cost effective section of the channel. The guidelines set by USBR have been adopted that recommends a bed width to depth ratio of 1.0 to 1.1 for discharges up to 25.5 cumecs.

3.7.9 Permissible Velocities

Higher velocities up to 2.5 m/s can be safely allowed in lined channels. However, keeping in view the project area terrain and other constraints, velocities in the range of 0.5 to 0.85 m/s has been used in the design of main and secondary canals.

3.10 DESIGN OF TERTIARY CANALS

Manning's formula has been used for the design of unlined tertiary canal. The various parameters adopted for the design are described hereunder. All analysis and design have been affected in S.I. units.

3.10.1 Values of Manning's Roughness Co-efficient "n"

The coefficient of roughness "n" for the lined canal has been adopted as 0.025 for earth canal.

3.10.2 Discharge Capacities

The design capacities of the main canal, branches, distributaries, minors and watercourses have been determined on the basis of crop water requirements for the rice plus losses in the reaches.

3.10.3 Freeboard

Freeboard for the unlined tertiary canal has been adopted on the basis of guidelines provided by U.S. Bureau of Reclamation for different ranges of design discharges. For DIP freeboard of 0.3m was taken considering different aspects of the project area.

3.10.4 Side Slope

A slope of 1V:1.0H has been found safe for tertiary canals on water side of the canal.

3.10.5 Bed-Width Ratio

The irrigation canals design parameters like bed slope and geometry have been fixed in such a way that the bed to width ratio is maintained to achieve a hydraulic more efficient and cost effective section of the channel. The guidelines set by USBR have been adopted that recommends a bed width to depth ratio of 1.0 for discharges up to 0.5 cumecs.

3.10.6 Permissible Velocities

Higher velocities up to 0.9 m/s can be safely allowed in unlined canals. However, keeping in view the project area terrain and other constraints, velocities in the range of 0.5 to 0.6 m/s has been used in the design of tertiary canal.

3.11 DESIGN OF HYDRAULIC STRUCTURES

Design of hydraulic structures has been broadly divided into surface flow analysis and sub-surface flow analysis. The surface flow analysis of the hydraulic structure is meant to fix the dimensions of the structure and the external stability of the structure affected by surface flow phenomenon is ascertained. The internal stability of the hydraulic structure prompted by piping or undermining and direct failure by uplift pressure resulting from head across has been dealt under the sub-surface flow analysis. The need for flexible protection works necessitated by surface or sub-surface flow residual energy is also dealt in the section.

3.11.1 Surface Flow Analysis

The waterway or dimensions of the hydraulic structure depending upon its peculiar setting in the system have been determined whether the structure would behave as broad crested weir, sharp crested weir or orifice etc.

Broad Crested Weir Formula

For the structures behaving as broad crested weir, the following formula has been used:

		$Q \; C_d \; B \; H^{3/2}$
Where,		
Cd	=	**Coefficient of Discharge (Cd = 1.70 in SI units)**
B	=	**Crest Width of the Structure**
H	=	**Head over the Crest**

The value Cd has been modified depending upon submergence ratio. Gibson's curve has been used to calculate the reduction in coefficient of discharge value.

The effective crest width of the structure, B has determined by taking into account abutment contraction coefficient as suggested by US Corps of Engineers: Hydraulic Design Criteria.

Orifice Flow Formula

The flow through the structures openings could also behave as orifice flow. For such flow conditions, the following orifice formula has been used:

$$Q \quad C_d \; A \; \sqrt{2g(h \quad ha)}$$

Cd	=	**Discharge Coefficient (Cd=0.62 SI Units)**
A	=	**Orifice Flow Area**
g	=	**Acceleration due to gravity (g=9.81 m/s^2)**
h	=	**Head Across**
ha	=	**Velocity head**

3.11.2 Energy Dissipation Structure

The "energy dissipating structures" is usually restricted to those facilities which convert super-critical flows to the sub-critical range. An energy dissipating device of almost universal application in open channel systems is the hydraulic jump stilling basin. The primary emphasis is to outline the principles governing the design of hydraulic jump, stilling basin and to establish detailed application of these principles as they apply to the design of hydraulic structures.

3.11.3 Hydraulic Jump

The form of hydraulic jump and its effectiveness as an energy dissipater varies over a considerable range. Experimental work by the United States Bureau of Reclamation (USBR) has shown that a convenient parameter by which the difference can be distinguished is the Froude number of the flow immediately upstream of the jump. The Froude number F = V/(g D)1/2 being a measure of the degree to which the flow velocity may exceed critical velocity, has been used to determine the type of stilling basin required for a particular structure. The reference has been made to USBR Engineering Monograph 25: Hydraulic Design of Stilling Basins and Energy Dissipators. The basic data required for the design of stilling basin are the discharge intensity, the energy to be dissipated (drop) and the tail water level.

Several factors considered regarding the energy dissipation requirements are as follows:-

i) The head losses required over the design flow operating conditions;
ii) The jump should generally form on the sloping glacis, but shall never be permitted to sweep out of the basin;
iii) If downstream retrogression in anticipated, the energy losses for the ultimate regime condition must be considered as well as those of the initial design condition.

The cross sectional flow area of the structures is rectangular and the stilling basin is of the same width as the contiguous structures. Accordingly, the design of those structures has been accomplished on unit width basis. Froude number for incoming flow has been calculated by the relationship:-

		F	**V**
			gy
And	**q**		**= V_1 y_1**

The sequent depth y_2 is given by the formula:-			
Y_2	=	$y_1/2$	$[(1+8F^2)^{1/2} - 1]$

The bed elevation of the stilling basin is theoretically set by matching the conjugate depth to the tail water elevation. To provide adequate margin of safety, the bed level of stilling basin shall be set at 1.10 times computed sequent depth below the tail-water level. The length of stilling basin has been taken as the full length of jump. To determine the position of jump and stilling basin level various approaches based on the basic hydraulic jump equation have been used.

3.11.4 Sub-Surface Flow Analysis

Whenever a hydraulic structure is founded on alluvial soil foundations, it is subjected to seepage water beneath the structure. The water seeping below the body of the hydraulic structure may endanger the stability of the structure and cause its failure either by piping or by direct uplift.

3.11.5 Failure by Piping or Undermining

When the seepage water retains sufficient residual head at the emerging downstream end of the work, it may lift up the soil particles. This leads to increased porosity of the soil by progressive removal of the soil from beneath the foundations, and the structure may fail by the formation of voids. In order that the soil particles at exit remain stable, the upward pressure at exit should be safe. The limit of exit gradient depends on soil texture and its permeability. The exit gradient generally ranges from 1/5 to 1/7 for a structure to be safe.

The depth of the downstream end cut- off or pile line controls the exit gradient, which has been worked out with Khosla's Exit Gradient Equation: -

		GE	H			1	
			d				
Where							
H	**=**	**Total**	**head across the structure under worst**				

	Conditions in feet.		

		$\frac{1}{1+\frac{1^2}{}}$
	=	**b/d**
b	=	**Total length of floor**
d	=	**Depth of downstream cut-off / sheet pile line in feet.**

3.11.6 Failure by Direct Uplift

The water seeping below the structure exerts an uplift pressure on the floor of the structure. If the pressure is not counter-balanced by the weight of concrete or masonry floor or by the moment of resistance of concrete section in case of RCC floors, the structure will fail by rupture of a part of the floor. Cut -off of sufficient depth are needed both on upstream and downstream of the hydraulic structure to ensure the structure stability.

The hydraulic structures for the project have been designed for the uplift pressure as calibrated from the flow nets (exponential lines) established in Khosla's theory. The values of the uplift pressures determined by Khosla's method of Independent variables refer to the join of sheet pile line with the floor surface. These values have been corrected for the thickness of floor; slope of the floor and for mutual interference of plies.

3.11.7 Failure by Uplift Due to Formation of Jump on Downstream Apron

The failure due to the uplift pressure also occurs in the region of the trough of the hydraulic jump formed downstream. The thickness of floor as determined by standing wave considerations has been checked, where considered necessary.

3.11.8 Flexible Protection Works

Flexible protection has provided upstream and downstream of the hydraulic structures to prevent a scour hole moving close to the upstream apron floor or to the stilling basin floor. Flexible protection essentially forms a fairly cheap first line of defense against under undermining and failure of a structure. The flexible protection has been provided in accordance with the following criteria;

3.11.9 Scour Depth Calculation

The Lacey's empirical formula has been used to compute the depth of scour.The design scour depth below bed level is given below:

Design Scour Depth, D = XR - Y (SI Units)

Where: **X**=scour factor dependent on type of reach (see table below)
Y = design depth of flow (m)
R= 1.35 $(q^2/f)^{1/3}$

q = the maximum discharge per unit width ($m^3/s/m$)

Length of Launching Apron **f**= Lacey's silt factor
Minimum lengths of stone aprons are as follows:

Length = 1.25 D (upstream)

Length =1.50 D (downstream)

Where, D is the scour depth below the channel bed.

Stone Size and Thickness

USBR (USBR-1983) recommends the following formula for determining the size of stone rip-rap:

		$D_{50} = [$	$\frac{V_{av}}{4.915}$	$]^2$
Where:		**V_{av}**= average velocity of flow for maximum discharge (m/s)		
		D_{50}=average stone size (m).		

3.12 CONVEYANCE STRUCTURES

The conveyance structures for this particular project include all the inline canal structures viz; falls cross drainage or storm water crossings, road culverts. A brief of the methodology or approach adopted for design of each structure category is described in the following sections.

3.12.1 Fall Structures

The criteria to design a fall structures either as vertical or glacis type has been based on the USBR guidelines given in Canals and Related Structures; Design Standard 3. Vertical fall or drop structures have been provided at the locations where maximum vertical fall in water surface is 1.5 meter for discharge of 2.0 cumecs or less. All other falls beyond this limit will have to be designed as glacis type fall structure.

3.12.2 Vertical Drop Fall

In this type of fall the energy of the flowing water is dissipated by means of impact and sudden deflection of velocity from vertical to horizontal direction. A water cushion is provided at the toe of the drop, so as to reduce the impact of the falling jet and thus to save the downstream from scour. The water cushion is formed by depressing the floor below the downstream bed of the channel.

3.12.3 Road culverts

Road culverts have been provided at the locations where existing road cross the canal. The carriage way of the structure has been kept as per existing track requirements. The waterway for the canal under these road culverts has been provided by taking account of various losses and balance of the energy equation. To accommodate the losses, a head loss across the structures has been provided.

3.13 REGULATING STRUCTURES

The structures providing the control of flow across the irrigation system have been termed as regulating structures. These structures are cross regulators, head regulators, pond intake and outlet structures on main, secondary and tertiary canals. The structures dividing the flow in the system though regulate the flow in a broader sense but have been termed as flow division structures. These structures can also be used as flow measurement structures provided ratings curves. A brief method of design for each type of regulating structure is given as under:

3.13.1 Head Regulator and Cross Regulator Structures

To provide control of flow and to regulate flow in various higher order canals and then into the lower order canals, structures across the canal has been provided. The cross regulator structures also include free flow spillway structure for storage ponds, gated orifice type pond intake and head regulator for branch canals. A minimum of 0.25m head across the structure has been provided. The design procedure adopted for the cross regulator along the main canal and secondary canals is as under:

The waterway for the structure has been fixed by taking into account abutment coefficient and drop in water surface profile for full design discharge.

The change energy due to in water surface elevation in the canal profile has been taken care of by providing stilling basins for containing hydraulic jump.

The internal stability of the structure related to sub-surface flow conditions has been designed for worst condition i.e. upstream water level at design discharge and downstream is empty. The downstream and upstream cutoffs have been provided to meet the exit gradient criteria.

3.14 GATE EQUIPMENT DESIGN

Only one type of gate equipment i.e; sliding gate have been recommended for regulation and control of canal water for this project. Sliding type gates with hoist are provided at cross regulators of main and secondary canals, whereas simple slide type gates are provided at the head regulators and flow division structures, and farm turnouts at various lower order canals. Each gate equipment comprises gate leaf, embedded parts and hoisting system.

3.14.1 Design Standards

The names of the main standards under which the gate equipment has been designed are given below:

American National Standards Institute	**ANSI**
Federal Specifications Board	**U.S. Fed. Spec.**
United States Bureau of Reclamation	**USBR**
International Organization for Standardization	**ISO**
National Bureau of Standards	**NBS**

3.15 Project Proposed Activities

The project activities will follow the project routines which will include pre-construction activities, construction activities and finally operations and maintenance activities.

Detailed surveys and investigations activity involving road alignment and condition survey, detailed topographical survey, detailed soils, materials investigation and infrastructure have been undertaken for effective implementation of this project. Furthermore, sites or sources for construction materials such as gravels and stones can be agreed to be the existing ones unless the existing sources are depleted. In case there will be need to opening new borrow

pits and quarries, the contractor will have to make all necessary arrangement for land acquisition in accordance with Uganda laws and independent EIAs and Project Briefs should be conducted before mining of murram begins. The assessment also considers both positive and negative impacts of the project and proposes mitigation measures for the negative impacts.

The pre-construction activities also include the economic analysis. This stage will also involve mobilization of the construction human resources, construction equipment and plant, construction materials and erection of workers' camp. At this stage, wastes (solid, liquid and gaseous) will be generated from construction of camp. The staff camp like any other domestic place will generate garbage, packaging, sacks, papers, cardboard boxes, plastic, wood crates, bottles, glass, metal cans and the like. Such wastes will need to be segregated for recycling or incinerating at site.

3.15.1 Cut to spoil material

The setting out of the road works and its general civil works within the irrigation scheme is anticipated to generate huge Volumes of Cut to Spoil Materials that will need to be disposed off. This EIA cannot with certainty establish the quantities of such materials. However during project implementation, the contractor in liaison with the district environment officer will select a suitable site for dumping these huge quantities of cut to spoil materials.

Table 3-8: Types, amounts and treatment/disposal of wastes during the construction phase

Waste	Type	Estimated quantity	Treatment/Handling
Solid waste (Degradable)	Vegetation (existing trees, grass and other vegetation types).	About 300m³ of the biomass	Source of energy for residents within the jurisdiction of Doho scheme.
	Food remains, papers and other domestic waste	20kg per day (based on generation rate of 0.1kg/per/person for 200 people	Collected in a large skip bucket at campsite then disposed off by licensed waste collection company/ District.
Solid waste (Non-Degradable)	Top-soils	13cm³ (Based on removal of 10cm top soil from the (5x25.2.5) m² area on both sides of the proposed roads.	Backfilling material in the borrow pits, fill the diversions
	Scrap metals, drums, tins plastics	15kg per day	Sold to recyclers
Liquid waste	Used oil and grease	20litres per-day depending on vehicle servicing	Collected in drums at the mechanic workshop then collected by suppliers or NEMA licensed hazardous waste collection company.
	Sewage	4m³/day (Based on 200 people per day water consumption	Septic tank-soak way system at the campsite and mobile toilets on site.

Transportation

Materials (fine and course aggregates) from quarries will be transported by trucks to the construction sites. Water will be moved by water boozers. Other materials like cement, timber and reinforcement bars will be transported by Lorries to the construction site.

Storage

Some of the materials from borrow pits will be used directly after delivery and as such no piling up is expected. Other materials like aggregates and sand will be stored at the backyard of the camp site/office ready for use. Cement and reinforcement bars will be stored in special storage rooms.

3.16 Required offsite investments

The road and infrastructure construction activities at the scheme are going to require various locally available building materials. Such locally available materials required include aggregates, gravel or crushed stone, sand, water etc.

3.16.1 Construction materials

Concrete Aggregates

The granitic/gneissic aggregates that were found are located in Mbale district close to Mbale town were a functional quarry exists and also hand crushed aggregates are available at the same location. The quarry is called Blue Stone Quarries in Namagumba, Mbale district on UTM Coordinates 634177E, 127430N.

A quarry of hand crushed granitic stone is located on the Mbale –Tororo highway at Waale village, Busiu Sub county Mbale district on UTM Coordinates 626270E, 102492N.

Sands

Coarse and fine sand in vast quantity are situated in Miyaya village, Mazimasa Sub County, Butaleja District on UTM Coordinates 616726E, 105342N.

Road Wearing Course

The gravelly like formations that were being used for the road wearing course were already rejected by the road construction company that was leveling the Butaleja roads so no location for the obtaining of road wearing course material was found close by.

Clay

Fatty Clay soil is available within the Irrigation area on UTM Coordinates 668126E, 167560N within an area of radius of about 30m to a depth of 2m.

Water

The Manafwa river waters are heavily laden with the brown mud load from the mountain near to the scheme. This load is gradually deposited along the river course and clearer water eventually emerge near the River crossing along the Mbale –Butaleja highway at UTM Coordinates 610155E, 102846N. The Contractor shall be required to comply with the Water policy, 1999 and the water Act, Cap 152 through applying for the water abstraction permit from the Directorate of Water Resource Development (DWRD) for sustainable use and protection of the water resource to be used during all construction activities.

3.17 Workers Camps, Machine Workshops and Equipment Yards

A workers' camp, machine maintenance workshop and equipment yard need to be identified by the Contractor as the Design Consultant did not establish this. The exact location is a responsibility of the contractor and choice will be based on environmental considerations. Butaleja District Local Government have reasonable infrastructure, commercial and worship areas to offer acceptable living conditions to construction workers. Before and during irrigation scheme construction activities, the contractor will provide required necessities at the workers' camp. The camp should have Ventilated Improved Pit (VIP) latrines at a ratio of 1 stance per 5 employees.

The camp is projected to generate about 0.1 kg of wastes per person per day leading to an estimated quantity of 10 kg per day for a camp occupancy of 40 -100 workers. Most local labourers are expected to commute from home hence this waste estimate could be lower than actual operational volumes. For onsite waste collection and temporary storage, bins will be provided to ensure onsite segregation into recyclable and non-recyclable streams.

A maintenance workshop and equipment park yard will be established adjacent to the workers' camp. The site will be equipped with a temporary office block, maintenance bays, parking yard and materials store.

3.17.1 Demobilization Phase

At this stage, when scheme construction works are finished all construction equipments such as bulldozers, excavators and the like will be shifted to another site or rather to storage place. Similarly, structures like workers camps, workshops; stores for different materials will also be dismantled, packed and transported to their appropriate place. However, various wastes will be generated during this stage of which the same methods used to manage waste for previous phases will apply. These will include solid wastes from packaging materials, wood and steel crates, cardboard, wrapping materials, boxes, sacks, drums, cans and chemical containers and any other unused materials. Along with this, upgrading for damaged areas will be carried out before commissioning the project.

On the other hand wastewater will also be generated, mainly emanating from storage tanks for petroleum products and maintenance workshops. Other wastewater sources include work camps, and runoffs crossing hydrocarbon contaminated areas. As this wastewater can cause detrimental effects to the surrounding environment, conventional wastewater treatment systems such as septic tank and soak away pit will be employed to ensure safe and proper onsite disposal of.

After the project closure, temporary workers especially unskilled ones will have to resume to their normal business.

3.18 Operational Phase Activities

3.18.1 Proposed project operation activities

Upon the first development activities, the irrigation scheme operation activities are a continous process since it involves harvesting of the planted rice and replanting for the next seasons. Upon harvesting of one season, the process will begin again for the next season. Crop production is a rotational process as illustrated below:

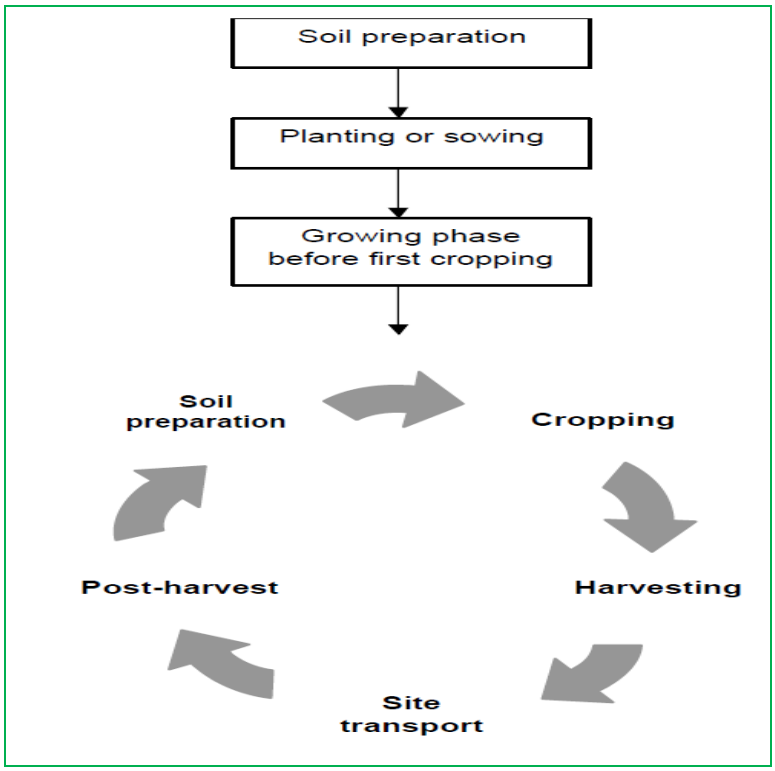

Figure 3-7: Typical crop production cycle

The operation phase activities include mainly the following activities:-

3.18.2 Nursery preparation and transplanting

Wet nursery will be established in a part of main field to prepare seedlings in these years. Nursery period is estimated to be at 3 to 5 weeks in this area. Farmers will be trained to employ line planting method.

3.18.3 Pest and disease control

The most serious diseases in rice are rice blast and yellow mottle virus. About a half of rice growers use agro-chemicals to control those diseases. About 29 % of farmers do not care about pest and disease control so much. Bird scaring is commonly done by young boys during ripening period.

3.18.4 Weeding

Timely weeding will be practiced to reduce population of weeds with minimum labor input. For instance, only 1 time weeding at about 3 weeks after transplanting is enough for 4-month rice varieties. Proper control of water level in plots is another way to reduce weeds, i.e., deep water prevents growth of most kinds of weeds.

3.18.5 Harvesting

Upon maturity, the rice will be ready for harvesting. The harvesting at the scheme will employ manual labour. The harvested rice will be sun dried at the proposed facilites prior to packaging for sale. Some of the seeds will be kept and used for replanting for the next seasons.

3.19 Project Maintenance

The Project Support Officer (PSO) at the scheme should have intensified training on on-farm water management. More so, farmers should be trained on various water management patterns. This will promote coexistence since various water users will be efficiently served both at the scheme and downstream. There should be training on crop husbandry in order to have a good return in terms of quantity and quality to the farmers. In addition, the area PSO should implement all the conditions well stipulated under the water abstraction permit issued by Directorate of Water Resources Development (DWRD) so as to optimize water abstraction and further avoid water wastage.

3.19.1 Project Management

The management of the project (Project Implementation Unit) will involve decision making for irrigation water allocation among the various water users especially the upstream versus the downstream users. Waters sources may also have to be managed through the conveyance of water to the farmers, water distribution to farmers, water allocation and application and the removal of the surplus when it is necessary. There is need to effectively follow all the conditions well stipulated under the water abstraction permit issued by DWRD

so as to avoid water wastage as well as conflicts that might arise between the upstream and downstream users.

4.0 Policy, Legislation and institution framework

The consultancy team reviewed and assessed the conformity of the proposed development to existing relevant Ugandan legislation, policies, and guidelines that have direct bearing on FIEFOC-II. The section also briefly describes some of the African Development Bank Safeguards polices applicable to the project, the following laws and regulations will be put under consideration and observed for the smooth implementation of the project.

Table 4.1: Policy, Legislation and institution framework

Policy	Relevance

4.1.1 The Constitution of the Republic of Uganda, 1995	The Constitution of the Republic of Uganda, 1995 is the main legislation body in the country. It offers, "every Ugandan the right to clean and healthy environment (clause 39) while at the same time expects citizens to play their part in creating a healthy environment. According to the Constitution, "It is the duty of every Ugandan to create and protect a clean and healthy environment" (clause 17j). The Constitution provides that the State shall "stimulate agricultural, industrial, technological and scientific development by adopting appropriate policies and enactment of enabling legislation." It also provides that the state shall "take appropriate steps" to encourage people to grow and store adequate food." It bestows responsibility for management of the agriculture sector with the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). One of MAAIF core functions is formulation, review and implementation of policies, laws, regulations, plans and strategies for the agriculture sector. For that matter therefore the project implementing authority should work hand in hand with MAAIF to comply with all the conditions within the constitution.
4.1.2 National Environment Act of 1995 Cap 153	The National Environment Act of 1995 Cap 153 is the main law relating to the protection of the environment in Uganda. The Act provides for various strategies and tools for environment management, which also include EIA (Section 19) for projects likely to have significant impacts on the environment. The Act imposes a mandatory duty on a project developer to have an Environmental Impacts Assessment conducted before embarking on a project. The Third Schedule of the Act made under section 18 of the Act lists the types of the projects to be subjected to EIA, including large-scale agriculture and flood protection. The NEMA was created under the NEA and is mandated with the responsibility to oversee, coordinate and

	supervise environmental management in Uganda, including the review of environmental impact assessments carried out for various projects. The EIA for the proposed project has been conducted as well stipulated by the Act.

4.1.3 The Water Act, Cap 152	The Water Act, Cap 152 of 1995 provides for the management of water in Uganda under the mandate of the Directorate of Water Resources Management in the Ministry of Water and Environment. Section 31, subsection (1) of the Water Act deals with prohibition of pollution to water and stipulates that a person commits an offence that, unless authorized under this Act, causes or allows:- a) Waste to come into contact with any water; b) Waste to be discharged directly or indirectly into water; and c) Water to be polluted. Under section 107, the Water (Waste Discharge) Regulations (1998); the Water Supply Regulations (1999) and the Sewerage Regulations (1999) have been put in place in order to implement this Act and are aimed at minimizing pollution of public waters by developers and other users. To abide by this Act, Water Users association shall be formed to promote equity to all farmers using Manafwa river (upstream and Downstream farmers)
4.1.4 The Land Act, Cap 227	The Land Act, Cap 227 of 1998 provides that the Government or the local government shall hold land in trust for the people and protect natural lakes, ground water, natural streams, wetlands and any other land reserved for ecological purposes for the common good of the citizens of Uganda. A local government may, upon request to the government, be allowed, to hold land in trust for the people and the common good of the citizens of Uganda. Sections 43, 44 and 45(1) and (2) of the Land Act (1998), provides that national or local government may acquire land in accordance with the provisions

	of Article 26 and clause (2) of Article 237 of the Constitution of the Republic of Uganda. A person who owns or occupies land shall manage and utilize the land in accordance with the National Environment Act, Cap 153 and any other laws binding. Part III sections 43, 44, and 45 specifically address the utilization of land in accordance with the various statutes and acts of environmental concern, which include the National Environment Act, The Water Act, and any other law. In addition section 45 addresses the control of environmentally sensitive areas.

4.1.5 The Local Government Act, 1997	The Local Government Act, 1997 provides for decentralization and devolution of Government functions, powers and services from the central to local governments and sets up the political and administrative functions of local governments. The local governments are responsible for the protection of the environment at the district level. This therefore, implies that local governments shall be consulted on projects to be located within their areas of jurisdiction and on matters that affect their environment. The Local Government Act, 1997 sets out the decentralization of functions, powers, responsibilities and services to Local Governments. Issues to do with WfAP are the responsibility of the Production sector in collaboration with the Department for Water. During project implementation, district technical staff shall be involved at every level for the smooth running of the project.
4.1.6 The Occupational Safety and Health Act, 2006	The Occupational Safety and Health Act, 2006 consolidate, harmonize and update the law relating to occupational safety and health and repeal the Factories Act of 1964. It makes provisions for the health, safety, welfare and appropriate training of persons in work places. The application of this act will be critical during the re-establishment phases as well as during the operation and maintenance of the irrigation project.
4.1.7 Water Act, Cap 152	The objective of the Act is to enable equitable and sustainable management, use, and protection of water resources of Uganda through supervision and coordination of public and private activities that may impact water quantity and quality. Section 18 requires that before constructing or operation of any water works, a person should obtain a permit from Water Resources Management Directorate (WRMD). Irrigation scheme project is herein defined to include alteration, improvement,

	maintenance and repair of water systems. The Act also aims to control pollution of water resources (Sections 28 and 31). This Act is specifically applicable to one aspect of the proposed scheme project which will divert the river to access different sections of the gardens. Different canals will be constructed within the scheme.

4.1.8 Environmental Impact Assessment Regulations, 1998	The procedures for conducting EIAs and guidelines for EIA practitioners and regulatory bodies are stipulated in this document. The regulations require a detailed study to be conducted to determine the possible environmental impacts, and measures to mitigate such impacts. At the end of the study, the environmental assessment report is submitted to NEMA to take a decision as to whether to approve or reject the project. The Guidelines also stipulate that the EIA process should be participatory, that is the public should be consulted widely to inform them and get their views about the proposed investment. The developer has the legal obligation to seek the views of the public, persons that may be affected by the proposed project, as well as all other stakeholders. In this case, key stakeholders have been consulted in the course of the study and their views have been integrated into the study (See section 6).
4.2 Policy Framework	
4.2.1 The Plan for Modernization of Agriculture	The Plan for Modernization of Agriculture (PMA) is a multi-sectoral policy framework for agriculture and rural development, is responsible for shaping the policy environment for agriculture in Uganda over the past eight years or so. The PMA pillars include: - research and technology development; national agriculture advisory services; rural finance; agro processing and marketing; agricultural education, physical infrastructure and sustainable natural resource utilization and management. The PMA outlines the national agricultural goals and priorities (Uganda Government, 2010). Linkages with PMA interventions have been used in designing recommendations for this project.
4.2.2 The National Environment Management Policy, 1994	The National Environment Management Policy, 1994 is the cornerstone of Uganda's commitment to socio-economic development that is

	environmentally sustainable and brings the benefits of a better life to all. The National Environment Management Policy gives the overall policy framework, which calls for sustainable development that maintains and enhances environmental quality and resources productivity to meet human needs of the present generation without compromising ability of future generations to meet their own needs. The policy sets a guiding principle that Environmental Impact Assessment should be required for any activities which may cause significant impact on the environment. In response to the guiding principle of the policy, EIA has been conducted to with a well articulated ESMP highlighting all the potential impacts of the project.

4.2.3 The National Wetland Conservation and Management Policy	The National Wetland Conservation and Management Policy requires the preparation of Environmental Impact Assessment and Audit procedures for all activities to be carried out that will have an impact on a wetland (s). Furthermore, the policy aims at maintaining an optimum diversity of uses and users and consideration for other stakeholders when using a wetland.
4.2.4 The National Water Policy, 1999	The National Water Policy, 1999 aims at promoting an integrated approach to manage the water resources in ways that are sustainable and most beneficial to the people of Uganda. It stipulates that the quality of drainage water shall be such as not to pollute the receiving water or ground water and that all measures must be taken by the users to prevent increase in salinity levels in receiving waters, to prevent the accumulation of dangerous or toxic compounds in the subsoil, capable of contaminating underground waters.
4.2.5 The National Environment (Riverbanks, Lakeshores and Wetlands) regulations, 2000	The National Environment (Riverbanks, Lakeshores and Wetlands) regulations, 2000 provides a list of regulated activities whose implementation in wetlands is subject to issuance of a Permit granted by NEMA in consultation with the Lead Agencies. These include, among others, cultivation, drainage, commercial exploitation, sewerage filtration, fish farming and aquaculture. Environmental Impact Assessment is mandatory- under the statue-for all activities in the wetlands, riverbanks and lakeshores and special measures are essential for protection of these ecosystems.
4.3 Institutional Framework	
Institution	**Role and Responsibilities**

4.3.1 The Ministry of Water and Environment	The Ministry of Water and Environment (MWE) is the principal Executing Agency for FIEFOC-II project and will be responsible for the overall monitoring and management of the project during both construction and operation, including ensuring the implementation of the mitigation and enhancement measures and adherence to Uganda's environmental regulations and the Bank's Operational Safeguards. Other institutions that will be directly and indirectly involved in the implementation process include the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), the Uganda National Environmental Management Authority (NEMA), the Ministry of Finance, Planning and Economic Development (MFPED), Ministry of Gender, Labour and Social Development, and the Ministry of Local Government (MLG).
4.3.2 The National Project Coordination Unit	The National Project Coordination Unit (PCU) established under FIEFOC-Phase 1 and housed in the MWE will coordinate the activities of all institutions. The PCU shall have 1 or 2 environmental and social safeguard specialist(s) (recruited or appointed by the MWE) who will monitor and manage the implementation of the ESMP. The functions of the specialists will include working with consultants and reviewing reports as well as ensuring that safeguard decisions are adequately mainstreamed. They will also participate in monitoring and evaluation exercises.MWE/PCU, in liaison with District Local Government, the Ministry of Works, Directorate of Water Resources Development, Department of Water Resources Management, Wetlands Management Department, the department of Occupational Health and Safety (MGLSD), Civil Society and the Farmers' Organization will undertake regular environmental, social, safety and health inspections. A monitoring committee is proposed, comprising the above stakeholders to undertake quarterly environmental

	and social monitoring of project implementation.
4.3.3 The National Environmental Management Authority	The National Environmental Management Authority (NEMA) will be responsible for review, comment and overall approval of the ESIA/ESMPs reports for the proposed irrigation scheme. Once approved, NEMA will issue Conditional Approval Certificates for the ESIA for the proposed construction and operation of the irrigation scheme.
4.3.4 Butaleja District Local Government (BDLG)	Since the proposed irrigation scheme is within the jurisdiction of Butaleja district (Himutu, Mazimasa and Kachonga sub-counties), the technical staff of this respective district will participate in the monitoring and enforcement of the environmental regulations, provision of extension services, and; mobilization of communities, sensitization and capacity building activities. The District will designate a Project Support Officer (PSO) among its staff, who will support the implementation and technical supervision of the Project, including sensitization of farmers, training, and monitoring and evaluation. More so, the district environment officer will be responsible for ensuring the compliance of all the project components in line with relevant regulations and conditions during construction and the operation of the irrigation schemes. The district environment officer will relay environmental and/or social concerns on the project to NEMA for technical guidance. These selected district officers will report periodically to the MWE/PCU on all issues related to the irrigation scheme activities including environmental and social safeguards.

4.4 PERMITS AND LICENCES

For effective project execution, the assigned contractor in liaison with the client will be required to secure a list of permits and licenses before commencement of any on-site work:

Table 4-2: Permits/License required by proposed development

Permits/License	Issuing Agency	Use	Responsible Party
Environmental approval ESIA certificate	NEMA	Approval commencement of the EIA study	MWE
Water abstraction permit	Water Resources Management Directorate, (WRMD)	Abstraction of water during road construction activities.	Contractor
Hazardous waste storage license	NEMA	Onsite storage of hazardous waste (e.g. used oil)	Contractor
Petroleum construction permit and petroleum operating license	Petroleum Supply Department, Ministry of Energy & Mineral Development	Transport, onsite storage and dispensing petroleum fuel during construction activities of the irrigation scheme	Contractor

4.5 African Development Bank's Environmental and Social Safeguard Policies

The African Development Bank's Strategy for 2013-2022 emphasizes the need to assist regional member countries in their efforts to achieve inclusive growth and transition to green growth. In addition, the Bank is committed to ensuring the social and environmental sustainability of the projects it supports.

The Integrated Safeguard System (ISS) is designed to promote the sustainability of project outcomes by protecting the environment and people from the potentially adverse impacts of projects. The safeguards aim to (i) avoid adverse impacts of projects on the environment and affected people, while maximizing potential development benefits to the extent possible; (b) minimize, mitigate, and/or compensate for adverse impacts on the environment and affected people when avoidance is not possible; and (c) assist borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks

The Bank requires that borrowers/clients comply with these safeguards requirements during project preparation and implementation. The Integrated Safeguards Policy Statement sets out the basic tenets that guide and underpin the Bank's approach to environmental safeguards. In addition, the Bank has adopted five Operational Safeguards (OSs), limiting

their number to just what is required to achieve the goals and optimal functioning of the ISS:-

Table 4.3: African Development Bank's Environmental and Social Safeguard Policies

Operational safeguards	Relevance

4.5.1 Operational Safeguard 1: Environmental and Social Assessment	This overarching safeguard governs the process of determining a project's environmental and social category and the resulting environmental and social requirements. The FIEFOC-II project activities include the construction and use of irrigation infrastructures that may likely have significant environmental impacts such as loss of vegetation, soil erosion, pesticide use, wetland degradation and increase in waterborne diseases. These risks will be managed through implementation of mitigation measures elaborated in site specific Environmental and Impact Social Assessment (ESIA)/Environmental and Social Management Plans (ESMP).
4.5.2 Operational Safeguard 2: Involuntary Resettlement: Land acquisition, population displacement and compensation.	This safeguard consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and incorporate a number of refinements designed to improve the operational effectiveness of those requirements. The proposed irrigation schemes will not require land acquisition or resettlements. The scheme will be sited on lands owned by the community who are the direct beneficiaries of the proposed project, and as such there is no likelihood of a change in land status at this stage.
4.5.3 Operational Safeguard 3: Biodiversity and ecosystem services	This safeguard aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management in operational requirements. FIEFOC-II project activities will be implemented on existing irrigated/farm land; hence degradation of natural habitats (wetlands and natural vegetation) is not anticipated from a modified habitat.
4.5.4 Operational Safeguard 4:	This safeguard covers the range of key impacts

Pollution prevention and control, hazardous and control, hazardous materials and resource efficiency	of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow. The FIEFOC-II project interventions may likely intensify the use of agro-chemicals including pesticides needed to enhance productivity. Sustainable agronomic practices will be promoted to farmer groups including the preparation of Pest Management Plan to promote integrated pest management. Soil and water quality will be monitored during construction phase of the project as per requirements of country's regulations.
4.5.5 Operational Safeguard 5: Labour conditions, health and safety.	This safeguard establishes the Bank's requirements for its borrowers or clients concerning workers' conditions rights and protection from abuse or exploitation. It also ensures greater harmonization with most other multilateral development banks. The Contractor shall comply with the Labour laws and Best Practice Occupational Health and Safety requirements.

4.6 International Conventions

4.6.1 United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC or FCCC is an international environmental treaty produced at the UNCED, informally known as the Earth Summit, held in Rio de Janeiro from June 3 to 14, 1992. The objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Uganda having ratified this convention and putting into consideration the nature of the proposed project, there is an apparent need to ensure all the activities to be undertaken at the proposed irrigation scheme live within the carrying capacity of the environment and to avoid the emission of potentially atmospheric debilitating gases.

4.6.2 The Kyoto Protocol

The Kyoto Protocol is an international agreement linked to the UNFCCC. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas emissions, these amounts to an average of five per cent against 1990 levels over the five-year period 2008-2012. The major distinction between the Protocol and the Convention is that while the Convention encouraged industrialized countries to stabilize GHG emissions, the Protocol commits them to do so. Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities." Observance to this protocol will influence future potential funding. There should be adherence to minimal carbon emission levels during the all phases of project implementation.

5.0 Environmental and Social Baseline Conditions

The description of the environment surrounding the project area is an integral part of an EIA Study. The impacts arising from the activities of a project are primarily felt by the immediate surroundings. The pertinent aspects of the surrounding environment are physical, biological and the socio-economic. The physical, biological and socio-economic aspects of the existing environment in the vicinity of the project site are described in this section. It provides the basis upon which impacts from project activities would be assessed.

5.1 Location

The area is located outside of the existing Doho Irrigation Scheme inside Manafwa wetland system of Butaleja district. The Manafwa Wetland System is categorized as a permanent wetland at its center, surrounded by peripheral seasonal wetlands. These peripheral wetlands appear during the months of April to May and July to August rains. The wetland is basically formed from the Manafwa River basin system.

The river in this wetland originates from Mt. Elgon and flows southward in the flat terrain of Butaleja district before it joins Namatala swamp and drain to Kyoga Lake System. Manafwa swamp covers an estimated area of about 84sq.km of Butaleja district.

The wetland area is one of the extensively developed areas of within Butaleja district for the production of paddy farm through Doho Rice Irrigation Scheme established by the government of Uganda through the support from Chinese Government. The scheme is managed by a government entity formed solely to operate and maintain the system and the farm communities living close to the scheme are producing rice on this scheme on the basis of renting the developed land. Furthermore, the farmers downstream of this scheme use tail water of the scheme for the production of rice on their land. Presently, more out grower of rice is established outside the existing Doho Rice Irrigation Scheme. Sometimes, there is conflict between the two beneficiaries on the distribution of water from the river.

This problem was solved through the provision of intake structure (barrage) upstream of the intake for Doho Irrigation Scheme Phase I funded by AfDB. The new intake structure is equipped with distribution of river water, proportionally, to the Doho Irrigation System and outside producers.

Flooding in the period between April and August is the major problem in the lower plains of the wetland. The absence of flood mitigating infrastructure like dyke upstream and along the River Manafwa means the problem is becoming serious annually. The flood protection dyke that was installed long time ago along River Manafwa was destroyed and never rehabilitated. Crops in field, homes and property are destroyed every year during flood period. The people are yet to appreciate the concept of wet lands and river banks in the district. Especially given that this comes with a price to pay in terms of surrendering portions of land that are used as settlements and cultivating rice. There is a constraint on

land and resources which are not available at the district level to resettle the households living in the low laying areas of Kachonga, Mazimasa, Himutu, Butaleja and Butaleja town council which are prone to floods and related effects. However, the coming of Doho Phase II is viewed as one way of reducing flood problems within the already highlighted sub-counties.

5.1.1 Target Project Area by District

The target project area is located inside Butaleja district covering three sub-counties; namely: Himutu, Mazimasa and Kachonga sub-counties. It lies approximately between latitude 0°55` and 1°00`North and Longitude 33°55`East and 34°10`East.

The recently available information collected from UBOS indicates that Butaleja district has 9 sub-counties, one town council, 67 parishes and 397 villages/wards. The breakdown of the administrative division is presented in Table 5-1 below.

Table 5-1: Number of Administrative Divisions in the Target District

District	Number of Sub County/TC	Number of Parishes	Number of villages/ward
Butaleja	10	67	397

5.1.2 Target Project Area by Sub-Counties

The target irrigation scheme is located inside Himutu, Kachonga and Mazimasa sub-counties, which has a total of 19 parishes and 138 villages covering a total land area of 162.4sq.km. Table 5-2 shows the administrative division of the target area of the project.

Table 5-2: Administrative Division of the Project Area

District	Target Sub County	Number of Parish in the Sub-county	Number of villages in the Sub-county	Sub-county Area (km2)
Butaleja	Himutu	6	26	58.6
	Kachonga	6	46	50.4
	Mazimasa	6	66	53.4
Total		**19**	**138**	**162.4**

Source: UBOS and DDP of Butaleja and Bumalimba district, 2010/2011-2014/2015

5.1.3 Target Project Area by Parishes and Village

Administratively, the target project area covers 6 parishes inside three sub-counties and the proposed planned irrigation scheme development is located inside the 6 parishes covering around 10 villages out of the 40 villages found inside these parishes of the target three sub-counties. Table 5-3 below shows the target sub-counties and parishes inside Butaleja District.

Table 5-3: Parish level Administrative Division of the Project Area

District	Target Sub	Target Parish	Number of Village	Number of Target

	County			Village
Butaleja	Himutu	Kanyenya	5	2
		Wangale	4	1
		Kangalaba	6	3
		Kaiti	6	1
	Kachonga	Namunasa	8	3
	Mazimasa	Doho	11	1
Total		**6**	**40**	**10**

5.2 Socio-Economic Condition of the Project Area

5.2.1 Target Beneficiary of the Scheme

The target area covers three sub counties and 6 parishes. The total population in the three target sub-counties is estimated to be 76,842 of which 35,008 are male and 41,836 are female comprising of 16,567 households. The breakdown of population per each parish inside Manafwa sub-county is presented in Table 5-4 below.

Table 5-4: Demography of the Project Area per Parish

Target Sub-county	No. of Parishes in the Sub-county	No. of Villages in the Sub-county	Demography			
			HH	Male	female	Total
Himutu	6	28	2577	6964	7348	14310
Kachonga	6	48	7530	12396	17636	30032
Mazimasa	7	67	6460	15648	16852	32500
Total	**19**	**142**	**16,567**	**35,008**	**41,836**	**76,842**

Source: Butaleja District Planning Department, Hearing from Sub-counties officers

Out of the total people living inside the three target sub-county a total of 3,376 households (or about 21,232 people) live inside the target six parishes (Namely; Kanyenya, Wangale, Kangalaba and Kaiti in Himutu sub-county, Namunasa in Kachonga sub-county and Doho in Mazimasa sub-county) distributed over ten villages of the target area. The detail demography and estimated beneficiaries of this scheme is presented in the following table (Table 5-5)**.** In the determination of the beneficiaries of the project two approaches were adopted. The first approach assumed the household living inside each target villages is considered as direct beneficiaries of the project and presented in the table below as

"**Estimated Beneficiaries (HH)[3]**" . On the other hand, in the second approach the result of household survey is used to determine the beneficiary of the planned irrigable area.
According to the result of household survey, the farmers in Sironko area has on average 1.6acres per household. Using the average size of acreage and the planned irrigable area of this project the total beneficiaries of the project is calculated and presented in the table (Table 5-5) as "**Estimated Beneficiaries (HH)**".
The difference in the size of project beneficiary determined using the above two approaches can be explained as that the beneficiaries of the project are not limited to the villages inside the project area.

In the project area it is customary that farmers from other neighboring villages also utilize the wetland either through land rental basis or through understanding to use the communal land as member of the community

Table 5-5: Demography and Estimated Beneficiary of the Project Area

TargetSub-County	Target Parish	Number of Villages	Number of Household (HH)	Estimated Beneficiaries (HH)3	Planned Irrigation Area (ha)	Estimated Beneficiaries (HH)
Himutu	Kanyenya	5	339	88	178	444
	Wangale	4	456	132	264	659
	Kangalaba	6	651	314	704	1754
	Kaiti	6	598	99	16	41
Kachonga	Namunasa	8	656	218	249	623
Mazimasa	Doho	11	676	50	14	49
Total	**6**	**40**	**3376**	**901**	**1428**	**3570**

Source: DDP of Butaleja district 2010/2011-2014/2015

5.2.2 Economic Activity of the Area

Agriculture forms a base of the mainstream economic life of the people. The area still has vast land which if well harnessed can form a strong economic base. The major economic activities include; semi-intensive agriculture, fishing, trade and commerce, transport, stone quarrying, sand mining. The existence of Doho rice Irrigation Scheme in the area helps the farmers to engage more in rice production inside Manafwa swamp. The agricultural production is characterized by small land holdings with major cash crops as rice and cotton. The area also grows millet, beans, sweet potatoes, sorghum, cassava, yams, maize and rice for food crops. Livestock include cattle, goats, sheep, pigs and poultry.

5.3 Social Infrastructure

5.3.1 Education

Both government aided and private education facilities are available which are distributed throughout the target are. There is a total of 24 UPE aided primary schools, 23 private primary schools, five secondary schools in the target three sub-counties. The schools are distributed throughout all the parishes with some parishes having two primary schools. There are also many schools in the neighboring sub-counties or district which can be accessible to the communities in the project area. The breakdown of educational institution found in the target project area per each sub-county is presented in 5-6 table below.

Table 5-6: Numbers of schools in each sub-county of the Project Area

District	Target Sub-county	Number of School			
		Primary School		Secondary School	
		Government	Private	Government	Private
Butaleja	Himutu	6	5	1	0
	Kachonga	8	14	1	0
	Mazimasa	10	4	2	1
Total		**24**	**23**	**4**	**1**

5.3.2 Health

In the target project area there are five health centers of which one is private hospital, three are HC II and one is HC III. There are also many private clinic or drug stores in all the trading centers. The list of these health centers are tabulated in Table 5-7. Malaria has remained the leading cause of morbidity and mortality especially in the under fives with prevalence at 79%. HIV/AIDS is on the rise more especially among married couples thus increasing the risks of mother to child HIV/AIDS transmission. The increasing unregistered training institutions, quack health service providers, negative cultural beliefs and practices affect the health seeking behaviour resulting into failure of clients seeking the right treatment at the right time.

Table 5-7: Number of Health facilities in each sub-county of the Project Area

District	Target Sub-county	Number of Health Center		PrivateClinic/Hospital
		HC II	HC III	
	Kachonga	1	1	NA

	Himutu	0	0	NA
	Mazimasa	2	0	1
Total		**3**	**1**	**1**

Source: Development Plan of all sub-counties

5.3.3 Access road

The project area generally has relatively high road network, in terms of length, compared to other area of the country. However, except for few kilometers of all-weathered roads, most of the road networks are inaccessible during rainy season, especially those areas found inside swamp. The existence of Doho Irrigation Project helps the target area to have more road network.

5.3.4 Water Supply

The source of portable water to the communities living in the project area is stream, spring, tap stands and borehole. According to the information collected from sub-county district development plan, there are over 77 boreholes, 7 protected spring, and many tap stands which supplying portable water to the community. The breakdown of water supply points in the project area is shown in table 5-8 below. In addition, every year each sub-county receive budget from district for drilling of, on average, two boreholes.

Table 5-8: Breakdown of water supply facilities inside the Project Area

District	Target Sub-county	Number of Boreholes		Spring + RWH + HDW
		Functional	Broken	
District	Kachonga	45	NA	7
	Himutu	NA	NA	NA
	Mazimasa	32	9	NA
Total		**Over 77**	**Over 9**	**Over 7**

Source; DDP of Butaleja
RWH = Rainwater harvest; HDW= Hand dug well

5.3.5 Other infrastructure

The target sub-counties have many trading center where the community uses as market out-let for their produce. Since the area is predominantly producing rice, there is at least one rice-milling-machine at each trading centers. Most of these machines are privately owned and some of them are seasonal or mobile depending on the intensity of rice production in the area. There are also many milling machine to produce millet and maize flour.

5.4 Physical Condition of the Area

5.4.1 Topography

The topography of the project area is generally characterized as flat plain with very few dotted rocky hills. The flat terrain of the area makes it suitable for large scale mechanized agricultural activity without risking severe run-off of the top soil. The huge flood water originated from Manafwa River brings fertile soil to the low lying land of the area despite its devastating nature to the crops and houses in the area.

5.4.2 Geology

The proposed extension of the Doho II Irrigation Scheme is to be located in Butaleja District of east Uganda adjacent to the already existing irrigation scheme. The rocks found around Doho comprise the basement complex that are of Precambrian age. The rocks are metamorphosed and consist of undifferentiated gneisses.

The scheme is situated in the basin of the Manafwa river which carries along with it heavy loads of volcanic sediments which have, over time, been deposited in this area. Doho area is affected by its proximity to the Elgon Mountains which is a large low angle volcano of tertiary age. The volcano consists of fossiliferous sediments and or tuffs below or within the basal volcanics. The sediments accumulate in basins, troughs and valleys and consist of nephelinites, Melilite, Phonolites, Trachytes and Trachyandesites, coarse pyroclastics and agglomerates. These are released into the River Manafwa flowing out of the Mountain and deposited along the river banks in the form the brown recent sediments known as the Bugisu series that now overlie most of the areas close to the river. The Bugisu series have a maximum thickness of 253m comprising of two sub-series, the upper being a series of mud flows only and the lower sediments of arenite rudites and calcareous types

5.4.3 Vegetation Cover

The project area is predominantly covered with grassland and woodland with very few bushes. The bulk of the area is covered with cultivated land and wetland. The tree cover is diminishing through human deliberate activities like animal grazing, construction, cutting of grass and trees for firewood and bush burnings.

Figure 5-1: Some of the vegetation with the jurisdiction of the scheme area

5.4.4Flora/ Vegetation

Indigenous fauna in wetland converted in agricultural land are replaced by macrophytes such as crops like rice, coco yams and sugar cane, banana, maize. Raphia, *Cyperus rotundos*, Vossia, Pragmites, Macdonald eye, Spear grass, Typha, Black Jack, water lilies, remnants of Papyrus, eucalyptus plantations and sausage trees are identified. These plants are scattered in different parts of the site.

Figure 5-2: Maize and banana intercropped at the scheme

5.4.5River and Water Body

The main river system in the project area is Manafwa River basin which emerges from mountainous area of Mt. Elgon and flows toward south and passing through Manafwa wetland, which is the project area, before joining Namatala River which is part of Namatala wetland. There are also many tributaries flowing towards the Manafwa swamps, the major ones are Mpologoma Rive and Namatala River.

Figure 5-3: Manafwa river system

5.5 CLIMATE AND HYDROLOGICAL STUDIES OF THE PROPOSED SITE

The scope of this hydrological study is mainly focused on updating studies conducted by the consultant and deriving reliable hydrologic and climatic information and hydrologic design parameters for the design of, irrigation systems, flood protection works and drainage system. A review of available water sources within close proximity to the project area identified to be is Manafwa River which is the best possible water source.

5.5.1 Characteristics of Manafwa catchment

The Manafwa River in this wetland originates from Mt. Elgon and flows southward in the flat terrain before it join Namatala swamp and drain to Kyoga Lake System.

At the Luwoba head work location, the river has a catchment area of about 512.5 Km^2, whereas at the gauging station the catchment area is 494 Km^2. The catchment has a mean slope of 26.2% and mean catchment elevation of 1675 masl that ranges from 4136 masl to 1096 masl at the head work.

The study area is located in zone F it is assumed that there is virtually one rainy season from March to October, with the main peak in April and a secondary peak in August and one dry season December to about mid-March.

According to the modified Köpen system, the climate of the catchment is classified as Tropical Climate II characterized by a mean annual rainfall between 1200 to 1600 mm and mean Temperature of the coldest month above 22ºC.

The catchment is dominantly covered by a Plinthosol with some part of the catchment in the west consisting Gleysol are found near the flat region.

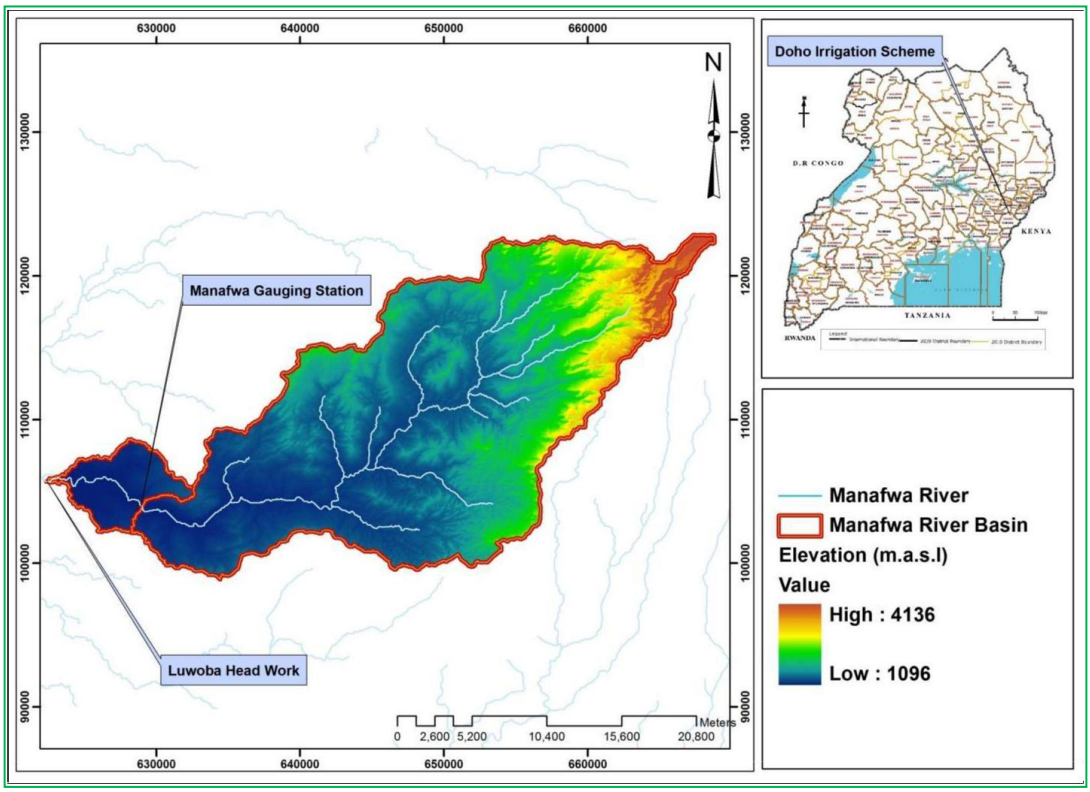

Figure 5-4: Manafwa River Basins

5.5.2 Climate Data

To successfully implement the Doho Irrigation Project sustainably, the data on climate, river flows and sedimentation become relevant with respect to hydrological modelling and water resources planning.

The climate data like sunshine duration, relative humidity, wind speeds and temperature in the resolution levels of monthly means, become very important parameters with respect to the proposed command area development. These, in association with command area rainfall, form the basic inputs for the estimation of the crop water requirement exercise.

5.5.3 Rainfall Data

There is no single rain gauge station to represent the command area to directly estimate parameters like rainfall, ETo etc. Hence the command area rainfall could best be estimated

by the nearby Tororo station. All climatic parameters in the analysis were extracted from Tororo station

5.5.4 River Flow Data

Manafwa River is gauged for most of its portion which is convenient for proper quantitative estimation of flow and is useful in assessing the yield of catchment directly at the existing head work site.

5.5.5 Sediment data

No sediment concentration measurement was available. So it has been tried to employ different empirical methods to quantify the sediment yield of the catchments.

5.5.6 Climate

The climate of Manafwa catchment varies from tropical humid in the highlands that include the extreme south to the hot arid climate in the south western parts of the flood plain. Intermediate between these extremes and for greater part of the basin the climate is tropical sub-humid. The seasonal variation in climate is associated with the oscillation of the Inter-Tropical Convergence Zone (ITCZ) in which the project area is under the influence of Atlantic equatorial weasterlies and southerly winds from the Indian Ocean.

5.5.7 Rainfall analysis

The entire available climatic data, in association with command area rainfall forms the basic inputs for the estimation of the crop water requirement. The data position at the command area and its vicinity is very poor. However, by making judicious analysis the mean and dependable rainfall values have been estimated. The temporal distribution of the Mean monthly rainfall at the command area is shown (Fig 5-5).

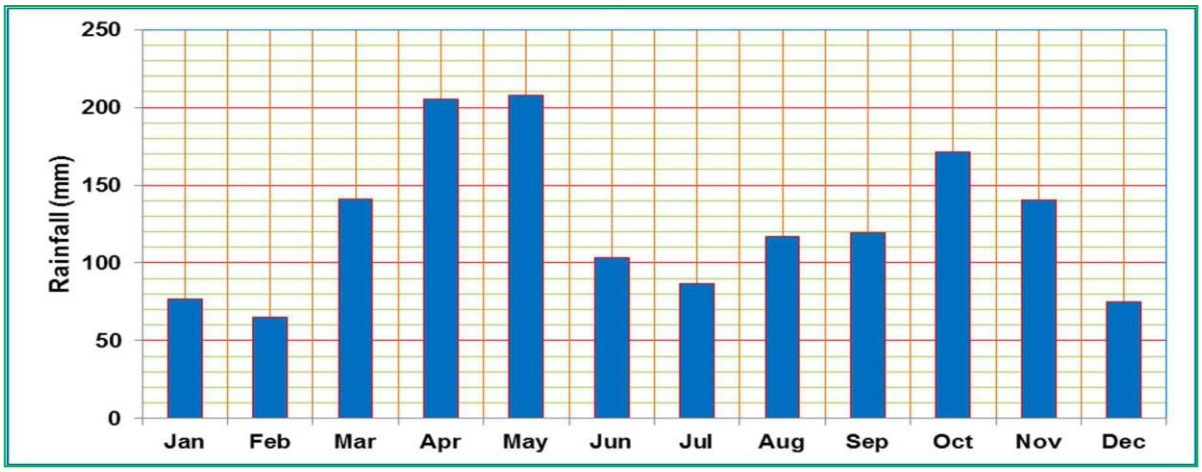

Figure 5-5: Command Area Mean Monthly Rainfall

The rainfall data were made available from Tororo metrological station; starting from 1992-2014 is summarized in Table 5-9 which provides time span of 23 years.

Table 5-9: Command Area Synthetic Rainfall (mm)

Year	Months												Annual Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1992	32.4	83.4	63.4	226.6	171.1	118.4	52.9	147.5	118.3	102.5	178.4	107.0	1401.9
1993	38.7	24.7	127.5	136.2	268.3	79.4	30.9	30.5	137.3	59.1	62.4	53.4	1048.4
1994	73.8	29.7	175.9	175.9	208.9	164.8	156.2	63.2	114.8	109.6	283.0	0.0	1555.8
1995	71.7	82.0	171.5	262.3	177.3	108.7	96.2	93.2	87.8	233.6	160.3	43.8	1588.4
1996	87.6	118.8	162.9	306.6	199.5	59.4	52.9	185.0	167.3	231.8	174.0	20.1	1765.9
1997	54.8	0.7	95.1	167.2	139.6	102.5	77.7	0.0	0.0	239.2	333.4	215.8	1426.0
1998	302.0	118.9	130.5	266.4	348.3	94.6	69.9	111.9	84.6	188.6	99.4	24.8	1839.9
1999	110.5	0.4	272.5	136.5	0.0	75.4	66.2	169.7	141.8	154.2	140.3	101.2	1368.7
2000	62.1	16.7	79.5	177.5	181.4	86.1	99.1	100.4	103.5	237.5	170.1	106.2	1420.1
2001	102.9	39.1	186.4	162.8	228.8	128.0	117.4	87.8	150.2	169.5	137.3	6.7	1516.9
2002	32.4	54.0	107.4	279.2	146.5	63.8	50.3	81.4	73.9	103.8	206.5	231.2	1430.4
2003	141.0	159.6	77.9	169.8	182.3	123.4	66.8	93.4	92.6	99.0	206.5	89.4	1501.7
2004	33.3	48.7	76.8	162.5	136.5	69.6	64.7	188.9	203.9	126.9	89.5	62.2	1263.5
2005	32.2	17.4	217.8	223.5	306.5	139.6	177.3	54.8	73.0	140.1	97.1	0.0	1479.3
2006	46.6	98.7	238.1	235.6	222.8	239.5	90.2	173.7	130.3	279.9	0.0	61.6	1817.0
2007	100.8	114.5	77.3	167.7	203.3	111.2	174.8	142.5	122.8	140.9	103.7	49.0	1508.5
2008	49.3	68.1	163.9	120.9	40.5	65.2	185.4	131.3	131.3	155.2	55.5	4.4	1171.0
2009	109.2	75.9	99.0	319.3	195.5	41.2	52.3	111.3	109.7	156.6	111.6	154.6	1536.2
2010	92.4	293.7	163.1	266.0	215.7	52.8	86.6	127.2	82.1	112.9	84.8	101.6	1678.9
2011	44.7	15.2	148.5	193.6	338.0	98.9	62.2	198.1	105.2	312.0	98.3	44.6	1659.3
2012	0.0	11.2	109.7	226.4	387.7	155.9	77.1	102.3	103.3	201.6	159.6	111.8	1646.6
2013	70.9	9.8	236.3	228.1	232.9	43.3	37.8	187.5	229.2	92.6	168.2	52.5	1589.1
2014	83.3	18.6	57.7	113.9	242.5	148.8	50.2	107.8	182.2	291.0	116.4	88.6	1501.0
Min	0.0	0.4	57.7	113.9	0.0	41.2	30.9	0.0	0.0	59.1	0.0	0.0	1048.4
Max	302.0	293.7	272.5	319.3	387.7	239.5	185.4	198.1	229.2	312.0	333.4	231.2	1839.9

Mean	77.1	65.2	140.8	205.4	207.6	103.1	86.7	116.9	119.4	171.2	140.7	75.2	1536.4
Median	70.9	48.7	130.5	193.6	203.3	98.9	69.9	111.3	114.8	155.2	137.3	61.6	1396.0
STD	59.3	67.0	61.3	59.0	88.8	46.5	45.6	52.7	48.2	70.3	73.3	62.5	190.2

5.5.8 Long Term Rainfall

The Tororo annual rainfall record shows pronounced periods of wetter and drier fluctuations. The early period (from 1999 to 2005) is comparatively dry (average 1425 mm), but this is followed by a wet period (from 2006 to 2014) with an annual average of 1567 mm. The driest year in the record is 1993, with an annual rainfall of 1048 mm. The wettest year is 1998, when the total was 1839 mm. The mean and median of the annual series rainfall are 1509 mm and 1508 mm respectively. 70% of the annual rainfalls are above 1430 mm and 80% above 1410 mm.

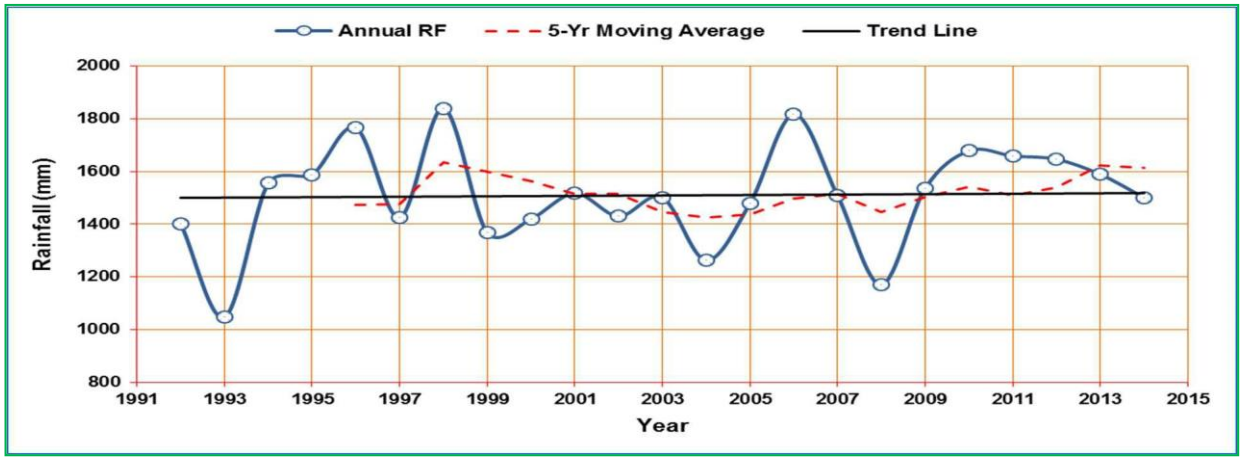

Figure 5-6: Tororo Annual Rainfall Time Series

5.5.9 Rainfall Frequency Analysis

Determination of the frequency of occurrence of extreme hydrological events like floods, drought, and maximum rainfall are important in water resources planning and determination of maximum discharges pass through culverts and bridges. There is a definite relation between the frequency of occurrences and magnitude; the ordinary events occur almost regularly than the severe storms. Then the general equation for frequency analysis proposed by Chow (1951) is used in this project frequency analysis.

$X_T X_{av} K$	
Where	X^T Event (magnitude) at return period of T **Xav** years Mean of the sample data **σ** Standard deviation and

	K Frequency factor,

Based on the above equation the Annual 24-hour maximum rainfall was fitted to different statistical distributions. Since Gumbel method gives best estimate for the stations in the project area, it is selected to compute the extreme value of daily rainfall.

Table 5-10: The Extreme values of rainfall at 24hr in the Project area

Return Period									
2	5	10	20	25	50	100	200	500	1000
24hr Max. Rain fall									
76.9	93.7	103.5	112.6	115.4	124.1	132.6	141.1	152.3	160.7

5.5.10 Rainfall – Intensity – Duration

Intensity/Duration/Frequency (IDF) curves have been derived using Tororo station for annual periods. The frequency analysis was based on fitting Gumbel to the maxima for the selected period.

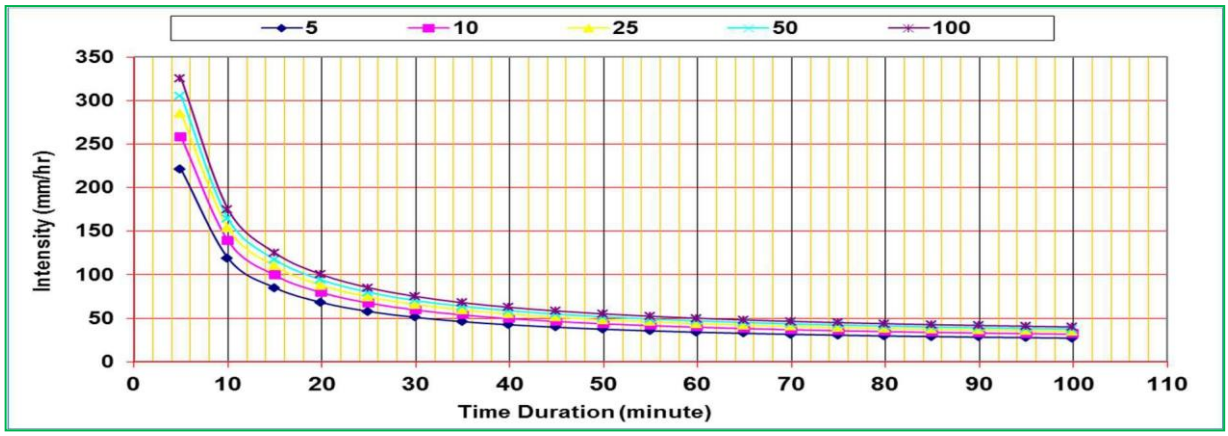

Figure 5-7: Intensity-Duration-frequency curve of Tororo station

5.5.11 Dependable Rainfall

The water requirements of rice crop that is going to be cultivated in the proposed project area can be fulfilled from two major sources namely irrigation water from the river and effective rainfall. Dependable rainfall at levels of 75 %, 80 % and 90 % is estimated by statistical method (Weibull and percentile) considering decadal rainfall over years as normally distributed.

Table 5-11: Decadal Dependable Rainfall for the Project Area (mm)

Decade	Dependability	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
I	90%	0.0	0.0	1.3	14.8	27.5	14.3	1.7	0.7	16.5	18.2	12.3	1.9
	80%	2.0	0.6	6.6	21.9	40.3	16.0	5.9	7.7	23.6	23.7	24.2	4.3
	75%	4.9	0.7	10.3	28.5	45.2	18.5	8.5	11.9	26.9	30.1	27.4	4.6
II	90%	0.9	0.0	7.7	18.3	15.3	10.7	2.0	7.9	21.1	13.2	6.2	0.0
	80%	7.6	0.5	13.0	36.4	34.9	14.7	6.7	15.4	23.7	20.9	12.7	0.0
	75%	9.8	0.8	17.5	47.5	46.5	15.6	9.3	18.3	24.5	25.6	16.1	0.8
III	90%	0.0	0.0	12.2	22.6	14.4	1.7	10.1	8.5	13.9	15.6	0.3	0.0
	80%	0.0	1.2	24.6	35.3	26.4	13.4	13.6	11.7	16.6	25.8	7.0	0.0
	75%	0.2	2.2	31.0	38.9	34.1	16.4	14.8	15.7	18.0	34.8	7.7	0.9

5.5.12 Effective Rainfall

The Effective monthly rainfall corresponding to 75% dependable rainfall at irrigation project area is estimated by CROPWAT (version 8) developed by FAO (2009) and the result is shown below.

Table 5-12: Effective Rainfall (mm) at 75 % Dependability

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					1st	Decade						
Dependable RF	4.9	0.7	10.3	28.5	45.2	18.5	8.5	11.9	26.9	30.1	27.4	4.6
Effective RF	4.8	0.7	9.8	24.5	35.3	16.8	8.2	11.1	23.4	25.8	23.8	4.5
					2nd Decade							
Dependable RF	9.8	0.8	17.5	47.5	46.5	15.6	9.3	18.3	24.5	25.6	16.1	0.8

Effective RF	9.3	0.8	15.9	36.7	36.1	14.4	8.9	16.7	21.5	22.5	14.9	0.8
					3rd	Decade						
Dependable RF	0.2	2.2	31.0	38.9	34.1	16.4	14.8	15.7	18.0	34.8	7.7	0.9
Effective RF	0.1	2.2	26.4	31.6	28.5	15.1	13.7	14.5	16.4	29.0	7.4	0.9

5.5.13 Estimation of Crop Reference Evapotranspiration

Since the direct measurements of ETo using lysimeter or water balance approach are not common in most project areas, it is estimated indirectly using climatic data. The indirect estimation of ETo using climatic data is varying from simple empirical relation to complex physical process based combination methods. Among various approaches FAO Penman-Monteith methods was selected for the estimation of the project area reference evapotranspiration.

The FAO Penman-Monteith equation determines the potential evapotranspiration from the hypothetical grass reference surface and provides a standard to which evapotranspiration for various crops growing in the project command area can be related. The meteorological factors determining potential evapo-transpiration are weather parameters which provide energy for evaporation and remove water vapour from the evaporating surface. The principal climatic parameters to consider are presented below.

Temperature

The minimum and maximum temperature as given in (Table 5-13), exhibit the monthly maximum and minimum temperatures of 31.9^{0}C and 16.4 ^{0}C respectively. The highest is recorded in the month of February followed by January and March. The minimum is recorded in the month of August followed by September (Figure 5-8).

Sunshine

The average sunshine hour in the area is 7.63 hours. The highest number of hours is 9.2 in January, followed by February and March as shown in (Table 5-13 and Figure 5-8).

Relative Humidity

The annual average relative humidity is 67.43 %, and the highest of 70.2 % is experienced in the months of May. The lowest humidity of 57.6 % is in the month of February (Table 5-13 and Figure 5-8).

Wind Speed

The annual average wind speed is 3.96 m/s with the highest value of 4.44 m/s in February. The minimum wind speed has been recorded as 3.56 m/s in June. The monthly variation of wind speed is shown in (Table 5-13 and Figure 5-8).

Table 5-13: Mean Monthly Climatic Factors over the Command Area

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min T(°c)	17.0	17.4	17.8	17.9	17.6	16.9	16.5	16.4	16.8	17.2	17.1	16.8
Max T (°c)	31.1	31.9	31.1	29.8	29.6	28.5	28.4	28.9	29.2	29.6	29.2	30.1
RH (%)	62.1	57.6	64.5	70.2	72.0	69.4	68.0	70.1	69.1	70.3	70.8	65.1
Wind (m/sec)	4.12	4.44	4.10	4.08	3.67	3.56	3.63	3.87	3.80	3.98	4.10	4.15
Sunshine(hr)	9.2	8.1	8.0	6.9	7.5	7.6	6.5	6.8	7.7	7.6	7.3	8.3

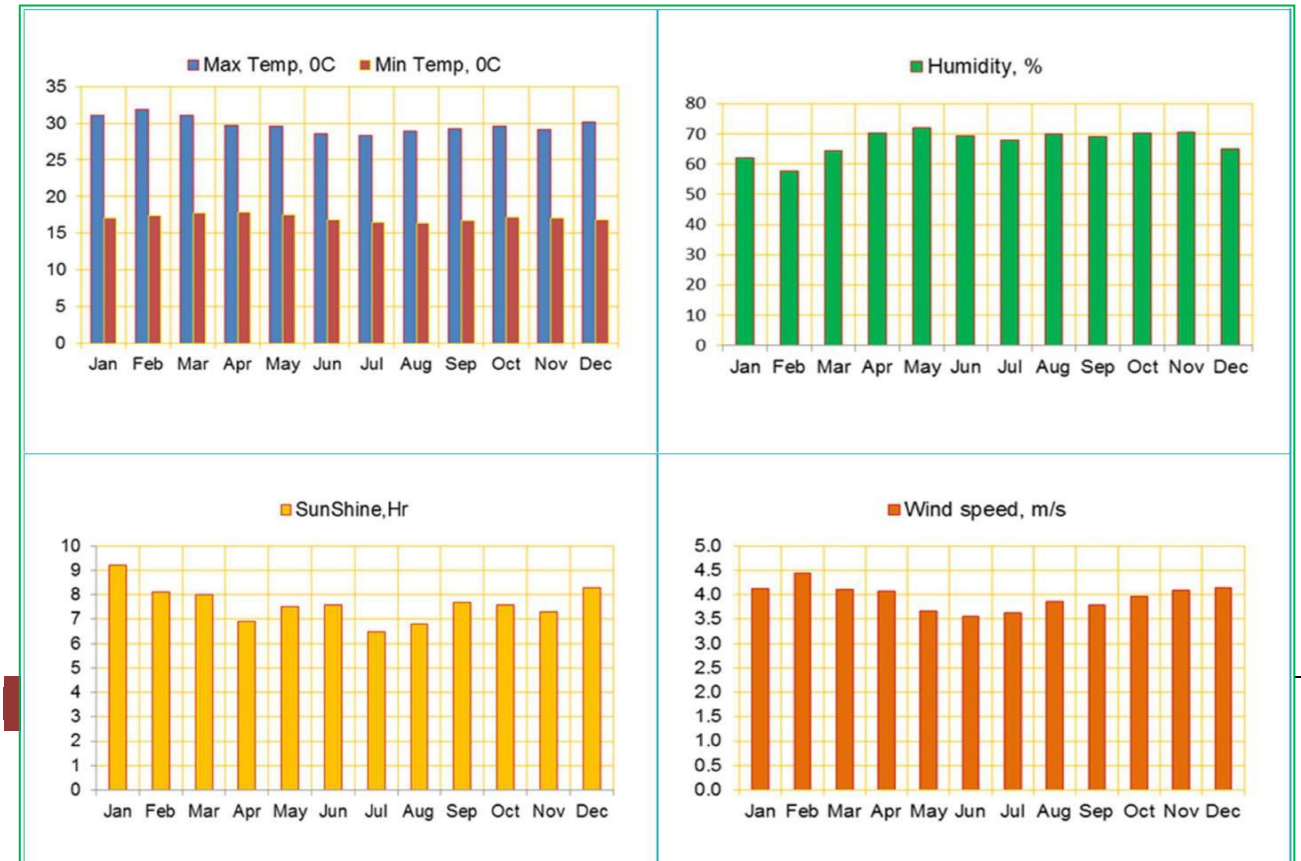

Figure 5-8: Shows Max and Min Temperature °C, Humidity %, Sunshine duration, Hr and Wind speed, m/s

The knowledge of evaporation and evapotranspiration is of direct importance to the investigation of water resource planning, utilization and management. The water requirement estimation particularly in the case of irrigation requires good understanding of evaporation and evapotranspiration rates are presented in Table 5-14.

Table 5-14 Monthly ETo Values

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ETo, mm/day	5.5	5.2	4.5	4.4	4.3	4.6	4.6	4.8	4.7	5.1	5.8	5.3
ETo, mm/month	170.4	145.3	140.8	132.5	134.8	139.5	144.0	149.7	140.6	158.0	172.5	164.5

The mean annual potential evapo-transpiration estimate is 1,792 mm

5.6 Soils

Petric Plinthosols and Gleysols are dominant in the lower land of the area. Plinthosols present considerable management problems. Poor natural soil fertility caused by strong weathering, water logging in bottomlands and drought are serious limitations. Many Plinthosols outside of the wet tropics have continuous petroplinthite at shallow depth, which limits the rooting volume to the extent that arable farming is not possible; such land can at best be used for low-volume grazing. Many soil and water conservation techniques are used to improve these soils for urban and peri-urban agriculture in West Africa.

Gleysols comprise soils saturated with groundwater for long enough periods to develop reducing conditions resulting in gleyic properties, including underwater and tidal soils. For many Gleysols, the main obstacle to utilization is the necessity to install a drainage system to lower the groundwater table. Adequately drained Gleysols can be used for arable cropping, dairy farming and horticulture. Gleysols can be used for wetland rice cultivation where the climate is appropriate. Gleysols with a thionic horizon or oxidized hypersulfidic material suffer from severe acidity and high levels of Al toxicity.

The area lies on an alluvial plain with sediment from rivers. According to the Socio-economic Survey, most farmers in the area satisfy soil fertility in their farmland.

5.6.1 Soil Textural Classes

The soils have been studied up to 1.5 meter depth from the natural surface level. Two textural classes have been recognized and mapped. The area has been grouped in to four classes and their statistics is given below in Table 5-15.

Table 5-15: Soil Textural Groups

Mapping Unit	Textural Class	Area(ha)	Extent (%)
PETRIC PLINTHOSOLS	Fine textured soils with Sandy loam surface	698.77	73.4
GLEYSOLS	Fine textured soils with Silty loam surface	253.47	26.6
	Total	**952.24**	**100**

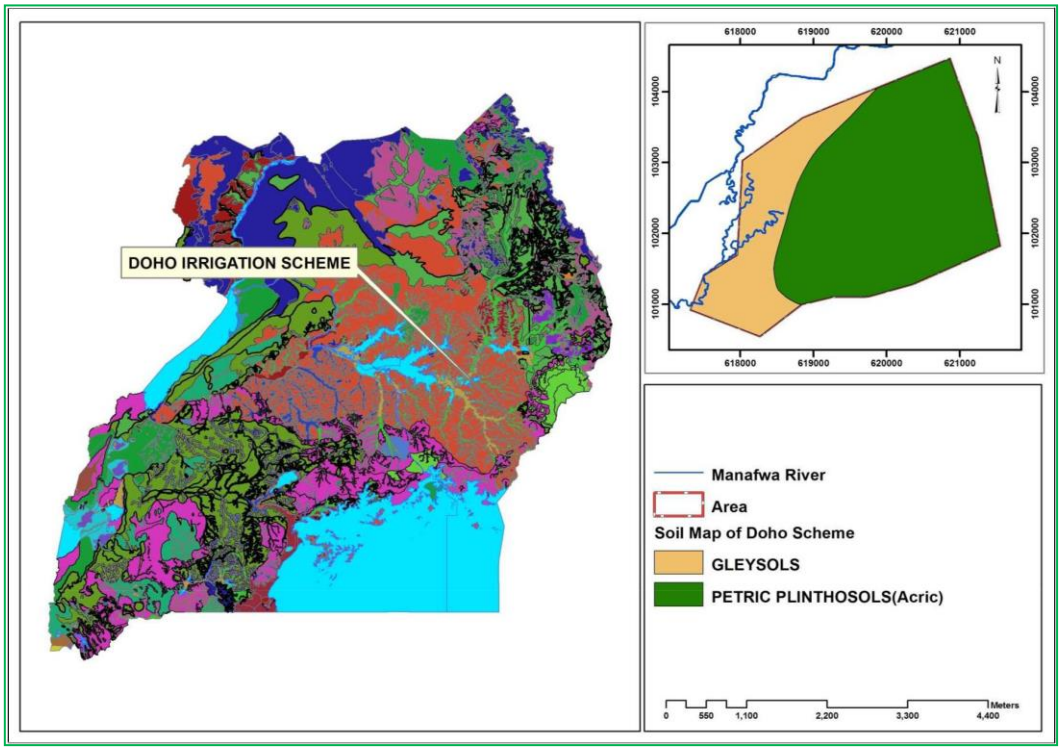

Figure 5-9: Soil map of Doho Irrigation scheme

5.6.2 Infiltration Estimation

The infiltration values were derived using the textural analysis result from National Agricultural Research Laboratory of Uganda and by utilizing SPAW (USDA Soil and Water Characteristics) model. The average intake rates of four soil types are given below in Table 5-16.

5.6.3 Bulk Density

All of estimated bulk density values were less than 1.50 g/cm^3. These are generally low and the results indicate that no major problems of root penetration or of soil aeration and drainage are likely to occur in the study area. Table 5-17 presents the summary values of bulk density and available Water Holding Capacity (AHC) by soil types.

Table 5-17: Summary of Available Water Holding Capacity

Mapping Unit	Textural Class	Bulk Density (g/cm^3)	FC (%)	PWP (%)	AWC (mm)
PETRIC PLINTHOSOLS	Fine textured soils with Sandy loam surface	1.50	15.2	9.3	60
GLEYSOLS	Fine textured soils with Silty loam surface	1.31	29.8	11.6	180

5.7 SURFACE WATER RESOURCES

Even though there is no vivid coverage of the Hydrological aspects of the Manafwa catchment, the present study had to handle the Hydrological planning in a specific project oriented fashion. These have been spelt in the approach for the present study indicating as to how best these processed data were utilized after appropriate updating and screening of the available the Manafwa River data and making the best use of it in statistical, stochastic or conceptual hydrological models to assess the success of the planned Project. The availability of data has been made up as a time series for 17 years (1998-2014) and the present study has relied only on it.

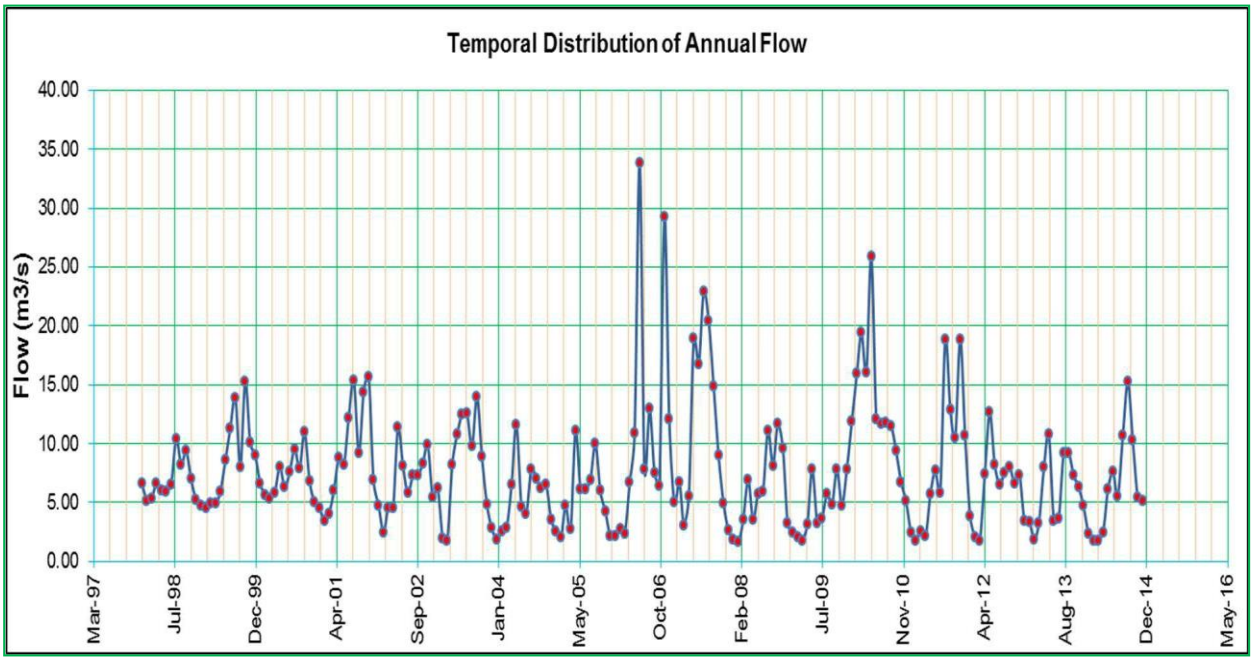

Figure 5-10: Temporal distribution of Rivers flow at Manafwa Gauging Station

5.7.1 Processing of the River Flow Data

The Manafwa data as the observed gauges and computed discharges is available at the gauge-discharge station for one blocks; that is for the years 1998 to 2014 (with intermittent gaps). Identifiable variations were found with respect to the flows computed for the block. The problem with respect to the processing of these data centers on the following issues:

1) Rating curve development based on the available concurrent data on the observed gauge heights and measured discharges;
2) Converting the observed gauge heights in to discharges on the basis of the optimal rating curve established;
3) Filling up the intermittent gaps (when there is no gauge height data) in the flows; Establishment of a broken historical flows series at the gauge- discharge station;
4) Transferring of this long term flow time series to the respective Luwoba diversion site by an appropriate transfer mechanism in the zone of data inadequacy coupled with rapid variations in the Hydro-meteorological parameters.

5.7.2 Transferring of Manafwa River Flows to Luwoba diversion sites

This is the critical part of the Hydrological studies in the context of the present Project associated with all types of inadequacy of data, coupled with limited coverage of the Project Area by the available data. Many transfer mechanisms could be possible with a good database, through Statistical models; or by conceptual catchment Hydrological models. Here such possibilities are completely ruled out. In addition to inadequacy of the data, The Project Area is subjected to sharp variations in the basic Hydro-meteorological parameters

compounding all the complications. However, the Hydrological tools need to solve all the obstacles and as such, in such situations some of the empirical models for a particular region, come as relevant aid.

In this particular aspect, it has been attempted to develop with one such useful empirical model. This is one of the optimal transfer mechanisms to transfer the flows from the Sipi gauge-discharge station to the diversion sites.

Table 5-18: Transferred Runoff at Luwoba Diversion Site (m^3/s)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual
1998	6.89	5.33	5.49	6.83	6.22	6.13	6.81	10.79	8.46	9.74	7.23	5.45	85.36
1999	4.88	4.66	5.13	5.09	6.16	8.96	11.72	14.42	8.31	15.87	10.42	9.38	105.01
2000	6.89	5.83	5.58	6.08	8.33	6.52	7.87	9.88	8.22	11.39	7.09	5.22	88.92
2001	4.73	3.59	4.17	6.28	9.18	8.47	12.67	15.96	9.51	14.87	16.27	7.16	112.85
2002	4.94	2.56	4.70	4.70	11.76	8.37	6.02	7.54	7.62	8.59	10.22	5.67	82.69
2003	6.44	2.06	1.81	8.47	11.14	12.99	13.03	10.15	14.50	9.22	5.03	2.92	97.77
2004	1.94	2.63	2.92	6.74	12.02	4.83	4.15	8.09	7.29	6.47	6.78	3.73	67.59
2005	2.65	2.17	4.96	2.84	11.48	6.36	6.36	7.20	10.34	6.22	4.41	2.24	67.22
2006	2.22	2.84	2.40	7.01	11.29	35.03	8.12	13.44	7.80	6.68	30.33	12.50	139.66
2007	5.22	7.00	3.20	5.74	19.58	17.35	23.70	21.16	15.39	9.33	5.12	2.74	135.52
2008	1.89	1.71	3.67	7.19	3.66	5.97	6.14	11.47	8.46	12.08	9.94	3.32	75.50
2009	2.49	2.16	1.83	3.25	8.10	3.37	3.81	5.95	5.04	8.07	4.94	8.14	57.17
2010	12.33	16.56	20.10	16.64	26.86	12.53	12.15	12.24	11.94	9.73	7.01	5.29	163.39
2011	2.59	1.87	2.66	2.20	5.90	8.01	6.08	19.54	13.38	10.87	19.57	11.10	103.76
2012	3.99	2.12	1.81	7.67	13.11	8.53	6.79	7.79	8.32	6.88	7.59	3.58	78.19
2013	3.46	1.90	3.37	8.26	11.14	3.54	3.79	9.57	9.57	7.59	6.56	4.86	73.60
2014	2.47	1.82	1.87	2.56	6.35	7.85	5.76	11.06	15.79	10.65	5.65	5.34	77.16
Mean	4.47	3.93	4.45	6.33	10.72	9.70	8.53	11.55	10.00	9.66	9.66	5.80	94.79

5.7.3 Dependable flow

Dependable flow from a surface source defines the availability of water for continuous manner during projected future conditions, including a repetition of the most severe drought or record, without creating undesirable effects on the project. Because of the extreme variations in seasonal and monthly distribution of the annual runoff there is a great need to develop sound procedures which will enable to forecast the river dependable flow.

Commonly, the dependable flow of a given stream can be computed using the minimum flow different time scale like month or decade. But for the case of Doho Irrigation project we considered the mean decadal flow due to two main reasons.

The catchment area is characterized by high rainfall area with low potential evaporation, which increases the water availability in the downstream. The bi-annual nature of rainfall in the area also provides water for the two or three cropping season without significant stress condition.

The decadal 75% and 80% dependable flow of the river at the diversion point is computed using Gringorten (1963) plotting position formula, which gives us

$$P= (m-0.44)/ (N + 0.12) * 100,$$

Where P is the probability of the event of the given amount of flow, m is the rank of flows with their descending order and N is the number of years. Then the result is presented as follow in table and chart format. The recurrence interval (T) of this computation is computed from the relation T=1/P.

Table 5-19: Decadal value of 75% and 80% dependable flow at Luwoba diversion site

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75% dependable					1st Decade							
	2.71	1.93	1.79	2.57	5.61	6.23	4.58	7.92	7.20	8.19	5.87	3.51
80% dependable	2.57	1.89	1.78	2.47	5.47	6.03	4.37	7.02	6.59	7.67	5.62	3.27
75% dependable					2nd Decade							
	2.20	1.93	2.00	3.84	6.32	5.82	4.02	8.98	7.09	6.28	4.79	3.06
80% dependable	2.15	1.81	1.88	3.23	6.16	4.77	3.81	8.42	6.96	5.89	4.68	2.98
75% dependable					3rd Decade							

	2.28	1.74	2.22	4.63	5.65	5.58	6.94	8.06	7.17	5.85	4.26	3.33
80% dependable	2.16	1.71	2.21	3.50	5.50	5.34	5.73	7.48	7.06	5.72	4.13	2.80

5.8 Wetlands

Proposed sites are located in Butaleja District, and its areas are about 1,454 ha. All are wetlands that belong to the Doho-Namatala wetland system. The Doho-Namatala wetland system is a permanent wetland with seasonal wetlands within. They form part of the Lake Kyoga drainage system. All these systems drain into Mpologoma system which flows along the western boarder of the district through Namutumba, Kaliro, Budaka, and Pallisa, District, and finally into Lake Kyoga.

The water sources for the wetland system of the proposed site are diverse, namely; rivers, streams, ground water, precipitation and run off. The peak rainy seasons are around March to May and August to November. During these rainy seasons wetlands have enough water and often flood. The Manafwa River is the main river within the wetlands and main water shade is on the slopes of Mt. Elgon.

5.9Fauna

The existence of animals within the site has been affected by the conversion of wetland into agricultural farmlands. The following faunas are identified; squirrels, rats, and monkeys. Reptiles like monitor lizards, frogs, lizards, and snakes like black water cobra were identified. Cat fish, Lungfish and Mudfish are also common. Insects are bees, flies, butterflies, grasshoppers.

As for birds, common birds identified and reported are; herons, egrets, weaverbirds (Quela Quela birds) especially within the rice paddies, ibis and crows. Doho Rice Scheme which is located next to the project site is identified as an Important Bird Area (IBA).In managing the project, presence of IBA has to be considered.

Table 5-20: Doho Rice Scheme IBA

Location	Uganda, Tororo
Central coordinates	34° 0.00' East 0° 53.00' North
IBA criteria	A1, A3, A4i
Area	3,200 ha
Altitude	1,100 - 1,220m
Year of IBA assessment	2001

Source: Birdlife International available at http://www.birdlife.org/datazone/sitefactsheet.php?id=7064, accessible as of 30 May 2017

Table 5-21: Populations of IBA Trigger Species

Species	Season	Population	IBA	IUCN[2]

		estimate	Criteria	Category
Glossy Ibis *Plegadis falcinellus*	**Winter**	1,420 individuals	A4i	Least Concern
Marsh Sandpiper *Tringa stagnatilis*	winter	680 individuals	A4i	Least Concern
Wood Sandpiper *Tringa glareola*	winter	13,400 individuals	A4i	Least Concern
Papyrus Gonolek *Laniarius mufumbiri*	resident	present	A1, A3	Near Threatened
White-winged Scrub-warbler *Bradypterus carpalis*	resident	present	A3	Least Concern
Papyrus Yellow Warbler *Chloropeta gracilirostris*	resident	present	A3	Vulnerable
Red-chested Sunbird*Nectarinia erythrocerca*	resident	present	A3	Least Concern
Northern Brown-throated Weaver *Ploceus castanops*	resident	present	A3	Least Concern
Papyrus Canary *Serinus koliensis*	resident	present	A3	Least Concern

Source: Birdlife International available at http://www.birdlife.org/datazone/sitefactsheet.php?id=7064, accessible as of 30 May 2017

6 Public participation and consultation

The National Environment Act, Cap 153, the EIA Regulations 1998, the conduct of Environment Practitioners Regulations, 2001, and the Guidelines for the EIA in Uganda all emphasize public participation in the EIA process. Consequently, several stakeholders and the community neighbouring the site were met and consulted. The consultations were aimed at getting views of stakeholders and the community on a number of issues such as health, safety, economic and others, in regard to the proposed irrigation scheme. Figure 6.1 below illustrate consultations on-going with some of the official and community members of Himutu and Mazimasa sub counties about the proposed project. The majority of the residents and other relevant stakeholders in the area acknowledged the fact that improved agriculture was necessary for the development of their area given the fact that there is presence of large chunk of land to boot crop growing.

6.1 Objective of stakeholder consultations

The objectives of stakeholder consultations include the following:-

1) To disclose the proposed development to the community surrounding it;
2) To provide sufficient information to all stakeholders and interested parties that will help them to participate in the whole process of the project;
3) To obtain views from stakeholders on anticipated benefits, fears, opportunities and any other concerns of the community as well suggestions on how best to mitigate their fears in regard to the project;
4) Putting stakeholders concerns into consideration during project implementation.

6.2 Stakeholder Identification

The stakeholders consulted were categorized into the national level technocrats from MWE, MAAIF and relevant sectoral agencies; the district technocrats and members of the community around the project area, as indicated in Table 6-1(a) and the various names and contacts of the respondents have been annexed (See appendix 3). The views from the different stakeholders consulted are summarized in Table 6-1(b)

Table 6-1 (a): Categories of stakeholders consulted

Level	Stakeholders
National stakeholders(Government institutions)	1. Ministry of Agriculture, Animal, Industry and Fisheries (MAAIF)- Department of Agriculture mechanization and water for production; 2. Ministry of Water and Environment (MWE)- Department Wetland

	Management.
Local Government	1. District chairperson 2. Chairman LCIII-Himutu 3. Parish Chief-Himutu; 4. District Forestry Officer-Butaleja District; 5. District Natural Resources officer; 6. District Environment Officer

Fig 6.1: Consultation with the officials of Himutu Sub County

Fig 6.2: Consultation with the community members of Mazimasa

6.3 Issues arising from the consultative meeting

Issues raised during the stakeholder engagement process were compiled and summarized in table 6-1 below and have been elaborated in more detail and considered in proceeding chapters for impact assessment and incorporation in the Environmental impact and management plan.

Table 6-1: Stakeholders consulted and their remarks

Stakeholder		Raised issues	Actions
National Level	**Ministry of Water and Environment** (Wetlands Department) **Principle Wetlands officer** Barugahare Vincent 0774434969	✓ Integrated water management strategy should be considered key during project implementation. (Water catchment protection); ✓ The role of community development officers should be clearly streamlined; ✓ District political and technical officials should work hand in hand for the common goal of developing the scheme; ✓ There should be equity in accessing the scheme resources; ✓ Water reservoirs should be thought of in the designs; ✓ Boundaries on the ecological resources should be clear in order to avoid encroachment.	✓ Water users associations shall be formed to effectively manage the water catchment areas as well as water usage within the scheme; ✓ The role of selected community development officers shall be clearly explained to the beneficiaries; ✓ Since the project is looking forward to enhancing farmers income, no politics should be brought on board during implementation; ✓ The dam shall be constructed to store water during dry spells; ✓ Specific tree species shall be planted in the boundaries of the river to avoid encroachment on the river banks.
	Ministry of Agriculture Animal Industries and Fisheries (Department of Agriculture Mechanization and Water for Production) **Benon Lwanga-** Senior Engineer	✓ Land leveling to guarantee a good slope to effect irrigation exercise; ✓ Water from the scheme should be well managed through provision of proper drainage system; ✓ Issues of fertilizer and pesticide application should be well dealt with through liaison with district agriculture officer and other technical staff at the scheme; ✓ Nutrient loads should be controlled in the scheme before joining the main	✓ During construction land leveling shall be conducted to effect water flow in the scheme; ✓ Proper drainage shall be included in the designing process; ✓ The implementing authority shall station a well trained agronomist to guide famers' on proper fertilizer and pesticide application; ✓ Crops that provide quick returns shall be thought of during operation phase.

	0772892580	water sources; ✓ High value crops should be considered in relation to the costs incurred during water pumping; ✓ Crops grown should target market not for home consumption.	
District Level	**Political section** **Richard Waya** District Chairperson 0772453838	✓ Supervision of the scheme works by the district technical team; ✓ Empowering the community to own the project. ✓ Weak emphasis on environmental issues during construction works; ✓ Sanitation should be emphasized during construction and operation works; ✓ Creation of employment opportunities to the youth in the area; ✓ Compensation issues should be looked into prior to any construction works; ✓ Woodlots should be thought of to avoid further encroachment on forests; ✓ Integrated water management should be considered key during operation phase of the scheme; ✓ There should be quarterly joint meetings between the ministry and the district for smooth running of the scheme; ✓ Creation of buffer zones to avoid	✓ All construction works at the scheme shall be keenly monitored by the selected district technocrats; ✓ Proper engagement of the community shall be mandatory since they are the direct beneficiaries of the project; ✓ Sanitary facilities shall be planned considering the number of people conducting their farming activities within the scheme; ✓ During construction works different job opportunities shall be created both for skilled and casual; ✓ Resettlement Action Plan (RAP) report shall iron out all issues related to compensation; ✓ Plans for planting trees shall be put forward under the guidance of the district forest officer; ✓ To avoid water shortage that are likely to spark off conflicts, there shall be formulation of water user groups;

		cultivation along the river banks.	✓ MAAIF and MWE as the lead government agencies shall spearhead quarterly joint meetings to check on the progress of the scheme.
	Higenyi Febiano Chairperson LIII-Himutu S/County 0782848354	✓ The development is good for the area since there is high demand for infrastructures facilities like internal roads within the rice fields; ✓ The proposed irrigation scheme activities will create more job opportunities to the people in the area. More so, the scheme will boost production of rice; ✓ People working at the scheme will be equipped with skills regarding rice growing thus building their capacity; ✓ The revenues collected should partly help in developing the area within the jurisdiction of the development.	✓ Road construction shall be a prerequisite in development of the scheme; ✓ More job opportunities shall be created both for skilled and unskilled labour force and several groups will acquire skills; ✓ High yielding varieties of rice shall be introduced at the scheme.
	Malwa Augustine District Councillor-Mazimasa S/County 0782614939	✓ Employment should prioritize the youth when sourcing the labour during construction activities; ✓ Establishment of irrigation scheme will also, solve the rampant youth unemployment problem in the area; ✓ The revenues collected should partly help in developing the area within the jurisdiction of the project the district as a whole; ✓ There should be a good working relationship between the implementing unit and the farmers as well as the	✓ To avoid high cost incurred while providing logistics to workers during construction works, the constructor shall source labour from the surrounding communities; ✓ The district planning unit shall look into the issues of revenue collected and planning for the irrigation scheme community; ✓ Emphasis shall be put on cooperation to boost the irrigation scheme.

		Butaleja district.	
	Technical section **Were Lamula** District Natural Resources Officer-Butaleja 0782608259	✓ Maintenance of canals should be effected; ✓ Sensitization of the community about the dangers of poor farming practices at the scheme; ✓ Ecotourism should be planned at the proposed dam; ✓ Tree planting to protect the river banks at least 10-12 metres; ✓ Regulation on the use of fertilizers and other chemicals.	✓ De-silting of the canals shall be prioritised at least twice a month; ✓ Community sensitisation shall be mandatory if the government id to maintain smooth running of the scheme; ✓ The district technical people shall look into the issues of ecotourism at the proposed dam; ✓ One of the priority under FIEFOC II is tree planting therefore this shall be implemented; ✓ It shall be the role of the district agriculture officer to train farmers on better techniques of fertilizer application.
	Tom Wandera Environment Officer-Butaleja 0781421432	✓ Construction of the dam to store water in the dry seasons; ✓ Collaboration in the management of the water catchment for equal benefit of both upstream and downstream users; ✓ The implementing Ministry should intervene in solving the emerging conflicts of water through formulation of water user groups in different sections of Doho irrigation scheme; ✓ Minimize increased use of fertilizers.	✓ The water reservoir shall be constructed to sort out the issues of water shortage during dry spells; ✓ Water user groups shall be formed to strengthen water management in the scheme; ✓ The district agriculture officer shall train the farmers better techniques of fertilizer application.

	Banamwita Charles Joshua District Forest Officer-Butaleja 0752501993	✓ The proposed rice growing at the scheme should be integrated with fishing activity as a new innovation; ✓ The Project Support Officer should train farmers around the proposed site and this will improve on their production; ✓ There is need for a project Implementation Unit to come up with a strategy of controlling floods which are prominent during heavy rains; ✓ The proposed irrigation scheme will boost the market for rice and other products in the area; ✓ The scheme will increase on government revenue through paying taxes; ✓ The project will change the face of the area thus improving its standards.	
	Wasose Richard District Water Officer-Butaleja 0782030226	✓ Alternative source of water such as underground water abstraction should be thought of; ✓ If possible other crops should be introduced at the scheme other than rice which demands a lot of water; ✓ The proposed infrastructure under FIEFOC II should be effectively managed; ✓ Institutionalization during implementation of this project.	✓ District water officer in liaison with the project implementing ministry shall work hand in hand on the issue of alternative water source; ✓ Since the project is focusing on enhancing farmers income, suitable crops shall be thought of by the district production officer after thorough consultation with other technocrats; ✓ The roles of each institution shall be streamlined to avoid overlaps.
Local Community		During consultation the community acknowledged the following: ✓ Increased rice yields once the project is	✓ Different rice varieties shall be introduced

	well implemented thus improving their living standards; ✓ Improved roads and other built structures within the scheme; ✓ Creation of Job opportunities during proposed construction works; ✓ The introduction of FIEFOC II project is likely to increased conflict over water use since much water will be needed to feed the scheme and yet all farmers depend entirely on river Manafwa whose volumes drastically reduce during dry seasons; ✓ There is fear that after modernization of the scheme the government might take full control and yet the land belongs to the community;	at the scheme to boost farmers harvests; ✓ Road construction work is part of FIEFOC II project, therefore new roads shall be constructed; ✓ New jobs shall be created in both casual and skilled labour force; ✓ Construction of water reserves and formation of Water users associations shall reduce of the conflicts.

7 Grievance Redress Mechanism

7.1 Scope of the grievance mechanism

A grievance mechanism must be made available to parties who have grievances or are not satisfied with any part of the resettlement and compensation process. These grievances could relate to the valuation of assets, amount of compensation paid, level of consultation, non-fulfillment of contracts, and timing of compensation, amongst others. Complaints and grievances also concern issues related to construction safety and nuisances caused by construction. Grievances will be handled through negotiation aimed at achieving consensus.

7.1.1 Grievance Committee

In order to address grievances, a Grievance Committee will be formed for dealing with any grievances as they arise. This will include a representative of the RAP team, representative of the District Lands Department, representative of the district Council, as well as a representative of the PAPs. It should also include an independent valuer if the grievances are in relation to compensation amounts. The grievance procedure will be simple and will be administered as far as possible by the Grievance Committee at the district and sub-county level.

7.1.2 Grievance Mechanism Procedures

At the beginning of the individual RAP processes, PAPs will be informed about how to register grievances or complaints, including specific concerns about compensation and relocation. The PAPs should also be informed about the dispute resolution process, specifically about how the disputes will be resolved in an impartial and timely manner.

All attempts shall be made to settle grievances amicably. The grievance redress mechanism is designed with the objective of solving disputes at the earliest possible time, which will be in the interest of all parties concerned and therefore, it implicitly discourages referring such matters to the Government authorities or National level courts for resolution.

Compensation and resettlement plans (contracts) will be binding under statute. The Grievance Committee shall maintain records where grievances and complaints, including minutes of discussions, recommendations and resolutions made, will be recorded. The procedure for handling grievances should be as follows:

The affected person should file his grievance in writing to the sub county leader. The grievance note should be signed and dated by the aggrieved person. Where the affected person is unable to write, he should obtain assistance to write the note and emboss the letter with his/her thumbprint.

The sub-county leader should notify the Grievance Committee and respond within 14 days during which any meetings and discussions to be held with the aggrieved person should be conducted. If the grievance relates to valuation of assets, an independent valuer should be

requested to revalue the assets, and this may necessitate a longer period. In this case, the aggrieved person must be notified by the sub-county Leader that his/her complaint is being considered.

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 district Administration.

The Grievance Committee will then attempt to resolve the problem (through dialogue and negotiation) within 14 days of the complaint being lodged. If no agreement is reached at this stage, then the complaint can be taken to Courts of Law for further hearing.

The complainants will be exempted from all administrative and legal fees that might be incurred in the resolution of their grievances and complaints. The Grievance Committee will prepare a report-containing summary of all grievances and will make this available to Municipality on a quarterly basis.

7.2 Recruitment of Workers

It is a responsibility of the Contractor to carry out recruitment of workers to help during Construction. Workers in this project phase are anticipated to be recruited from the surrounding community of Himutu, Mazimasa and Kachonga sub-counties. The recruitment of labourers will require a careful consideration whereby the contractor has to liaise with the local authorities. Order and discipline approach in recruitment process is required.

The following should be considered by the contractor as he prepares to initiate the recruitment process:-

- ✓ The maximum distance from which the labour will be chosen. Locally identify the area by landmarks or villages where people will come from;
- ✓ How many people are required by gender;
- ✓ Notifying the local chairpersons (their authority must not be undermined);
- ✓ The date and time they should arrive at the camp site/work place.

At a recruitment meeting, a brief explanation about the work and conditions of service should be given to all prospective candidates;

The required numbers of candidates selected should be based on their potential. There should be meritocracy in selecting workers;

The successful candidate must be given a detailed explanation of the work required and conditions of service. Among the important details are:

- ✓ The wage/salary rate;
- ✓ Time for work (8:00am-6:00pm)
- ✓ The system of task work;
- ✓ The pay periods and first pay date;

- ✓ Hand tool allocation and responsibility;
- ✓ Discipline and dismissal;
- ✓ Probable period of employment;
- ✓ Medical liability.

Ideally, a small leaflet containing this information in English and any other local language clearly understood by Job seekers should be availed to them.

The recruitment day is not a working day, and thus not a wage-earning day. After recruitment the people must be informed on which day to report for work.

7.2.1 Recruitment Procedure

- ❖ Identify the need for human resource
- ❖ Carry out advertisement by radio, news papers, television, notices, among others
- ❖ Carry out interviews for the shortlisted candidates
- ❖ Registration of bio-data for the selected candidates
- ❖ Award contract with signing of appointment letters. This should include provisions for paying tax, considering Trade Unions, among others

8.0 Impact Evaluation, Analysis and Mitigation

This section identifies both positive and negative impacts associated with the proposed construction of Doho II irrigation scheme project. These impacts are identified at three distinct phases of the project i.e. land clearing and preparation phase, operation phase and decommissioning phase although another study should be carried out during the project's decommissioning phase. The impacts were identified with due consideration to issues pertaining to the natural and socio-economic environment. These impacts are based on the design of the project, environmental and socio-economic baseline study, stakeholders' views, as well as expert judgment. While the positive impacts will be enhanced, adequate mitigation measures are provided for implementation to minimize, avoid, or mitigate the identified negative impacts. A detailed mitigation plan upon which each impact will be mitigated is given in table 8-1.

8.1 Impact assessment methodology

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need. The significances of the impacts were determined through a synthesis of the criteria as shown below:

Probability of occurrence: This describes the likelihood of the impact actually occurring. It can be;

Improbable: The possibility of the impact occurring is very low, due to the circumstances, design or experience (<25%).

Probable: There is a probability that the impact will occur to the extent that provision must be made thereof (25 – 75 %).

Highly Probable: It is most likely that the impact will occur at some stage of the development regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect (>75%).

Duration: This defines the lifetime/persistence of the impact on the subject environment as;

Temporary: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases (< 1 year).

Short term: The impact will last up to the end of the phases, where after it will be negated (1 – 3 years).

Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter (3 – 5 years).

Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient (> 5years).

Spatial Extent /Scale: Evaluates the area of occurrence/influence by the impact on the subject environment

Site specific: The impacted area extends only as far as the proposed site up to a distance within 1km radius of the site.

Local: The impact could affect the whole, or a measurable portion of the nearby environment including the neighbouring residential areas up to a distance within 5km radius.

Regional: The impact could affect a large area as far as regional level (above 5km).

Magnitude/ Severity: the quantifiable effects of impacts on the environment. Does the impact destroy the environment, or alter its function.

Low: The impact alters the affected environment in such a way that natural processes are not affected.

Medium: The affected environment is altered, but functions and processes continue in a modified way.

High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Overall impact Significance: This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. Using a combination of the above criteria, the overall importance of the impact is assigned a rating of **Severe, Substantial, Moderate, Minor, and Negligible** as described in the table 8.1 below.

Table 8.1: Criteria for rating impact significance

Impact Rating	Description of Impact
Severe	Highly noticeable, irreparable effect upon the environment Significant, widespread and permanent loss of resource Major contribution to a known global environmental problem with demonstrable effects Causing mortality to individuals of a species classified as

	globally or regionally endangered Major expedience of water/air quality and noise guidelines representing threat to human health in long and short term, causing widespread nuisance both on and off site
Substantial	Highly noticeable effects on the environment, difficult to reverse Widespread degradation of resources restricting potential for further usage Significant contribution to a known global environmental problem when compared with the industry world-wide Sub-lethal effects upon a globally or regionally endangered species compromising reproductive fitness and/or resulting in long-term disruption/disturbance to normal behaviour Air quality/noise approaching occupational exposure limits. Water quality parameters approaching maximum stipulated values Periodic widespread nuisance both on and off site
Moderate	Noticeable effects on the environment, reversible over the long term Localised degradation of resources restricting potential for further usage Sub-lethal effects upon a globally or regionally endangered species with no effect on reproductive fitness and/or resulting in disruption/disturbance to normal behaviour but returning to normal in the medium term Elevated contribution to global air pollution problem partly due to preventable releases Frequent breaches of water/air quality and noise guidelines Causing localised nuisance both on and off site
Minor	Noticeable effects on the environment, but returning naturally to original state in the medium term Slight local degradation of resources but not jeopardising further usage Disruption/disturbance to normal behaviour of a globally or regionally endangered species returning to normal in the short term Small contribution to global air problem through unavoidable releases Elevation in ambient water/air pollutant levels greater than 50% of guidelines Infrequent localised nuisance
Negligible	No noticeable or limited local effect upon the environment,

	rapidly returning to original state by natural action Unlikely to affect resources to noticeable degree No noticeable effects on globally or regionally endangered species No significant contribution to global air pollution problem Minor elevation in ambient water/air pollutant levels well below guidelines No reported nuisance effects

The anticipated **positive impacts** of the proposed Doho irrigation scheme project include the following:

8.2 POSITIVE IMPACTS

8.2.1 Improved Water for Productive Uses

The proposed irrigation scheme will help all farmers access enough water for agricultural production which will help them encounter the problems of frequent dry periods. Canals and other pipeline systems will be constructed throughout the rice fields. Apart from improving agricultural production this will avail additional water that would have been wasted to downstream users and thereby reduces water stress commonly experienced by farmers at the scheme.

8.2.2 Increased Agricultural Acreage and Productivity

The construction of the irrigation infrastructure and proper management of the irrigation scheme (through efficient water application and sustainable irrigation practices) is expected to yield considerable increase in the agricultural output of rice which is the main source of income to the surrounding communities. Over 817 hectares of land are projected to be put to use. The irrigation scheme will particularly encourage the rise of farmers groups that can support the supply of agricultural crops to the regional markets and will contribute to the overall economy of the regions and country as a whole.

8.2.3 Increased Job Opportunities

The project will provide substantive employment opportunities to local populations, particularly during the construction phase of the irrigation scheme. An influx of labourers and construction workers will characterize the construction phase, which will drive the demand for basic services including housing, transport, food and healthcare. The local communities will meet these needs; local women can provide food-vending services, homes can be rented out for the new population and small enterprises will benefit from increased sales of products and/or services.

During operation of the proposed irrigation scheme, increased agricultural employment and non-farm activities is also expected to occur as a result of increased agricultural acreage. Entrepreneurial activities in supplying inputs and other support services to the production activity will generate multiplier effects on the targeted communities through increased

income and creation of job opportunities especially to 50% of the targeted youth and women.

8.2.4 Environmental Protection

The proposed project will be based on a catchment approach that will not only improve the livelihood of people living in the catchment area, but also promote sustainable development of the watershed to address environmental challenges (land degradation) in the project areas. Tree planting and other watershed management activities planned as part of the project will contribute to restoration of forest cover and ecosystems (over 15-20 hectares are projected to be restored) thus reducing soil erosion, water pollution, combat desertification and deforestation as well as enhance water catchment functions. These activities will mitigate climate risks and contribute to reduced vulnerability to extreme weather events and provide a more secure social environment for targeted populations.

8.2.5 Market Creation

During the construction phase, the project will create a market for building and construction materials. Once the project is operational, demand for seeds, pesticides and herbicides will increase, spurring the market development. In addition, alternative livelihood sub-component of the project would create markets for farm raised fish production (aquaculture). The growth of markets, new businesses and economic development along the access road that connect the irrigation scheme with the nearby road network will have added social benefits including access to healthcare and educational facilities.

8.2.6 Opportunity for training and skills acquisition

Successful implementation of the project activities will require dynamic and multi-disciplinary professionals including agronomists, irrigation experts, among others. Regular short and tailor made training courses and seminars will be organized to reinforce the capacity of the farmers and project stakeholders. Some of the proposed training activities will be done for the operations and maintenance of the irrigation infrastructure and farm management. This will enhance the skills of community members.

Irrespective of the above stipulate positive impacts, FIEFOC-II project will contribute to long-term environmental positive impacts in the project areas including:-

a) Improved land conditions due to improved land management from sustainable land management activities promoted through the project to reduce land degradation and improve soil fertility; and
b) Enhanced soil and water conservation measures and activities as well as improved watershed management programme whose net impact will be improved soil and water conditions.

8.2.7 Sourcing of construction materials

Irrigation scheme construction activities will require considerable volume of materials including gravel (murram), aggregate (stone) etc. Other materials include lime, bitumen,

water, cement and culverts especially for effective drainage. Procurement of these resources connotes income to suppliers and owners of land where quarry sites will be located. This is a positive but short-term and reversible impact.

Impact enhancement:

- Earth materials shall be procured from legal / licensed quarries and agreements should be made between the site owners and the client. More so as a contractual obligation the contractor should restore all depleted quarry sites upon closure;
- Site restoration should utilize native vegetation species and replanting undertaken during rain seasons to ensure high re-vegetation success.

8.3 Potential Negative Impacts during Construction

In this section, potential impacts have been identified and their mitigation measures that should be adopted to avoid or minimize potential adverse impacts are recommended. Of which, some involve good engineering practices while others are viewed from socio-economic as well as administrative points of view. The impacts described in this section are potentially the most important as far as the overall impact of the project is concerned. In all cases, there is a relatively high probability of occurrence of these significant impacts if no mitigation measures are adopted.

8.3.1 Construction Phase

The construction phase involves several activities including; site clearing, site installations, trench/canal excavations, earth stripping, road network clearing and levelling, construction of a dyke, reservoir, canals, levelling and partitioning of land into rice paddy plots for cultivation. Anticipated adverse impacts are discussed hereafter.

8.3.2 Impacts of equipment yard and workers' camp site

Although the design consultant can propose location of the workers' camp and equipment yard, the final decision lies with the hands of the contractor(s) but any selected site would have to be approved by NEMA when the contractor has carried out independent Environment project briefs in liaison with a registered Environmental Practitioners.

Although a workers' camp and equipment yard would cover a relatively small area, they can cause significant environmental damage for a considerable time if not controlled. Land clearing will lead to loss of vegetation. The major causes are pollution (due to all forms of waste/ litter), high water demand, soil erosion, spillage of oils and fuel, fire and; explosion hazard at fuel storage/ refueling areas. Lack of emergency medical capability at the camp site can pose life threatening situations even from relatively simple incidents such as mosquito bites.

Socially, if the contractor does not come up with an effective plan, workers' camp could be hotspots for prostitution or illicit sexual relationships, breaking marriages and causing disquiet in adjoining community.

Camp and equipment yard will require land to develop, temporarily altering land use. Their operation will generate domestic and hazardous waste (waste oil) which if improperly managed will contaminate local environmental resources (soil, underground and surface water sources) and pose public health risks. Failure to restore camp and yard site would cause aesthetic blight and remnant contamination from fuel, oil or unused bitumen. Workers camp site is also associated with various forms of waste (food remains, plastic, paper etc). All these have potential for environmental contamination.

Other potential impacts from camp and equipment yard include light pollution when floodlights are not directed downwards. Derelict equipment left by contractor's at improperly restored camp or equipment yards pose environmental and public health risks.

Duration of impacts is short-term; the extent is local but the likelihood is high. Due to the small footprint, impact severity on receptor community will be moderate (medium) if the site is left uncontaminated rendering overall impact significance to be moderate.

This impact will occur where site camp and equipment yard are located (note that this will be a responsibility of the contractor and specific locations are not known at this point). The likely receptors will include:

i) Owners of sites left contaminated;
ii) Soil and water resources near storage site;
iii) Communities near camp site;
iv) Site construction crews (in case of OHS accidents and fire outbreak).

Mitigation measure(s)

i) The contractor shall undertake a project Brief for the camp site and equipment yard. The project brief should have a well detailed section addressing issues such as waste management, Occupational Health and Safety etc.

The waste management plan should present likely sources of waste, their type (liquid, solid, domestic etc) and quantity estimates based on proposed equipment and workers. Based on the type of wastes generated, treatment and disposal mechanisms should be presented. Measures for waste reduction, treatment and disposal should be implemented. Record of all disposal locations and potential disposal locations which require approval of the Supervising Engineer in liaison with subcontracted licensed waste collection companies are to be presented. These should necessarily include details of:

i) Disposal of cut-to-spoil indicating quantity generated, disposal and disposal locations / potential locations with photographs;
ii) Waste concrete, bitumen, cement and empty cement bags indicating quantity expected to be generated and disposed;
iii) Waste oils from service bay and oil spills as well as oil from cleaning of service bay
iv) Oil and grease from vehicle washing bays;

v) Kitchen waste indicating quantity generated, quantity disposed and location of disposal;
vi) Sanitary waste management.

Camp waste shall be segregated and stored in separate containers. Waste such as food remains, plastics, paper should be kept on site after being sorted until collected and hauled to the recognized land fill by Butaleja District. This is intended to reduce potential risk for surface and groundwater contamination at the site under construction. The contractor should collect and store waste oil on site awaiting collection by NEMA licensed Hazardous Waste Collection Company. The site contractor should on the other hand obtain petroleum fuel storage license from Petroleum Supply Department under Ministry of Energy and Mineral Development.

Mitigation measure(s)

i) Contractor should sensitize workers about potential for environmental contamination due to improper waste management practices;
ii) The contractor should ensure waste types (organics, inorganic, hazardous etc) are segregated and responsibly disposed of. Containers should be provided for safe onsite waste containment and segregation before final disposal;
iii) Camp site and yard should have adequate sanitation facilities (mobile toilets) that are gender considerate;
iv) Living quarters should be gender friendly as well;
v) Contractor should provide clean water at camp site, ensuring that water supply is permitted by National Water and Sewerage Corporation;
vi) Contractor should not dump waste oil in drains, watercourse or on land but instead be collected and disposed of by a licensed firm.

Onsite combustion of waste shall not be done at camp;
Smoking in communal areas at camp and near fuel storage areas should be prohibited and signs to this effect posted in visible areas;
A site clinic should be set up with a medical practitioner and medical facilities including condoms for HIV/AIDS control;
HIV/AIDS sensitization programmes shall be conducted at the camp depending on the procedure and schedule devised by the HIV/AIDS Sensitization and Control service providers;
On completion of the project, contractor should remove structures and site restored to its original state to leave room to local community or land owner for use; Exposed areas shall be replanted with indigenous vegetation species to enable it regain its original appearance;
For fire safety, contractor should provide fire extinguishers and signage in camp including refueling areas;
Contractor should ensure that potentially contaminated runoff from storage areas should be drained through oil traps/interceptors;

All on site living structures should have approved electrical wiring for safety of occupants;
At end of camp and equipment yard useful life, these sites should be remediated and all equipment and waste carried away for disposal by NEMA-licensed entities. This is especially in regard to:

- ✓ Waste tires;
- ✓ Containers originally containing bitumen;
- ✓ Containers originally containing road marking paints.

8.3.3 Occupational safety and health risks for workers

Construction works are likely to be associated with the following occupational safety and health risks with potential to cause serious injuries to on-site workers:

i) Accidental burns as a result of handling hot bitumen;
ii) Electrocution;
iii) Poor sanitation;
iv) Injuries most especially at the quarry site i.e. flying rocks during blasting that is incase the contractor decides to opens up its own site;
v) Noise and body vibration from machinery equipment.

Construction machinery is projected to be noise intensive and cause discomfort to the nearby communities. Construction noise is a major source of environmental noise pollution and a cluster of equipment at construction site can produce a steady roar from morning to evening hours. Lack of hand wash water and mobile toilet facilities at work sites could also pose considerable health risk to workers and the surrounding communities where the proposed project is taking place.

Occupational Safety and Health (OSH) impacts will potentially occur at any point during construction activities and whilst some accidents could be minor, others might be severe leading to disability or loss of life of construction workers.

Part III Section 8 (1) of the National Environment (Noise Standards and Control) Regulations, 2003 requires machinery operators, to use the best practicable means to ensure that the emission of noise does not exceed the permissible noise levels. The regulations require that persons to be exposed to occupational noise exceeding 85 dBA for 8 hours should be provided with requisite ear protection.

The Bank regulations on the other hand require that the noise level does not increase 70 dB (A), thus supplanting the national guidelines. This presents the regular practice under the African Development Bank projects, when in case of divergences between national and AfDB guidelines the more stringent apply.

Duration of the impact will be short-term occurring only during the construction phase. Extent of the impact will be local or national depending on origin of construction workers.

Likelihood of the impact occurring is high considering the usually low level of safety at most road construction sites.

Mitigation measure(s)

The contractor will develop a comprehensive OSH plan with clear and well articulated assignment of responsibilities which should among others address the following:-

i) Provision of all workers with requisite protective gear i.e. gloves, gumboots, overalls, muffs. To effect this, the contractor shallemploy a full time health and safety officer to ensure compliance;
ii) The contractor shall set up a functional site clinic with a registered nurse and Doctor on call to provide basic treatment to injured workers;
iii) Provision of onsite mobile sanitary facilities;
iv) The contractor shall provide functional and well stocked first aid kits to all work sites and have staff trained in provision of first aid services;
v) The contractor shall prepare a Contractor's Environment and Social Management Plan (CESMP) to ensure effective implementation of the environment and social mitigation measures. This shall be reviewed by the client and approved by the supervising consultant.

Impact management

Project supervising engineers should inspect contractors' compliance with safety precautions during construction.

8.3.4 Sourcing of construction materials (gravel, sand and stone)

Scheme construction activities will require different types of materials ranging from earth materials that is, Sub-base material (natural gravel or murram) and Base course material (hard rock /crushed rock aggregates) for the roads and other proposed infrastructures.

Even though it is a responsibility of the assigned contractor to select preferred sources (locations) of aforementioned earth materials that meet design specifications, the consultant has also proposed sites with appropriate raw materials to be used during construction and these areas were found in Miyaya village, Mazimasa Sub county, Butaleja District for the sand/gravel and Waale village, Busiu Sub county Mbale district for the stone aggregates and the assessments have been made. It is important to note that even though the consultant has identified these quarries and borrow sites, the final decision still remains with the contractor. All the sites proposed to be opened up during construction need to be restored upon completion of the project. More so, where these materials are obtained from, method of their extraction, haulage and state in which sites are left upon project completion all have potential for socio-environmental impacts below:-

i) Clearing of vegetation to create access to material sources;
ii) Excessive noise, vibrations and dust from stone blasting and crushing. Noise would affect local communities and quarry workers and vibrations will crack structures and

affect health of especially elderly people around stone quarries;
iii) Fly rock which damages crops, dwellings/ structures and even pose injures people within the jurisdiction of the quarries;
iv) Haulage impacts, for example, accident risks and road dust;
v) Safety and public health risks of un-restored quarries and borrow pits.

Direct and secondary effects (noise, vibrations, dust, fly rock injuries, etc) associated with stone/ rock quarrying and excavation of gravel can pose negative and sometimes irreversible social impacts. Gaping pits due to un-restored pits cause visual blight and scarring of landscapes besides posing public health and safety risks. Some secondary impacts of stone blasting and quarrying such as injury or death caused by fly rock are irreversible. Damage to dwellings near quarries would be a considerable social impact in rural poor communities. Unless a firm contractual commitment is made by the contractor, leaving un-restored quarry sites is a common practice by road construction companies and likelihood of this impact occurring is high. Impact severity is medium (or even low) except when quarries are located close to communities, an unlikely situation unless alternative sites cannot be found. Impact significance is therefore moderate.

Mitigation measure(s)

All stone quarry sites to be opened up will be subjected to a standalone EIA by contractor while borrow pits should undertake a Project Brief and should be a contractual requirement for the contractor to integrate quarry restoration plans in the general project implementation. To this effect, the contractor should ensure that contracts are made between the landlords and the client (contractor) and copies made available. The agreement should entail:

i) Site restoration as construction commence concurrently so that cut to spoil is used to fill up quarry sites;
ii) Height and orientation of the quarry face need to be controlled if reinstatement is to be effective;
iii) Excess soil (overburden) from road excavations should be stockpiled at quarry sites to be used during site restoration;
iv) Access road to quarries if not needed by local community should be scarified and re-vegetated;
v) Site restoration should utilize native vegetation species and replanting undertaken during rainy season to ensure high re-vegetation success;
vi) Rock blasting should utilize licensed blasters and all explosives handled as per national security requirements.

It is worth noting that in case the contractor decides to use construction materials from the already existing quarry and borrow sites, the site owners/operators should share EIA

Certificates with the contractor (client) of which he has to adhere to all the stipulated approval conditions.

8.3.5Soil Erosion

Activities including; site clearing, excavations for the dyke, roads and reservoir, road clearing, excavation of trenches for irrigation delivery and distribution canals, will all involve clearing of vegetation where the soil will be exposed to the agents of erosion, mostly run-off and wind. This impact, though occurring on during construction period, If not combated, it can develop into a cumulative impact of loss of valuable productive soils to the receiving waters, sedimentation of receiving waters, silting and blockage of delivering canals, and loss of agricultural productivity of the marshland.

Mitigation Measure(s)

Soil erosion effect can be avoided or reduced by implementing a number of measures. These are:-

i) Plan to excavate the plot sections demarcated for construction, in stages to avoid opening up of big sizes of the area and increasing the level of risk to erosion at any one time;
ii) The project can possibly be fast tracked so that the time the land is left bare and exposed to potential erosion agents is minimized;
iii) Debris in the compaction and construction of the foundation for the structures should be resurfaced and leveled;
iv) After any excavation or trenching is completed on site, immediate backfilling and resurfacing should be done to avoid facilitation of erosion agents. Compaction will be necessary to stabilize the soil. Planting of grass on bare land, slopes of the dyke embankments to minimize erosion tendencies should be given priority;
v) Avoiding vegetation clearance that will expose soil to agents of erosion during construction phase;
vi) Re-vegetate the cleared sites with local species of vegetation.

8.3.6 Haulage of earth construction materials

Scheme construction activities will necessitate transportation of materials from sources to worksites. Haulage of gravel (murram), sand and crushed stone (aggregate) from sources to construction work sites will be associated with traffic accidents involving people, noise from haulage fleet and staining of community business and households with dust.

Oftentimes no compensation is given to the affected communities. Staining of trade commodities in roadside shops (especially merchandise) with dust translates into a financial loss for local business owners.

Excessive dust poses health impact especially to children and elderly people that are within the pass ways of haulage fleet. Unless speeds are controlled, material haulage poses a risk

of road accidents especially near school crossings, livestock crossings and in Doho irrigation scheme site itself.

Risk of this potential impact occurring will be highest in trading centres most especially along the road connecting to the site. Material haulage will be short-term ceasing with completion of construction activities but secondary effects (if they occurred) such as accidents (hence disability or death) have negative, long-term and possibly irreversible socio-economic impact. If mitigation recommendations are implemented, likelihood of impact occurring is medium but (if not well attended to) impact severity will be high especially when accidents involve loss of lives. Disabled people, children, women and elderly people are especially at risk of road accidents. Significance of dust will be comparatively highest within the entire proposed site.

Mitigation measure(s)

i) The contractor shall control dust by sprinkling water wherever necessary at least twice a day;
ii) Contractor shall provide temporary road signage during construction and ensure drivers observe speed limits and for safety of other road users;
iii) Contractor should deploy traffic guides warning signs where necessary, most especially along the proposed sites under construction;
iv) Contractor shall provide temporary and permanent speed reducing devices e.g. ramps;
v) Contractor shall erect temporary signs along routes used by haulage trucks;
vi) To avoid excessive haulage traffic noise at proposed roads, the contractor should not install temporary speed reduction features (ramps). This would avoid noise associated with high speed deceleration and acceleration at ramps.

Impact management:

- The contractor should sensitize project drivers on accident risk and control measures;
- The contractor should compensate victims of accidents.

8.3.7Asphalt plant impacts

In case the implementing Ministry plans to surface the irrigation scheme roads, it will require bitumen. Location of the plant, bitumen preparation, storage and application could have socio-environmental impacts. Littering due to poor housekeeping at the asphalt plant or improper disposal of unused bitumen and aggregates or bitumen spills would have the localized impact of contaminating environmental resource (soil and water). This impact is negative, temporary and reversible but likelihood of it occurring is low since ingredients of asphalt (bitumen and aggregate) represent a financial cost to the contractor and waste is unlikely. Since contamination impact would often be localized, spatial extent is small. For the foregoing reasons impact significance is moderate.

Mitigation measure(s)

i) Locate the plant away from sensitive ecological areas or resources;
ii) Ensure good housekeeping to avoid onsite and offsite environmental contamination by bitumen;
iii) The contractor shall collect leftover bitumen and aggregates properly keeping it for use on other sections of the road;
iv) Contractor shall use bitumen emulsion where feasible. In hilly areas with steep road gradients, cut-back bitumen should be used;
v) Contractor shall not discharge bitumen into road side drains;
vi) Contractor shall collect and store empty bitumen drums at equipment yards and not abandon them at the site.

8.3.8 Traffic diversion during construction activities

It is inevitable for irrigation construction works not to have diversions of traffic from sections being worked on (especially roads); this will be done to allow fast and safe road works or continued use of the road. However, construction being a rural setting impact is negative but temporary (short-term) and reversible (note that effects of accidents such as loss of life are irreversible). Likelihood of this impact occurring is very low; however it will be short-term ceasing with end of construction hence medium severity. Additionally, not all proposed roads within the irrigation scheme will necessitate diversions hence impact severity is medium and overall impact significance is therefore moderate.

Mitigation measure(s)

i) Contractor should place signs warning to road users about traffic detours;
ii) Contractor should have guides at detours to organize traffic.

8.3.9Management of Cut to Spoil

The setting out of the road works and its general civil works is anticipated to generate huge Volumes of Cut to Spoil Materials that will need to be disposed of. This EIA cannot with certainty establish the quantities of such materials. However during project implementation, the contractor in liaison with the district environment officer will select a suitable site for dumping these huge quantities of cut to spoil materials.

Mitigation measure (s)

i) No dumping of such materials should be encouraged along the road especially at the road reserve areas;
ii) The Contractor will have to acquire dump sites where the cut to spoil materials will be deposited; this will be attained through liaising with the district Environment officer to identify a suitable site;
iii) There should be consent with land owner guided by the local authorities to the effect that some of the cut to spoil could be used in restoration of some sites in their areas.

Table 8-2: Solid Waste Management

Solid Waste Management Issues		Waste Management and Disposal Methods / Provisions
1.	Responsibility of waste generator (Contractor)	❖ Waste from construction activities shall be disposed in designated waste disposal area approved by the District environment officer; ❖ Waste generated shall be collected, segregated at the source and disposed off in designated waste receptacles only (e.g. excavated materials from the site during site preparation); ❖ Waste contractor should ensure that waste is transported by a person who is licensed to transport and dispose off waste in designated waste disposal area within the municipality.
2.	Segregation of waste generated	❖ Use the 3R Waste Management Approach, i.e. ***Reduce,Reuse*** *and* ***Recycle*** whereby waste shall be segregated – plastics, glass, tins, papers, wood, metals etc (later to be re-used or recycled);
3	Application of Cleaner Production principles (Waste minimization from the source)	❖ Enabling the recovery and re-use of waste where possible (e.g. plastics bottles etc)
4	Waste Transportation	❖ During the construction and operation of the project, all the waste transport vehicles from the proposed project shall be from licensed waste collection firms by the relevant authorities.

8.3.10 Social ills of construction workforce

The influx of workers, typically young males seeking irrigation scheme construction jobs will be associated with a series of social challenges such as crime, alcoholism/illicit drug abuse and prostitution. These are often related to the spread of sexually transmitted diseases including HIV/AIDS. Vices such as drug abuse and prostitution would affect social coherence

and security in project communities tarnishing the image and intent of an otherwise good project.

a) Crime, drug abuse and prostitution

Unless sensitization of all workers is undertaken by contractor, the likelihood of the impact occurring is medium (considering some level of awareness among general populace). Duration of above-mentioned social ills will be short-term ending with completion of the irrigation scheme project but associated social and health effects can be long-term and irreversible, especially new HIV infections. The risk of HIV makes this impact of high significance and likely to affect road construction workers and local communities within the three sub-counties of the scheme.

Mitigation measure(s)

i) The contractor shall involve local leaders in labour recruitment to ensure people hired have no criminal record;
ii) Butaleja district local government and the contractor shall collaborate with all security organs to contain criminal activities;
iii) Locals should be encouraged to actively participate in construction of the project thereby reducing on need for migrating population for work that can otherwise be done by the locals in the area. The contractor should establish recruitment centres at village or sub-county level and public recruitment notices on public notice boards. This would reduce on the migrating population;

b) HIV/AIDS Concerns

The influx of male workers into the project area will increase the risk of HIV/AIDS transmission. The National AIDS survey of 2011 puts the HIV/AIDS prevalence for Butaleja categorized under Mid Eastern Uganda at 4.1%. By comparison, this is considerably a relatively higher prevalence which is attributed to the increased population of the district over the years, which creates socio-economic environment that increases vulnerability of individuals to high risk practices. Therefore, with the estimated influx of an estimated 30% workers to the area, the HIV/AIDS situation may be of concern.

Mitigation measure(s)

i) The project will engage an HIV/AIDS Service provider to provide HIV/AIDS related services such as awareness campaigns and amongst others.

Impact management

i) As a contractual obligation, the contractor should have an HIV/AIDS Policy and action plan to implement it for this project;
ii) Through posters, flyers or weekly sensitization sessions continually provide HIV/AIDS awareness to construction workers;

iii) The contractor shall prepare and enforce a code of conduct (approved by the client) as part of the CESMP to govern the behaviour of workers on site with the surrounding community.

8.3.11 Child labour

Construction activities at Doho irrigation scheme will employ a multitude of people, both experts and the non-expert teams ranging from foreign to local employees. These employees have different ranges of age and among these are workers under the age of 18. Due to the need of employment and opportunity to earn a living young boys under the age of 18 get involved in casual work that exposes them to a number of hazards and accidental risks.

Mitigation measure(s)

i) Adequate sensitization for the community targeting, the parents, children, schools and community associations not to allow their children to participate in irrigation scheme construction works due to the hazards and risky environments associated with them; and
ii) Contractor will keep record of the age numbers for all their employees so as to avoid employing those below the age of 18.

8.3.12 Gender Concerns

The Government of Uganda's (GoU) National Gender Policy seeks to ensure that, a gender perspective is taken in all development programs. Similarly, the government recognizes the importance of transport infrastructure in reducing poverty, promoting investment and human development, and strengthening the capacity to deliver social services of which women play a key role both as providers and recipients. While all persons in the Project area will be affected by the project; it is envisaged that women will bear a greater burden. The expected negative impacts on women include exposure to HIV/AIDS and STIs and increased sexual exploitation of young girls which will also lead to unwanted pregnancies, dropout from school and concerns of poor distribution of employment opportunities for the women.

Mitigation measure(s)

i) The contractor should allocate a certain percentage (e.g. 10%) of jobs to be taken up women. To the extent possible, there should be gender sensitivity in task allocation to the women;
ii) The contractor should conduct gender sensitization to the work force on matters such as gender sensitive communication and on the gender sensitive conduct of workers towards women amongst others;
iii) The contractor should hire a Gender Specialist to help engender the project in line with the National Policy on Gender provisions.

8.3.13 Accidents

Increased movement of vehicles during construction may lead to increased accidents among local communities, construction workers and vehicles operators. Educational campaigns will be mounted in order to reduce the risk of increased road accidents. Contractor in liaison with Butaleja district authority will enhance compliance with road safety measures for both the site workers and the neighbouring communities within the proposed irrigation scheme. The designs should include provisions for lay-byes to improve road safety.

8.3.14 Climate Change Impacts

Emissions from construction machinery contain greenhouse gasses. Quantities generated will depend on type, age and number of equipment used during construction while operation-phase emissions will depend on the number of vehicles accessing the scheme for rice. These emissions would have a cumulative negative effect on local air quality global climate change.

Embodied carbon associated with construction of the irrigation would also to some extent have Climate Change effects. Embodied carbon refers to energy consumed and resultant carbon emissions associated with production of materials used in construction of the proposed scheme activities, including extraction and transport of raw materials. To mitigate these impacts, the Contractor should ensure use of equipment in good mechanical condition; motorized equipment is in good mechanical condition and regularly services to reduce emissions hey generate; Use of low roughness: Fuel consumption of vehicles driving on a road depends, among others, on roughness of road surface. Low roughness will therefore reduce GHG, Use of modern bitumen plants that have the capacity to minimize carbon emissions.

8.3.15 Dust Pollution

Dust in construction areas originates mainly from the scraping of the earth surfaces. Dust can also originate from the movement of heavy machinery on earth roads especially deviation routes. Dust will also originate from haulage activities of the ballast chipping. Dust emissions from earthworks, operating equipment, and from construction traffic can be minimized by watering of deviations and works sites.

8.3.16 Conflicts due to competing water requirements

The water demand patterns indicate that, the increase in water for irrigation activities has affected the daily distribution pattern. This has affected the supply regime to the respective blocks. There are no other irrigation schemes around Manafwa river downstream which share the same water source, although release for domestic, livestock and other environmental demands are considered. The modifications may have detrimental effects on the water quality, water availability, aquatic life and riverine vegetation in the downstream area.

Mitigation measures

i) Regular maintenance of the irrigation infrastructure to remove silt will be ensured to allow sufficient water for downstream users including environmental flow requirements
ii) The design will ensure all drainage waters from the scheme are diverted back to the main river course;
iii) Water conservation measures will be promoted among farmers, efficient water management measures established and restrict water abstraction to what is absolutely necessary;
iv) Sensitization and capacity building of water users will be carried out to ensure efficient use of water.

8.3. 17 Loss of Crop and Income

The construction works will disrupt the water supply to the scheme that may affect the cropping calendar and hence the operation efficiency of plots. The construction works especially at the head works could affect the irrigation schedules and hence have an impact on critical crop growing stages that need adequate water supply especially during the dry season where severe water shortages are experienced. If unchecked, farmers within the scheme could lose their rice crop. Prior discussion with the community should be made in order to minimize the impacts of disruption of the flow to the scheme.

The area of influence of this negative impact is in the direct impact zone that is within the scheme and the downstream farms and it is likely to be temporary in nature. However this impact could also be wide where farmers have order for supply of produce to markets outside Butaleja district. In terms of intensity it is likely to be high in the dry season where water shortages can significantly affect crop yield. The probability of occurrence of such impact is high without mitigation. The overall significance of this impact is moderate. However with planned or phased leveling of fields and works on head works and canals, as well as diversions, the impact could be minor because while the construction works would have a short term effect on the flow of water to downstream farms (construction is planned for one year), returning normal after completion of works, and only one planting season will be affected with mitigation measures below implemented.

Mitigation

In order to ensure that farmers are not more vulnerable than they are at the moment the following measures should be put into account:

i) Plan for temporary diversion of water during the construction phase;
ii) Give redundant workers the first priority for jobs during the construction phase;
iii) In collaboration with other Government programmes ensure that access to food and social services is enhanced through support to communities so that even though there is likely temporary disruption in income, farmers do not have to spend more in times of shortage;
iv) The contractor to restrict equipment and truck movements along designated routes;

v) Farmers should be sensitized on planned works and schedules before the rehabilitation activities, and works on roads are carried out.
vi) The leveling of fields to be phased, and undertaken after harvest, with advance notification given to farmers

MWE and the Contractor to liaise with local Authorities, particularly the Butaleja District Natural Resources Department (Wetlands, Environment), Production, Water and Community Development Officers in carrying out sensitization of farmers and scheduling works.

8.4 Operation Phase

The operation phase entails holding water from Manafwa River by construction of a water intake and distributing water through canals to plots of land partitioned for rice growing.

8.4.1 Physical Environment

8.4.1.1 Loss of soil fertility from monoculture and use of inorganic fertilizers

With all year cultivation of the single crop of rice, no period left for soil to regain its fertility, soil fertility will continue to deteriorate hence calling for the application of fertilizers. Organic fertilizers application to boost soil fertility may cause acidification of the soil once they exceed threshold upon which it suffers what is termed as "field fatigue" from intensive monoculture. This could cumulative to low crop yield. If this is not tackled under the project program then the purpose of the irrigation scheme will fall short of its achievable goals.

Mitigation Measure(s)

As a government initiative to boost agricultural sector, the following are the mitigation measures towards avoiding loss of soil fertility from monoculture and use of organic fertilizers, the following suggestions were made:-

1. Practices such as intercropping rice with alternate crops which are adaptive to the soil conditions left by the rice from the previous season will mitigate monoculture. By breaking the continuity of rice growth, then the alternate crop may facilitate restoration of soil to its original fertility;
2. There is also a possibility of resting the land after a period of rice growing, to allow the soil to regain its fertility, hence reducing on the fertilizer required or promote use of rice variety with a four (4) month growing cycle instead of six (6) months hence reducing on strain imparted on the soil.

The remedial measures above seems fit for only small scale agriculture but for a project as large and intensive as this, such measures are not applicable, instead more robust measures are proposed:-

1. Periodic soils tests are recommended to measure its nutrient levels, acidity levels and other soil characteristics that might determine the trend of soil fertility. This monitoring will guide decisions on what amounts and types of fertilizer are required for these soils and any relevant practice required to improve soil fertility in case it's depreciating;

2. It is also proposed that a combination of inorganic fertilizers is applied with organic fertilizers to reduce on the acidity caused by inorganic fertilizer. As such a combination is applied, less inorganic fertilizer will be applied and instead more organic fertilizer will be used until only organic fertilizer is used. Organic fertilizers could not be proposed for application on their own as an alternative in the first place, for reasons that though they are the most suitable they are slower to effect soils positively plus they also take longer to be formed.

8.4.1.2 Water pollution

Use of fertilizers and pesticides is a non-point source potential for introduction of nutrients into the likely receiving waters downstream of the rice paddies as a result of run-off. Agro-chemical fertilizers such as; NPK and Urea ($CO(NH2)^2$) containing compounds of Nitrogen, Phosphorus and Potassium and, proposed for boosting soil fertility and pesticides will very likely drain into the river causing eutrophication (Enhanced evasive aquatic flora).

Nutrients will cause de-oxygenation of the water source, in this case Manafa River and downstream recipients of its waters, leading to complete reduction of oxygen which is a life support to all aquatic ecosystems. However, Water pollution from irrigation activities in this project is not going to be significant due to low quantity of agrichemicals used.

Mitigation Measure(s)

1. To avoid this impact, the farmers should adopt Integrated Pest Management practices instead of applying pesticides. For fertilizer, the farmers should be trained on the right application of fertilizer and safe use of pesticides. This is a practice that can immensely contribute to the reduction of possible chemical pollution of the receiving waters. Training on pesticide application may be specifically directed to the quantities to apply, timing (when), and protective gears to wear among others and should be incorporated in the Pest Management Plan.
2. Alternatively, a baseline test of the water quality and progressive tests are necessary to understand the effect of the project on the quality of water bodies and curb any likely impacts there may be before water quality deteriorates. This can be effected through liaison with the Directorate of Water Resources Development (DWRD) to monitor the quality of these waters for precaution purposes.

8.4.1.3 Water logging and salinization

There are several ways through which salinization can occur in irrigation practice. These ways are:-

a) Addition of lime in most of the soils during the cultivation to boost the soil fertility;
b) 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 rice crop;
c) Salts which occur naturally in soil may move into solution or may already be in solution in the form of saline groundwater. This problem often occurs in deserts or

arid areas where natural flushing of salts (leaching) does not occur and where the groundwater level is both high and saline, water will rise by capillary action and then evaporate, leaving salts on the surface and in the upper layers of the soil; and

d) 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. The salt concentration of incoming flows may increase in time with development activities upstream and if rising demand leads to drain water reuse; irrigated regime is intensified, even though the saline layers might be far below the soil surface and the irrigation water applied is of high quality.

Based on the above means of salinization, there is high probability of salt build up to occur in the intervention areas especially through the residue salts and salt build up in the soil profile.

Mitigation

1. 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;
2. 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.

8.5 Biological Environment

8.5.1 Invasive aquatic weeds

Eutrophication of the reservoir from contaminated run-off by fertilizers applied on rice fields could possibly encourage resurgence of water hyacinth and any other aquatic weeds in the reservoir. In addition native aquatic weeds are likely to become more invasive to the reservoir. This could eventually affect the efficiency of the reservoir to hold water resulting in insufficient irrigation in the command area.

Mitigation Measure(s)

1. Periodic manual removal of weeds from the reservoir should be considered to avoid the possibility of an uncontrollable invasion of the reservoir by weeds;
2. Introduction of fish species that feed on invasive aquatic weeds into the reservoir hence reducing on the possibility of large quantities of weeds in the reservoir;
3. Controlled use of fertilizers and pesticides on the fields to reduce on eutrophication from contaminated run-off.

8.5.2 Emergence of pests

Examples of pests are birds that feed on grain and would increase in number once rice fields are multiplied in the proposed area. Such pests could affect production if not well handled.

Mitigation measure(s)

i) Scare crows are an old traditional means of preventing birds from encroaching on the fields. These along with rotating shifts of adults watching rice fields are one way to solve this issue. **Caution:** Children should not be allowed to skip school to chase away birds from the rice fields.

8.5.3 Water conflicts as a result of irrigation scheme development

With the expansion of the rice irrigation scheme that involves demarcating of the marshland into plots, land consolidation program for collective growing and harvesting, distribution of water through canals for irrigation, if the locals are not organized into institutional frameworks, this might be a cause of conflict over who gets water for irrigation and what amount is meant for each of the plots, quarters or sectors. This can escalate in conflicts, enmity or vandalism.

Mitigation Measure

1. Farmers should be encourages to form cooperatives. Farmers will be sensitized on the importance of working together as well as attaining trainings in modern techniques of rice growing so as to have the benefit of irrigation for cultivation throughout the year.

8.5.4 Vandalism of Irrigation infrastructure

With the new proposal to construct the scheme, a number of infrastructure will be made from metal or steel or concrete, for example; sluice gates, valves, HDPE Pipes. 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. Therefore if farmers are not organized in such as to have community policing to guard the infrastructure and crops of the marshland, they will be vandalized and sold elsewhere.

Mitigation Measure(s)

1. Early establishment of cooperatives 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;
2. Regulations on penalties against perpetrators convicted of vandalism are necessary. Punitive actions towards perpetrators by the authorities will facilitate compliance by the locals thereby avoiding vandalism.

8.5.5 Increased spread of Water related diseases

In reference to expert knowledge, the presence of canals supplying water to different sections of the scheme is to increase incidences of contracting water related diseases such as; malaria, bilharzia, because the canals would serve as a breeding ground for mosquitoes and bilharzia snails. Water borne diseases such as; dysentery, diarrhoea, stomach-related

disorders specifically infestation by worms, all resulting from using the irrigation water for domestic purposes (drinking and cooking).

Mitigation measure(s)

i) The project management should liaise with MOH in issuing mosquito nets for those who don't have, to reduce on the spread of malaria resulting from the created water mass in these areas. This should go along with sensitization of sleeping under a mosquito net and its importance to the locals;
ii) Locals should be restricted from using water from the reservoir for domestic consumption; As a matter of fact, the project management should ensure the existence of alternative water points close enough to the locals in order to prevent locals from resorting to fetching unhealthy water from the canals;
iii) The project may also venture into semester surveys of health records at the community health centres, with the collaboration of MOH, to ascertain the spread or increase of malaria, bilharzia, dysentery or other water borne diseases that may be related to the project and come up with possible preventions;
iv) The project may introduce fish in the canals that feed on mosquito larvae, hence reducing on mosquitoes that would have otherwise spread malaria.

8.5.6 Wastage of water

Ignorance of farmers on the scheme could result in poor management of water distribution to the rice paddies. In experienced people managing the water realized from the intake into the canals, excessive amounts of water channeled to the rice paddies and cultivation close to the tertiary and secondary canals may create water leakages resulting in wastage of water meant for efficient irrigation.

Mitigation Measure(s)

i) Frequent inspection and repairs of leaking infrastructure is necessary to reduce on losses of water through leakages;
ii) Sensitization of farmers on proper management of water allocated for their paddies, preventing them from digging close to the canals to prevent embankment collapse and water leaks. Farmers could also be trained on identification infrastructure failures and possibly repair, such that they can alert technicians of any leakages hence reducing wastage of water;
iii) Water allocation infrastructure such as; sluice gates and water intakes should only be managed by trained technicians. This will avoid excessive distribution of water thereby preventing wastage of water from the reservoir.

8.5.7 Drowning of children and livestock

Existence of large mass of water reservoir could encourage locals to fetch water from it, children to venture into swimming in the reservoir and livestock to drink from it. These

activities expose mainly children and livestock to drowning in such a massive water body, if no precautions are taken to avoid encroaching the reservoir.

Mitigation measure(s)

i) Locals should be sensitized on the dangers of swimming in the reservoir. This could urge adults to prevent children or their livestock from accessing the reservoir;.
ii) Among the established cooperative and part of the local authorities (for example, local defense), a team of people should be assigned the task of patrolling the reservoir to prevent children and livestock from drowning in the reservoir.

8.6 Decommissioning phase

The Irrigation infrastructure might remain in operation for many years provided maintenance of the facility is given due attention. However, the facilities may be abandoned because of fresh development projects or even more profitable resource exploitation identified for this area. If this happens, environmental as well as social adverse impacts might occur.

8.6.1 Physical Environment

8.6.1.1 Dust and noise Pollution from demolition activities

Dust and noise pollution might occur when demolishing the intake point, filling canals and demolishing other infrastructure.

Mitigation Measure(s)

i) Controlled draining of the reservoir is crucial; considering recipients downstream or even the plots in the command area from flooding plus avoiding the river embankments from eroding;
ii) To mitigate the health hazard, workers participating in the demolition shall require protective gear, such as; eye goggles, nose masks, overalls, wellington boots, gloves and working ear phones;
iii) Spray of water to reduce dust;
iv) Compaction of soils in areas where demolition is complete;
v) For works that could cause noise, these will be done at hours when locals are out of the marshland, preferably in the afternoon.

8.6.1.2 Contamination and impaired Environment

In the event of future rehabilitations and upgrading of this proposed marshland, portions of the project infrastructure and associated facilities might need to be demolished and the necessity of disposal of demolished waste. Haphazard disposal might cause contamination/impaired quality of the receiving water bodies (Manafa River), especially land and water resources.

Mitigation Measure(s)

i) Monitoring of the waste disposal to authorized damping areas by NEMA, district and local authorities will be necessary to avoid contamination of receiving waters or causing human health hazards.

8.6.2 Socio-economic Environment

8.6.2.1 Abandoned Infrastructures

Doho marshland Irrigation project is established to run for a long time, as such decommissioning is not envisaged unless it occurs in unforeseeable eventualities which may force abandonment of Irrigation Infrastructure and other project facilities that may permanently render the project land useless.

Mitigation Measure(s)

i) Establishment of cooperatives, income and profits earned from the rice scheme will ensure locals have savings and businesses to turn to as alternative sources of income;
ii) The Government should put into consideration financing off-farm activities in areas of intervention thereby ensuring locals have alternative means of income other than this particular project.

8.6.2.2 Loss of livelihood

It is envisaged that farmers and their families will be depending directly or indirectly on the irrigation scheme for income and food for their households. Decommissioning of the project means loss of livelihood.

Mitigation Measure(s)

i) It is anticipated that farmers would have gained a lot from project trainings and development, to enable them sustain themselves even without the project support. Communities would have organized themselves into Cooperatives dealing in commercial agriculture. They would have been introduced to saving at an early stage hence reaching out to their savings accounts to invest in other income earning businesses;
ii) Off-farm income earning activities would have been adopted by project beneficiaries such that loss of irrigation scheme would not have a huge impact on their livelihood, for example; Making of art and craft from papyrus by women and brick laying by men as an off-farm activity done after returning from the rice paddies, could be turned to as an alternative income earner.

9 Analysis of Alternatives

9.1 Introduction

Integral to the Environmental impact assessment process is the consideration and evaluation of alternatives to the proposed development plan against the project need. Analysis of project alternatives considers other practicable strategies that can be taken to promote the elimination of negative environmental impacts identified. It is the basis for implementation of a development project with minimal environmental damage. The various alternatives were assessed in terms of both environmental acceptability and economic feasibility during the EIA phase of the project. The following alternatives were taken into consideration;

9.2 No Project Alternative

The EIS examined the impact of doing nothing (the "No Action" option) i.e. not constructing the proposed Doho II irrigation scheme. The do nothing option is retrogressive for an existing robust development such as Doho irrigation scheme whose vision is an integrated operation across the entire agricultural value chain that will introduce savings from economies of scale. The project shall also provide a potential long-term investment opportunity for the government from the profits received. The proposed project is also geared towards creating several employment and business opportunities in addition to the several positive impacts. The No-Action alternative will imply that essentially, none of the identified impacts of proceeding with the project will be experienced. However, choosing this option would entail perpetual losses on the part of the developer resulting from unutilized land. This would further undermine the championing of agriculture as an engine for economic growth in the country. Furthermore no employment opportunities are envisaged under this option. Therefore, the No-Action alternative is not recommended.

9.3 Alternative site location

At present, the development does not have an alternative site. Therefore, one location as proposed in this report was assessed. For over the years the development has been taking place in the intended site for rehabilitation. Relocating to a new site means that the project spearheading agency has to look for the land that is of the same size or bigger. Looking for the land to accommodate the scale and size of the project and completing official transaction on it may take up a lot of time which would delay project implementation. In addition to this, the intended land use (Rice growing) blends well with the area land use since it is mainly rice growing. The crop to be grown at the scheme is also indigenous crop common among the local community. Therefore the project does not conflict with the area land use. In consideration of the above concerns and assessment of the current proposed site, relocation of the project is not a viable option.

9.4 Action option

This alternative would see the implementation of the project as proposed by the developer, and as outlined in this EIA report (construction of Doho Rice scheme).The consultancy team made comprehensive environmental impact study for the proposed project. Details of the study are the subject of this report. The Action option as proposed in this report appears to be the most attractive and a onetime investment whose returns can be considerable. This option would certainly be a solution to the projected food demand in the country. Mitigation measures for the identified negative impacts of this alternative have been thoroughly discussed in this report. If they are implemented as proposed, the project will not be damaging to the environment. The consultancy team therefore recommends that this alternative is the most appropriate.

10.0 Environmental, social monitoring and management plan

Environmental monitoring will be carried out to ensure that all site activities comply and adhere to environment requirements. Clear monitoring plan is associated with the management plan as well elaborated in this chapter (10). In addition, implementation of mitigation measures in the EIA report. The project Environmental officer shall be designated to make day to day follow ups (e.g. supervision and liaising with stakeholders). Appropriate bills of quantities should clearly give actual figures. In any case the consultant used informed judgment to come up with these figures.

The core monitoring tool the Consultant will use is a standalone Environmental Monitoring Plan. This will serve as a reference document for planning, implementation, monitoring and reporting. Both the Consultant will have competent staff in the field of environmental and social management to ensure that commitments in the EIA report are implemented. Monitoring will involve measurements, observations, evaluations, assessment and reporting on the following variables during the implementation phases of the proposed project. Among others, implementation of the following will be monitored:

- ✓ Impact on ecosystems, e.g. Marshy vegetation of all types in the proposed area;
- ✓ Accidents during construction of the scheme;
- ✓ Socio-economic impacts of the project (e.g. water sources, etc);
- ✓ Measures for mitigation of air quality regularly;
- ✓ Measures for protection of water quality regularly;
- ✓ Measures for control of noise levels regularly;
- ✓ Measures for control of land degradation on a regular basis;
- ✓ Measures for Occupational Safety and Health.

Monitoring activities associated with afore mentioned issues should be documented and reported regularly to Butaleje district and other key stakeholders spearheading the project.

10.1 Environment Monitoring and Incidence Reports

This section describes the monitoring program and reporting required for ensuring effective implementation of the Environmental, Social Monitoring and Management Plan (ESMMP), including assignment of responsibilities and environmental performance monitoring to be conducted as part of the project. The locations for monitoring are specified as following:

- ✓ Water borne diseases – at sensitive receptors in the nearby settlements;
- ✓ Soil erosion – at erosion prone areas identified next to proposed project;
- ✓ Water pollution – at sensitive receptors –community;
- ✓ Sedimentation especially River Manafa the main reservoir.

10.2.1 Project Commencement Report

The government implementing body and the supervising team will document the physical, biological and cultural features and values in the area where the project will be

implemented. This will be achieved through assessment of the area by carrying out prior ESIA report. This task should be completed just before handing over the site to the Contractor. The Supervising Environmentalists will pinpoint sensitive areas so that the proposed mitigation plan can be implemented during ongoing activities. This data shall be included in inspection reports and submitted to concerned parties (MWE, Butaleja district, MAAIF) as part of the progress reports.

10.2.2 Routine Reports

The Supervising Environmentalist will inspect the works for compliance with the contract specifications, proposed activities mitigation measures and all relevant environmental regulatory requirements concerning the project on a continuous basis. The Environmentalist will also conduct random inspections while project activities are occurring on site.

Inspection/supervision will include all construction works of; intake point, canals, access roads and other project infrastructures. Other activities to be focused on will becultivation, waste management, water management.

10.2.3 Emergency/ Environmental Monitoring

The contractor shall prepare an emergence response plan for fire, flooding, disease outbreaks and other eventualities.

For monitoring emergencies, the Supervising consultant will target the following:

- ✓ The contractor's activities for non-compliance with environmental specifications;
- ✓ Grounds for non-compliance and notify the client. If non-compliance is not rectified and the significance of the non-compliance warrants it, the procedure to halt all the site activities will be initiated.

The supervising consultant can instruct the contractor to halt work if:

- ✓ Project activities are unexpectedly and significantly affecting environmentally sensitive areas or features;
- ✓ There is likelihood or actual occurrence for an environmental emergency;
- ✓ A government agency has ordered the work to halt to enable supervision of remedial activities before work can commence.

10.2.4 Progress Reporting

A monthly Inspection Summary Report and detailed monthly Environmental Report with clear illustrations will be prepared by the supervising consultant and submitted to the concerned stakeholders. The Detailed Environmental Report will form an appendix to the monthly and quarterly inspection and summary report. A copy of all written documentation and records of verbal communication will be submitted as part of the detailed monthly report which will result from a compilation of Weekly Reports. The weekly reports will also include:

- ✓ General progress of the project with special emphasis on work in environmentally sensitive areas;
- ✓ Routine mitigation measures being used and monitoring of effectiveness; and
- ✓ Environmental concerns encountered including community concerns, recommendations made and new mitigation measures taken (if any) including a list and record of all parties notified of any changes;
- ✓ Emerging environment impacts that were not anticipated during the design phase;
- ✓ Health and safety/site meetings held to discuss issues including progress on implementation of environment and social mitigation measures;
- ✓ Functionality of Grievance Redress Mechanisms;
- ✓ Progress of implementation of HIV/AIDS prevention program.

10.2.5 Final Mitigation Report

A final mitigation report will be prepared with the full involvement of Environmentalists at the site. The report will among others include:-

- ✓ A summary of all work in environmentally sensitive areas, including procedures used and success thereof;
- ✓ Routine mitigation measures used and mitigation effectiveness;
- ✓ Explanation of all design changes implemented for environmental reasons and/or recommended design changes;
- ✓ Summary of environmental concerns encountered and new mitigation measures taken;
- ✓ A summary of all correspondence and communication with Government agencies and the contractors (s); and
- ✓ A copy for all reports for halted works or environmental emergencies;
- ✓ An opinion on compliance with environmental requirements;
- ✓ Functionality of Grievance Redress Mechanisms;
- ✓ Progress of implementation of HIV/AIDS prevention program.

10.2.6 Institutional Arrangements and Roles

- **Who monitor and how:**

The proposed irrigation scheme project is within the jurisdiction of Butaleja district in Himutu, Kachonga and Mazimasa Sub Counties. It is important to note that monitoring is a requirement throughout the whole implementation process of project. For that matter therefore, it is a prerogative of Butaleja district technocrats (District agriculture, Environment officer, water engineer etc) to carryout routine inspection to get acquainted with what is on-going in the due course of irrigation scheme construction and operation activities. Monitoring will be done through site inspection, review of grievances logged by the community and ad hoc discussions with potentially affected persons. For each monitoring visit, a discussion with chairpersons of the villages where the scheme is situated

to ascertain insight into grievances a community has about the project. Minutes during discussion will be taken to act as benchmarks for the project under implementation. Other government agencies such as MAAIF, MWE, Ministry of Gender Labour and Social Development may undertake a third party in monitoring as mandated by the laws governing Uganda. These government entities have the authority to inspect any on-going work without making prior notification to effect compliance with national requirements.

- **Site environmental and safety officer Monitoring Report**

Monitoring will be undertaken monthly over the on-going construction activities. Detailed monthly monitoring reports with clear illustrations of implementation of mitigation measures shall be compiled by the site environmental and safety officer under oversight of the top management of the scheme. These detailed reports with evidence of compliance shall be prepared and appended to summary monthly reports.

Table 10-1: Environmental and Social Management Plan

		Impact and mitigation/Enhancement	Desired outcomes	Monitoring/performance indicators/Targets	Time	Responsible party	Total cost	Capacity building and requirement
A	**Construction Phase**							
	Positive Impact							
1	**Impact: Employment Opportunities**							
	Mitigation: ❖ Recruitment should be done at all the three sub-counties (Himutu, Kachonga and Mazimasa) covering Doho irrigation scheme conducted by the village LC I's; ❖ Publicize recruitment using appropriate media such radio stations within district.		Local residents are employed with special attention given to women.	❖ Percentage of residents employed at various levels; ❖ Percentage of Women employed at various levels.	Construction period	❖ Contractor; ❖ LCI's ❖ Butaleja district Authority.		❖ Induction training on occupational health and safety; ❖ Tooling in basic skills for different road construction tasks.
2	**Impact: Improved income generating opportunities**							
	Mitigation: Encourage local residents' especially raw material suppliers to form groups.		Local residents benefit from the procurement process to supply construction material demands.	❖ Number of local resident groups transacting business with the contractor; ❖ Percent value of contracts awarded to local resident suppliers.	Construction period	❖ Contractor; ❖ Butaleja district Authority		

B	**Operation Phase**						
3	**Impact: Improved access within the areas of the scheme**						
	Enhancement: Encourage local transport systems e.g. Boda-bodas and small trucks to ease carrying of rice sacks within the scheme.	Increased access to different parts of the scheme.	Number of accidents per month	Operational Phase	❖ Local authorities		Road use sensitization for all community members
4	**Impact: Soil erosion**						
	Mitigation: Soil control measures such as re-vegetation with fast growing grass and trees particularly the local species.	Improved aesthetic nature of the bare surfaces.	Area recovered with grass, trees.	Operational Phase	DEO-Butaleja; Agriculture officer	Part of the contractor's bid	Aesthetic management training for all assigned workers.
C	**Negative impact**						
	Construction						
5	**Destruction of Vegetation**						
	Mitigation: ❖ Identify valuable local tree species for planting on the cleared sites; ❖ Identify plant trees with socio-economic value (medicinal, timber, fruit etc) and conservation purposes; ❖ Recover valuable wood for use by the community.	Ensure effective protection of local tree species (Native species).	Number of trees destroyed/ felled	Construction Phase	Contractor; District Environment Officer		None
6	**Impact: Improper management of cut to spoil and debris**						
	Mitigation: ❖ Use soil spoils in levelling and backfilling; ❖ Use soil spoil for daily cover	❖ Elimination of blight due to unsightly heaps of overburden;	Rehabilitated sites using soil spoil	Construction phase	❖ Contractor; ❖ Supervising Engineer; ❖ District	Cost included in the contractor	Put in place waste disposal management plan under the

	at disposal sites e.g. Butaleja district landfill; ❖ Consult district Environment Officer on disposal of soil spoils.	❖ No illegal dumping of construction waste especially in Doho wetland area.			environment officer.	s bid	guidance of the site environmentalist
7	**Effects of operation of borrow pits and quarries**						
a)	**Impact: Visual impairment** **<u>Mitigation:</u>** ❖ Backfilling quarry pits with overburden; ❖ Disposal of cut to spoil in borrow pits; ❖ Backfilled pits should be left to settle before tree and grass planting takes place; ❖ Screen off quarry pits as recovery takes place.	❖ Restored sites with aesthetic beauty restored; ❖ Cut to spoil not dumped in sensitive ecosystems like wetlands; ❖ No accidents involving community members and livestock.	❖ Percentage of sites restored; ❖ Accidents recorded at abandoned quarry sites in addition to the complaints from the public; ❖ Records of amounts of cut to spoil delivered and utilized in restoration of borrow pits.	Construction phase	Contractor; NEMA; District Engineer and Environment Officer	Cost included in the contractors bid	None
b)	**Impact: Disease vectors in abandoned borrow and quarry pits** **<u>Mitigation:</u>** ❖ Backfill abandoned pits; ❖ Planting vegetation on restored sites; ❖ Screen off quarry sites.	❖ Elimination of vectors; ❖ Restored and aesthetically attractive sites.	Level of water retention at the restored site.	During and after construction	Contractor; District Environment Officer	Part of contractor's bid	None
c)	**Impacts associated with access roads to borrow or quarry sites** **<u>Mitigation:</u>** ❖ Install speed humps. Dust	❖ Accident free roads; ❖ No pollution arising from excessive dust.	❖ Number of accidents involving construction traffic; ❖ Area scarified and vegetated.	Construction phase; Decommissioning	Contractor; NEMA; District Environment Officers		None

	control through application of water; ❖ Scarify and vegetate service routes after decommissioning.			Phase.			
8	**Impact: Soil contamination by accidental spills of lubricants, fuels and other chemicals related to equipment yards**						
	Mitigation: ❖ Recycling lubricants; ❖ Design manual for handling waste oils and grease on site; ❖ Gazette areas for refilling and repair of construction equipment; ❖ Sensitize workers on managing hazardous waste; ❖ Draw up accident management plans especially from oil spills.	An elaborate hazardous waste disposal plan indicating records of on-site generated wastes and place where they are disposed off.	Levels of soil contamination at the storage yard.	Construction and post construction phase	❖ Contractor; ❖ Supervising Engineer; ❖ Butaleja district Environment officer; ❖ NEMA.	Part of the contractors bid	Sensitization of all site workers about the dangers of poor hazardous waste disposal
9	**Impact: Air pollution**						
	Mitigation: ❖ Enforce speed reduction on the irrigation scheme roads under construction; ❖ Sprinkle water to suppress fugitive dust; ❖ Cover trucks transporting construction materials.	Improved air quality with suspended particulate matter following National Air Quality standard, 2006.	❖ Level of suspended particulate matter in air at areas under construction; ❖ Level of complaints from the public.	Construction Phase	❖ Contractor; ❖ Supervising Engineer; ❖ NEMA; ❖ District Environment Officers		None
10	**Impact: Increased noise levels**						
	Mitigation:	Noise released does	❖ Monitored noise levels	Constructio	❖ Contractor;		None

	❖ Machinery not in use should be switched off; ❖ Ensure effective equipment maintenance schedules at least after work.	not exceed maximum permitted National standards (Noise Standards and Control) Regulations, 2003.	at construction sites; ❖ Level of complaints from the public.	n phase	❖ Supervising Engineer; ❖ NEMA; ❖ Environment Officer.		
11	**Impact: Effects of worker's camp and equipment yard**						
	<u>Mitigation:</u> ❖ Locate worker's camp and equipment yard away from sensitive ecosystems such as wetlands since most parts of Doho irrigation scheme in Butaleja fall in that docket of having many wetlands; ❖ Since project is within rural setting the site should be gazzated to deter community members from access since they will be attracted to different machinery that area new in their area; ❖ Enforce security; ❖ Develop waste management system; ❖ Management plan for construction waste; ❖ Present hazardous waste	❖ Good working relationships with the surrounding communities; ❖ High levels of sanitation at the campsite; ❖ No exposure to hazardous substances; ❖ Easy access to medical services when required Counseling services are easily accessed; ❖ Documentation requirements for applicants, requirement for contractors to maintain records of employees	❖ Reported complaints involving construction workers and local residents; ❖ Waste collection frequency; ❖ Reported incidences of exposure to hazardous wastes; ❖ Reported cases to site clinic.	Construction phase	❖ Contractor; ❖ Supervising Engineer; ❖ Environment officer; ❖ District Health Officer.		None

	management plan; ❖ Onsite sewage management system must be in place (especially for sanitary facilities); ❖ Develop an elaborate primary health care programme and have standby ambulance vehicle in place; ❖ Provide safe drinking water at the different work station points; ❖ Design vehicle wash areas so as not to contaminate the environment; ❖ Vehicle wash bays should have anti-pollution equipment e.g. oil interceptors; ❖ Solid waste disposal sites such as the district land fill will be used for domestic waste disposal; ❖ Wherever feasible, waste recovery and reuse will be undertaken.	showing age.					
12	**Impact: Storage of construction materials, accidental spills and fires**						
	<u>Mitigation:</u> ❖ Provide bunded storage for	❖ Pollutants resulting from	Regular audits on performance of pollution	Independent Environmental	❖ Contractor ;		Induced training in hazardous

	fuels; ❖ Install fire suppression systems through putting in place fire-fighting equipment; ❖ Design a site storage safety manual to be followed by workers; ❖ Maintain a portable spill control pack (Arrange in containers).	site activities do not contaminate the surrounding environment; ❖ Ensure workers safety at all times in the storage site.	control systems in place.	audits every 3 months during construction phase.	❖ NEMA; ❖ MEMD; ❖ DEO.		waste handling.
13	**Impact: Occupational Hazards and Health Risks**						
	<u>Mitigation:</u> ❖ Contractors should provide induction training to all workers on OHS develop occupational safety reference manual; ❖ Contractors should provide all workers appropriate PPE and effect monitoring; ❖ Install safety signage in all work places; ❖ Effect recommended working conditions for all workers as well stipulated by Occupational Safety and Health Department-MoGLSD. Hire environmental safety officer for proper	❖ No injuries to workers; ❖ Reduced risks to the work force; ❖ A safe and productive work environment.	No of injuries reported in every month during the construction phase.	Construction phase	❖ Contractor; ❖ MoGLSD; ❖ Supervising Engineer; ❖ Environment officer.		Induced training on the values of PPE usage; Training in HIV/AIDS counseling.

	implementation; ❖ Report accidents to police and supervising engineer; ❖ Provide onsite mobile toilet systems; ❖ Design an HIV/AIDS policy and strategies for awareness, counseling and support.						
14	**Impact: HIV/AIDS risk**						
	<u>Mitigation:</u> ❖ Design an HIV/AIDS policy and awareness program; ❖ Provide counseling and testing services; ❖ Semi-skilled and unskilled labour should be sourced from the locally within the three sub-counties (Himutu, Kachonga and Mazimasa) where Doho schemeis located; ❖ Weekend offs for non-resident workers on pay weekends.	No infections of HIV/AIDS	Periodic voluntary testing at workers	Construction phase	❖ Contractor; ❖ MoGLSD; ❖ Health officer.		Sensitization of workers
15	**Site restoration and tree planting**						
	<u>Mitigation:</u> ❖ Soil erosion from bare surfaces; ❖ Residual contamination at	❖ Embankment erosion prevented; ❖ Quarry and	❖ All embankment grassed with appropriate erosion control grass species;	Immediately upon completion of construction.	Contractor Resident engineer; District		None

	un-restored sites; ❖ Community and health risks of open borrow and quarry sites; ❖ Grass and tree planting for erosion control on bare surfaces.	borrow sites restored to pre-project condition; ❖ Temporary access provided on banks of watercourses removed after construction; ❖ Camp sites decommissioned; ❖ All restored areas replanted with native vegetation; ❖ Road reserve planted with trees. ❖ No abandoned equipment, materials and waste left on sites	❖ Decommissioning plans for quarry and borrow sites prepared and implemented; ❖ All borrow sites landscaped (including re-vegetation), provided with good drainage and side slopes tempered to reduce risk to livestock and people; ❖ Decommissioning plans for camps prepared and implemented; ❖ Number of trees planted in degraded areas; ❖ Nature and quantity of equipment/materials found on site.		Environment officer;		
16	**Impact: Gender and Child labour**						
	<u>Mitigation:</u> ❖ Children below 18 years should not be employed for any work at the site; ❖ Institute and enforce a sexual harassment policy.	Preserve rights of vulnerable people.	Complaints from vulnerable people.	Construction and operation phase	❖ Contractor; ❖ Labour officer: ❖ Supervising Engineer; ❖ District Environment officer.		None

17	**Impact: Public health and safety**						
	Mitigation: ❖ Maintain a well equipped first aid kit under the administration of a trained personnel; ❖ Sensitize the public on safety precautions; ❖ Install signage on the road to warn people of construction activities.	No accidents are recorded due to project activities.	Accident reports involving the public.	Construction Phase	❖ Contractor; ❖ Medical Personnel.		Train workers in offering first aid.
D	**OPERATIONAL PHASE**						
18	**Loss of soil fertility from monoculture and use of inorganic fertilizers**						
	Mitigation: ❖ Periodic soils tests are recommended to measure its nutrient levels, acidity levels and other soil characteristics that might determine the trend of soil fertility. Amounts of fertilizer applied and any techniques to improve soil fertility shall depend on these tests; ❖ It is also proposed that a combination of inorganic fertilizers is applied with organic fertilizers to reduce on the acidity caused by inorganic fertilizer. As trends go by, less inorganic fertilizer will be applied and	Good nutrient levels in the rice fields; Use of recommended fertilizers.	Soil test results	Operational phase	MAAIF; DAO.	Cost of soil tests for each period of examination could in the range of 800,000 to 1,000,000 Ugx.	Train farmers on better ways of using fertilizers

	instead more organic fertilizer will be used until only organic fertilizer is used.						
19	**Poor pesticide and agrochemical, Fertilizer management**						
	Mitigation: ❖ Technical assistance from MAAIF agronomist and a recruited agronomist specific for this project is proposed. They have the responsibility of determining which type of fertilizers and pesticides are required, amounts required for application, recommend the areas of application and will be charged with the responsibility of training and following up on how farmers adopt to these techniques hence reducing on the misuse of these products; ❖ An Integrated Pest Management (IPM) guide shall be adopted by this project.	Type of fertilizersand pesticides used at the scheme	Allocated agronomists on the scheme	Operational phase	MAAIF; DAO.	Part of the BOQ	
20	**Water pollution**						
	Mitigation: ❖ The Project site Agronomist and MAAIF's agronomist should conduct training to the local farmers on the safe	No records of pollution downstream	Monthly water tests	Operational phase	DWRD; NEMA; DAO; MAAIF.	Cost of water quality tests ranges between	Training local farmers on the safe application of pesticides and fertilizers.

	application of pesticides and fertilizers. This is a practice that can immensely contribute to the reduction of possible chemical pollution of the receiving waters. Training on pesticide application may be specifically directed to the quantities to apply, timing (when), and protective gears to wear among others and should be incorporated in the Pest Management Plan; ❖ Alternatively, a baseline test of the water quality and progressive tests are necessary to understand the effect of the project on the quality of water bodies and curb any likely impacts there may be before water quality deteriorates. This can be attained through liaison with DWRD.					8500000-1,000,000 Ugx.	
21	**Canal Siltation**						
	<u>Mitigation:</u> ❖ To avoid siltation, regular communal work for	No records of flooding.	Routine de-silting of the canals.	Operational phase	Agric Officer; MWE; MAAIF.	Part of BOQ	Train farmers on frequent maintenance of

	maintenance of canals should be mandatory for all rice growers; ❖ Regular inspection of canals and adjacent slopes is necessary to repair areas likely to collapse into the canals thereby reducing siltation.						the canals
22	**Wastage of water**						
	<u>Mitigation:</u> ❖ Frequent inspection and repairs of leaking infrastructure is necessary to reduce on losses of water through leakages; ❖ Sensitization of farmers on proper management of water allocated for their paddies, preventing them from digging close to the canals to prevent embankment collapse and water leaks. Farmers could also be trained on identification infrastructure failures and possibly repair, such that they can warn technicians of any leakages hence reducing wastage of water; ❖ Water allocation	No records of water loss; Records of repairs made.	Routine inspection of infrastructures (water canals, pipes etc)	Operational phase	District Water Engineer; DAO	Part of the bid document	Sensitize farmers about the effects of water loss to the rice crop

	infrastructure such as sluice gates and water intakes should only be managed by trained technicians. This will avoid excessive distribution of water thereby preventing wastage of water from the reservoir.						
23	**Drowning of children and livestock**						
	<u>Mitigation:</u> ❖ Locals should be sensitized on the dangers of swimming in the reservoir. This could urge adults to prevent children or their livestock from accessing the reservoir; ❖ The local authorities (for example, local defense team), should be assigned the task of routine inspection the reservoir to prevent children and livestock from drowning in the reservoir.	No records of drowning.	Routine inspection by local authority.	Operational phase	Local defense;	Part of the bid document	Sensitization of locals about the dangers of swimming in the reservoirs.
24	**Invasive aquatic weeds**						
	<u>Mitigation:</u> ❖ Periodic manual removal of weeds from the reservoir is proposed, to avoid the possibility of an uncontrollable invasion of the reservoir by weeds;	No records of aquatic weeds; No records of pollution.	Frequent removal of weeds; Introduction of fish species.	Operational phase	DAO; MAAIF Site Agronomist.	Part of the bid document	

	❖ Introduction of fish species that feed on invasive aquatic weeds into the reservoir hence reducing on the possibility of large quantities of weeds in the reservoir; ❖ Controlled use of fertilizers and pesticides to reduce on the level of eutrophication by run-off.						
E	**DECOMMISSIONING PHASE**						
25	**Abandoned infrastructures**						
	<u>Mitigation:</u> ❖ Finance off-farm activities in areas of intervention to ensure that locals have alternative means of income to resort to other than this particular project; ❖ Establishment of cooperatives, income and profits earned from the rice scheme will ensure locals have savings and businesses to turn to as alternative sources of income.	Alternative sources of income	Presence of off-farm activities; Number of cooperatives in place.	Operational phase	Existing cooperatives; MWE.	Part of the bid document	
26	**Dust and noise pollution from demolition activities**						
	<u>Mitigation:</u> ❖ To mitigate the health hazard, workers participating in the demolition shall require protective gear, such as eye goggles, nose masks, overalls, wellington boots,	No records of dust and noise; No injuries.	Presence of PPE; Number of litres sprinkled;	Operational phase	NEMA; DEO; Contractor	Cost can only be determined at the time of demolition.	

	gloves and working ear phones; ❖ Spray of water to reduce dust; ❖ Compaction of soils in areas where demolition is complete; ❖ For works that could cause noise, these will be done at hours when locals are out of the site, preferably in the afternoon.						
27	**Contamination and impaired environment**						
	<u>Mitigation:</u> Monitoring of the waste disposal in authorized damping areas by NEMA and district authorities will be necessary to avoid contamination of receiving waters or causing human health hazards.	No records of poor waste management	Presence of licensed waste handler	Operational phase	MWE; DEO.	Cost of water quality test is 1,000,000 Ugx per sample. For any other tests cost determined at demolition.	
28	**Loss of livelihood**						
	<u>Mitigation:</u> ❖ It is anticipated that farmers would have gained a lot	No records of unemployment	Presence of organized cooperatives and other off-farm activities.	Operational phase	MWE; Existing cooperatives.	Cost can only be determine	

	from project trainings and development, to enable them sustain themselves even without the project support; ❖ Farmers would have organized themselves into cooperatives dealing in commercial agriculture; ❖ They would have been introduced to saving at an early stage hence reaching out to their savings accounts to invest in other income earning businesses; ❖ Off-farm income earning activities would have been adopted by project beneficiaries such that loss of irrigation scheme would not have a huge impact on their livelihood, for example art and craft by women and brick making by men as an off-farm activity done after returning from the rice paddies, could be turned to as an alternative income earner.					d at the time of demolition .	

10.3 Environmental monitoring plan

Monitoring refers to the systematic collection of data through a series of repetitive measurements over a long period of time to provide information on characteristics and functioning of environmental and social variables in specific areas over time. In this chapter a monitoring plan is proposed and is provided in Table 10.2 below.

Table 10.2: Environmental Monitoring Plan

Impacts	Parameters	Indicator	Method	Frequency of measurement	Responsibility	Estimated cost
Oil spillage resulting in soil and water contamination	Soil and water quality	✓ Lead (Pb) levels, oil content ✓ Visible Oil spills on ground and water ✓ No. of installed oil interceptors	✓ Soil and water quality tests at the end point of the river and fuel refueling positions	Every six months	NEMA; DEO; DAO	Part of BOQ
Occupational health hazards during construction	Safety and human health	✓ No of Accidents, ✓ % increment in related diseases. (i.e. communal diseases, HIV/AIDS) and deaths	✓ Review of accident records or accident log, health records on site and nearby health centres.	Continuously during Construction period	DAO; Contractor; NEMA Site OHS officer.	Part of BOQ
Air and noise pollution	✓ Sound levels ✓ Air quality	✓ Sound/Noise levels in decibels; ✓ Greenhouse gas content (CO2, CO,	Application of noise monitoring systems.	At the time of works that emit a lot of noise or vibrations, for example; like; earth works or	Contractor; DEO Site OHS officer.	Part of BOQ

		CH4) and dust particles in the air.		concrete vibrations.		
Soil erosion	Soil cover loss	✓ Qualitative observation of rills and gullies; ✓ Sediment levels in runoff ✓ Quantity of soil loss/ha	✓ Use of erosion pins or pipes to determine eroded soil depth; ✓ Sieve analysis.	Every 6months.	Contractor; NEMA DEO; DAO.	Part of BOQ
Fire outbreaks	Fires	✓ No of fire incidences	✓ Review of incidencesreport that involved fires	Continuously.	Contractor; OHS officer; Police.	Part of BOQ
Construction waste management	Waste	✓ Heaps of waste and excavated material on site; ✓ Blockage of drainage system; ✓ Conflicts from the communities.	✓ Effect waste collection	Construction	Licensed waste handlers DEO	Part of BOQ
HIV/AIDS prevention	HIV/AIDS	✓ HIV/AIDS prevalence in the area	Establishment of HIV/AIDS testing centres	construction	MoH	Part of BOQ

Resource use conflict	Security	Cases of conflict	✓ Review of conflict case reports	Continuouslythrough the	Contractor; Police.	Part of BOQ
Modification of flows for downstream usage	Water quantity	Flow rate, Q (m^3/s)	✓ Establishment of weirs for flow measurement at specific points of the river.	By the seasons	DWRD; NEMA; DEO.	Regular monitoring of flow patterns is part of the irrigation infrastructure technician's job requirements.
Loss of soil fertility from monoculture and use of inorganic fertilizers	Soil fertility	Tests for soil pH and for plant nutrients in 3 categories: ✓ Major nutrients: nitrogen (N), phosphorus (P), and potassium (K) ✓ Secondary nutrients: sulphur, calcium, magnesium Minor nutrients: iron,	✓ Soil samples forqualitative tests	Twice a year	MAAIF; DAO; DWRD.	Cost of soil tests for each period of examination could in the range of 800,000-1,000,000Ugx

		manganese, copper, zinc, boron, molybdenum, aluminium				
Poor pesticide And agrochemical Fertilizer management	Water quality Soil quality.	✓ Nutrient load in water recipients from non-point sources (NO3 -, PO4 ^{2}-, K); ✓ NPK levels in the soils.	✓ Samples of water and soil quality tests.	Twice a year.	MAAIF; DAO.	Tests could cost up to 1,000,000Ugx per sample.
Water pollution	Water quality	✓ Nutrient load in water recipients from non-point sources (NO_3 -, PO4 ^{2}-, K).	✓ Samples of water and soil quality tests.	Twice a year.	MAAIF; DAO.	Cost of water quality tests shall be determined at the time of the MOU with the DWRD but might not exceed 1,000,000 for a complete quality test.
Water conflicts	Security	Incidences of conflicts	✓ Review of Incidences/	Continuouslythrough	Police	Not applicable

from different sub-counties sharing Doho Irrigation scheme			conflict reports	project life.		
Floods from reservoir over flow	Flooded area	Cracks or fissures on the intake site; Incidences of floods	✓ Inspection of main intake for fissures/ cracks ✓ Review of flood incidence reports.	Continuously through project life.	Contractor; Works Supervising firm; DAO.	Part of designs with Bills of quantities considered for the contractor's sum.
Increased spread of water related diseases (such as; Bilharzia, malaria, dysentery, diarrhoea, etc.)	Prevalence of diseases	Increased patient numbers with water related diseases relative to the baseline records done at start of project.	✓ Review of health records in the area	✓ Baseline done at project commencement; ✓ Every six months during project implementation/ operation stage.	Health inspector; MoH.	Part of BOQ
Canal Siltation	Canal blockage	Incidences of canal embankment collapse	✓ Review of canal embankment collapse incidence records	Continuously	Water engineer; DAO.	Part of BOQ

Water logging and salinization	Soil qualities	✓ Waterlogged soil; ✓ black greasy patches on the soil surface; ✓ salt crystals; ✓ Bare patches of soil; ✓ Alkalinity of the soil; ✓ Na^+, Cl^- content of soil	✓ Visual soil salinity symptoms identification; ✓ Soil salinity tests; ✓ Soil conductivity in dS/m	Every six months	DAO; Site agronomists.	Cost for soil salinity test is not more than 1000,000 Ugx per sample.
High sedimentation levels in the reservoir	Reservoir dead load	✓ Water turbidity; ✓ Sediment levels in runoff; ✓ Reservoir bed depth measurements(m)	✓ Water turbidity tests; ✓ Sieve analysis for collected runoff; Periodic measurement of reservoir bed depth	Every 6months.	MWE; DWRD.	Part of BOQ
Wastage of water	Water availability to individual plots	Flow rate , Q (m3/s)	✓ Small weirs alongcanals for stream gauging/ flow rate measurement.	Seasonally	PSO DAO DEO.	Part of BOQ
Drowning of	Safety of	Cases of Incidences, accidents or deaths at the	✓ Review of incidences,	Continuously	DEO;	Part of BOQ

children and livestock	Children and livelihood	reservoir	accidents or deaths reports	Through project life	Defense committee	
Emergence of pests and crop diseases	Prevalence of pests and crop diseases	Increased cases of pests attack and crop diseases	✓ Review of reports on pests attack and crop diseases	Continuously through project life	MAAIF; DAO.	Part of BOQ
Loss of livelihood	Income increment.	House hold income per annum	✓ Baseline, mid-term review and project completion studies of itsimpact on the locals.	Project commencement, mid-term of the project and at the end of the project	MWE MAAIF	Cost can only be determined at the time of demolition.

Table 10-3: ESMP Quantification table for the proposed Doho II irrigation scheme

No	Mitigation Measures	Particular	Time Line	Quantification	Unit Cost
1	OHS provisions for workers	General PPE (Helmet, Oval roll, Reflector Jackets, Boots & others)	Replaced after ware (quarterly)	200	
		Specific PPE (Gloves, Sound	Replaced after ware (quarterly)	100	

		Protectors, Welding & Dust Glasses & others)			
2	Road safety awareness and Public traffic flow management during construction	Community & contractors workers road use in relation to construction programme sensitization	Quarterly reports		
3	HIV/AIDS awareness and education	Community & contractors workers HIV/ AIDs sensitization and tools	Monthly reports		
4	Gender awareness	Community & contractors workers sensitization upon gender	Annual report		
5	Erosion and drainage control	Implementation of Erosion control measures and Contractors Erosion plan			
6	Air and water quality monitoring		Quarterly report		
8	ESMP Management and Audits	Implementation of the ESMP tools	Annual Audits		
9	Institutional Collaboration and Monitoring of the ESMP				

10	Implementation of a communication strategy				
11	Waste Management	Domestic	Daily/Weekly		
		Hazardous/ used oils	Daily/ weekly collection & Quarterly disposal		
12	Camp Site restoration	Grass planting, tree planting	After construction		
	TOTAL				

10.3 Preliminary decommissioning plan

Decommissioning of the proposed Doho II irrigation project will become necessary when the project completes its life cycle or when there is change of use. In a situation where main intake, delivery canals, sluice gates and small civil engineering infrastructure complete their lifecycle, decommissioning process will typically involve dismantling of the equipment, demolition of intake point, clearing of the site and reclaiming or restoring the affected land into a natural condition. It is assumed that the project spearheading authorities at the time shall be able to fund and implement all aspects of the project decommissioning, including but not limited to all engineering, environmental assessment, permitting construction and mitigation activities associated with the removal of the infrastructure in accordance with this plan and mitigation of the project removal impacts on site. The relevant government authorities along with district authorities at the time shall monitor environmental impacts during and after project removal to respond to defined events during the monitoring phase.

10.3.1 Change of use situation

In situations where there is a change of use, the decommissioning process may entail demolition of existing facilities (i.e. all irrigation infrastructures). Upon completion of the demolition, the affected land will need to be reclaimed or restored into a natural condition through landscaping and planting of native vegetation.

10.3.2 End of life situation

In a situation where the project infrastructure have completed their useful life, decommissioning process will entail demolition of the erected and dismantling of the structures including; the intakes, delivery canals and any other small irrigation infrastructure installed. Site clearing and reclaiming or restoring the affected land into a natural condition will then follow.

Restoration of the affected land may involve; the filling in of any open pits and grading the land to its natural state, then planting appropriate tree species and cover vegetation to hold the soil in place and to prevent flooding. Planting of trees however, may not be necessary if the site is immediately taken over for another development.

The debris resulting from the demolition will either be transported by licensed waste transporters for dumping at an approved damp site or used as base material for new construction work. The demolition process will entail removal of materials using crowbars and hammers, breaking of walling and reinforced slabs using sledge hammers and/or jack hammers, which utilize compressed air and lowering of materials from high to low levels.

The exercise will therefore entail working at high levels and all the necessary health and safety measures will need to be implemented including provision of personal protective equipment such as safety harnesses, helmets, gloves, nose masks, safety shoes, overall, goggles and ear protectors.

11 Conclusions and recommendations

11.1 Conclusions

The issues/impacts have been assessed and described in detail to gain an adequate understanding of possible environmental effects of the proposed project – from design to decommissioning, in order to formulate mitigation measures in response to negative aspects which will emerge. The Environmental Management Plan (EMP) provides a way forward for implementation of the identified mitigation measures. The EMP should be implemented as a prerequisite for a positive record of decision by the appropriate authorities.

The Environmental Monitoring Plan provides parameters to be monitored and responsibility. While the consultant is aware that each monitoring aspect need to have a separate budget line, for small projects which are remotely located this does not make economic sense. The consultant is recommending that the Project Proponent assigns the Environmental officer to undertake the monitoring of the mitigation measures for the project through its existence. This is the way the proponent will achieve sustainable project implementation at reduced cost for undertaking the monitoring.

Given the nature and location of the development, the conclusion is that the potential impacts associated with the proposed development are of a nature and extent that can be reduced, limited and eliminated by the application of appropriate mitigation measures.

11.2 Recommendations

It is recommended that, based on the findings of the EIA exercise and supplementary information that:-

1) Water Users Associations should be formed to promoted equity of water resource use by all farmers without marginalizing the downstream users as it is the case in Doho Phase I. This will resolve constant conflicts in the scheme;
2) Water diversion quantities require monitoring through periodic water level measures to avoid water resource depletion. This may be done under the supervision of the developer and the relevant authorities (MWE, Butaleja) in terms of delivery/demand and quality;
3) Integrated Pest Management (IPM) should be prepared for guidance in pesticide application;
4) A functional Grievance Redress Mechanism should be established;
5) An HIV/AIDS awareness program should be prepared and implemented;
6) Periodic soil tests to measure nutrient levels, acidity levels and relevant soil characteristics to determine the trend of soil fertility is necessary to guide on the effects of fertilizer application and monoculture cropping;
7) A baseline and progressive water quality tests of the river is necessary to determine mitigation measures for likely nonpoint source water pollution;
8) Agrochemical pollution control can be achieved through application of required amounts of fertilizers under the supervision of trained agronomists. Furthermore,

organic fertilizers can be applied along with agrochemicals with the option of eventually phasing out agrochemicals and only using organic manure;

9) Water related diseases can be avoided by introduction of fish, in the reservoir that feed on mosquito larvae thereby reducing on their breeding. Provision of mosquito nets, sensitization on the importance of sleeping under a mosquito net and encouraging locals on proper hygiene will reduce on the likelihood of contracting water related diseases;
10) Periodic manual removal of aquatic weeds from the reservoir to avoid the possibility of an uncontrollable invasion of the reservoir by weeds rendering it non-navigable and incapable of providing sufficient quantities to effective irrigate the command area.

Based on the assessment done, the Consultant is of the opinion that most of the potential environmental impacts identified can be mitigated. The proposed environmental management plan and environmental monitoring plan if implemented will safeguard the integrity of the environment.

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Appendices

Appendix 1: NEMA APPROVED TORS

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

RECEIVED 10 SEP 2015 PERMANENT SECRETARY MIN. OF WATER & ENVIRONMENT

NEMA House
Plot 17,19 & 21, Jinja Road,
P.O.Box 22255, Kampala, UGANDA.
Tel: 256-414- 251064, 251065, 251066
342758, 342759, 342717
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Website: www.nemaug.org

NEMA/4.5

3rd September, 2015

The Permanent Secretary,
Ministry of Water and Environment,
KAMPALA.
Tel: +256 (0)414 505945 / 221198

PERMANENT SECRETARY MINISTRY OF WATER & ENVIRONMENT 10 SEP 2015 P. O. BOX 20026, KAMPALA - UGANDA

RE: REVIEW OF TERMS OF REFERENCE PERTAINING TO THE PROPOSED REHABILITATION/RECONSTRUCTION OF FIVE SELECTED IRRIGATION SCHEMES, UNDER THE FARM INCOME ENHANCEMENT AND FOREST CONSERVATION PROJECT – PHASE-II

This is in reference to the Terms of Reference (TOR) for carrying out an environmental and social impact assessments (ESIAs) for proposed rehabilitation/reconstruction of **five selected irrigation schemes**, which you submitted to this Authority for review and consideration for approval. This Authority has finalised the review and grants formal **APPROVAL** of the said TOR, relating to the project sites listed in the table below.

Irrigation Scheme	Project / Location	District
1. Doho-II	Doho Parish, Nazimasa Sub-county, Bunyole East County.	Bulaleja
2. Mubuku-II	Sebwe Parish, Nyamwamba Division, Kasese Municipal Council	Kasese
3. Wadelai	Regem and Pakwinyo Parishes, Wadelai Sub-county, Jonam County	Nebbi
4. Ngenge	Kapkwai, Sikwo, Sosho and Chaptarre Parishes, Ngenge Sub-county, Kween County.	Kween
5. Tochi	Abanya Parish, Acaba, Oyam Sub-county, Oyam County.	Oyam

In addition, you are advised to consider the key aspects outlined below, during the conduct of the ESIAs and preparation of the ESIA reports.

(i) Note that the ESIA reports for the five proposed project areas **should be submitted separately for review.**

(ii) Carry out comprehensive stakeholder consultations involving, among others, the respective District Local Government Authorities, the concerned local communities in the targeted project areas that will accommodate the projects, and other Authorities responsible for provision and management of public utilities *(road network, among others)*, respectively; and, ensure that the concerns/views of the stakeholders **are well-documented and appended to the ESIA reports.**

1 of 2

(iii) Provide **correct citation of details of the location of the project areas** that will accommodate the project components / infrastructure, preferably in tabulated format – *by names of **villages**, zones, wards, parishes, sub-counties, division, county – whichever is applicable.*

(iv) Present the narratives on **any identified project-affected communities/entities** and the related compensation aspects, land-take aspects, shared resources, respectively, in a comprehensive manner.

(v) Provide comprehensive **baseline information/data** relating to the project areas and their environs, public utilities, regulated and sensitive/fragile areas, settlements, **water source** (supplying water for irrigation); and, **a set of coloured photographs** showing the current state of some of the critical sections of the targeted project area, respectively.

(vi) Include in the ESIA reports **coloured location/google maps** *(preferably covering A-4 or A-3 paper size)* that are clear, well-labelled and legible and showing the alignment of the project infrastructure, as well as sets of **GPS coordinates.**

(vii) Provide comprehensive narratives on all the **proposed project components, activities,** and the size of the workforce.

(viii) Include in the ESIA reports comprehensive **analyses of alternatives** in terms of project design, type of technologies, among other aspects.

(ix) Provide **detailed evaluation of the identified potential environmental impacts, residual impacts and risks** associated with the project components and activities.

(x) Ensure that **comprehensive mitigation and environmental management and monitoring plans** are well presented, respectively, that relate to the identified potential environmental impacts.

(xi) Consider any other critical environmental aspects/concerns not initially foreseen during the preparation of the TOR, and **include evaluations of such aspects/concerns** in the respective ESIA reports.

(xii) Indicate the **total project (investment) cost** covering all the project components and activities.

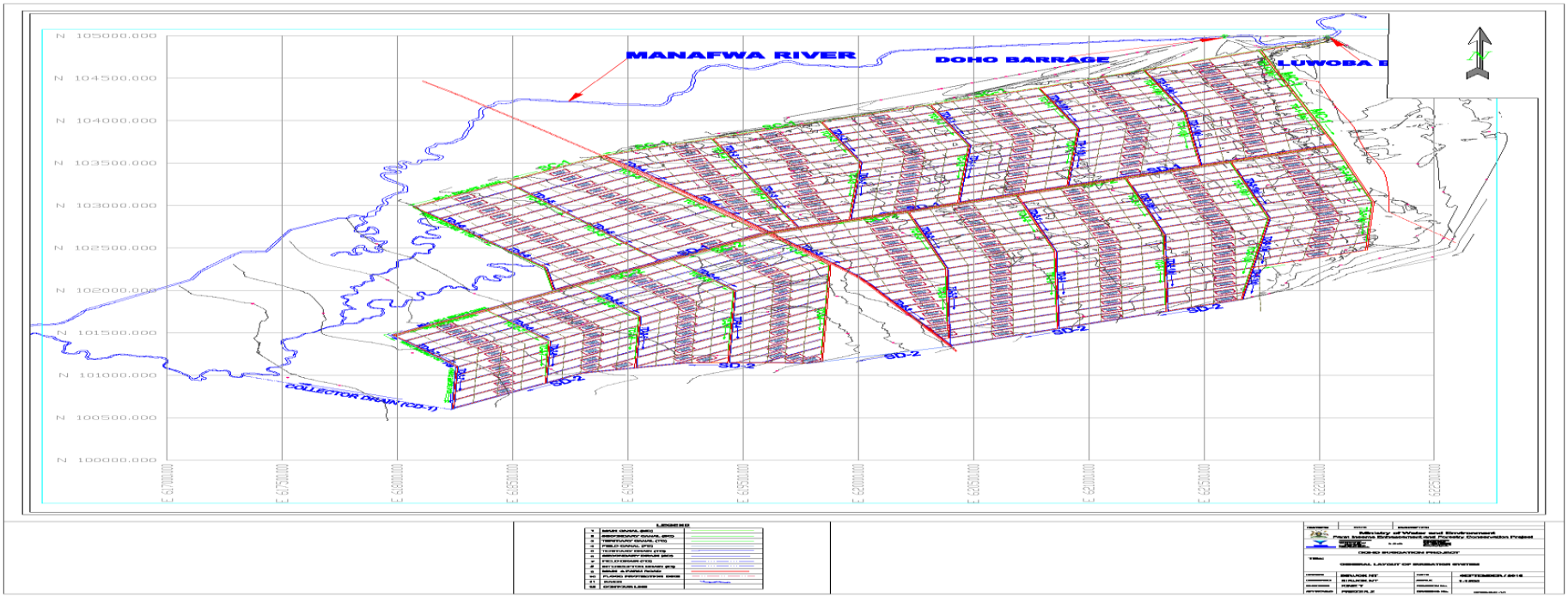
This is, therefore, to recommend that you proceed with carrying out the ESIAs for the proposed projects. We look forward to receipt of five sets of copies of comprehensive environmental and social impact statements, for our further action.

Margaret Aanyu
FOR: EXECUTIVE DIRECTOR

c.c The Director,
Directorate of Water Resources Management,
ENTEBBE.

2 of 2

Appendix 2: Layout Plan



Appendix 2: List of consulted stakeholders

Stakeholder consultation sheet for the proposed construction of irrigation scheme infrastructures and facilities Lot 2: in Doho II Butaleja district. Contract No: MWE/CONS/16-17/00040/2

Name	Contact/Designation	Signature
Wasige Richard	DWO-Butaleja 0782030228 rwasige@gmail.com	[illegible]
WERE LAMULA	Natural R'ces officer 0782608259 lamulaw@yahoo.com	[illegible]
Tom Wandera	Env't officer / 0781421432 Butaleja	[illegible]
WERE BEATRICE ALLEN	Sec Gender 0781844327	B. A'were
RICHARD WAYO	District Chairperson 0772453838	[illegible]
Malwa Augustine	Dst. Councillor 0782614939	[illegible]
	for Mazimasa S/C.	
Banamwita Charles Joshua	AFO	[illegible]
Bangalwe Vincent	PWO 0774434969	[illegible]
BENON LWANGA	SENIOR ENGINEER - MAAIF	[illegible]

Ministry of Water and Environment

Stakeholder consultation sheet for the proposed construction of irrigation scheme infrastructures and facilities Lot **2: in Doho II Butaleja district. Contract No: MWE/CONS/16-17/00040/2**

Name	Contact/Designation	Signature
Banamwita Charles	0752501993 DFO	
MUGULO AENIS	0775024845 FOR SAS	
FAGATO CHRISTINE	0781547013 P/CHIEF	
WANGALA JOHN	0702959082 O/M	
NJA-YE RICHARD	0782850513 LAND OWNER	
WANDERA AMOS	0781519511	
HIRENTI ISAAC RICHARD	0778149473 GISO	
HIGENYI FEBIANO	0782848354 C/man LC III	
MULOKI SWAIBU	0773646287 C/cpason	
JUSTINE MWIMA	0784799037 D/Councillor	
MWIMA SAM STEPHEN	0774926782 P/CHIEF	
WEKESA JOHN PAUL	0772287170 / Farmer	

Ministry of Water and Environment

Appendix 3: Geotechnical investigation analysis

GEOTECHNICAL INVESTIGATIONS – DOHO II

Vertical Electrical Sounding

DOHO1

District : Butaleja | Location : Doho II Irrigation Scheme

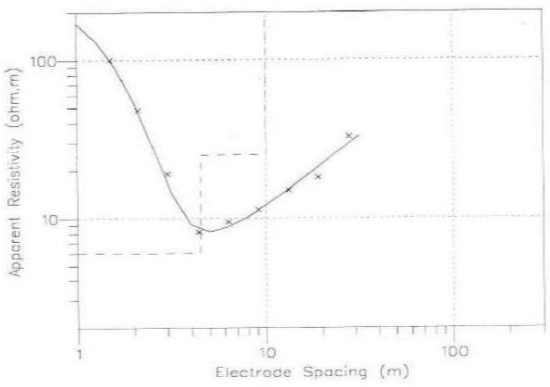
Array type : Schlumberger | Array direction : | Date : 08/04/2016

Readings and Unadjusted Apparent Resistivity Values

	Electrode Spacings AB/2 (m)	MN/2 (m)	Reading (ohm)	Geometric Factor (m)	Apparent Resistivity (ohm.m)	Ratio Adjusted / Unadjusted
						1.00
1	1.50	0.50	15.96	6.28	100.3	
2	2.10	0.50	3.69	13.07	48.2	
3	3.00	0.50	0.693	27.5	19.05	
4	4.40	0.50	0.1362	60.0	8.18	
5	6.30	0.50	0.0767	123.9	9.50	
6	9.10	0.50	0.0434	259	11.26	
7	13.2	0.50	0.0274	547	14.98	
8	19.0	0.50	0.01590	1133	18.02	
9	27.8	0.50	0.01350	2430	32.8	

Adjusted Apparent Resistivity Values

Spacing (m)	Apparent Resistivity (ohm.m)	Spacing (m)	Apparent Resistivity (ohm.m)	Spacing (m)	Apparent Resistivity (ohm.m)
1.50	100.3	4.40	8.18	13.2	14.98
2.10	48.2	6.30	9.50	19.0	18.02
3.00	19.05	9.10	11.26	27.8	32.8



Interpreted Model

Layer	Resistivity (ohm.m)	Depth (m)
1	250	0.70
2	6.00	4.50
3	25.0	10.0
4	300	

Coordinates 622553E, 103976N Alt 1098m
Proposed Reservior location

Techno Drill Ltd

Appendix 4: Construction materials tests

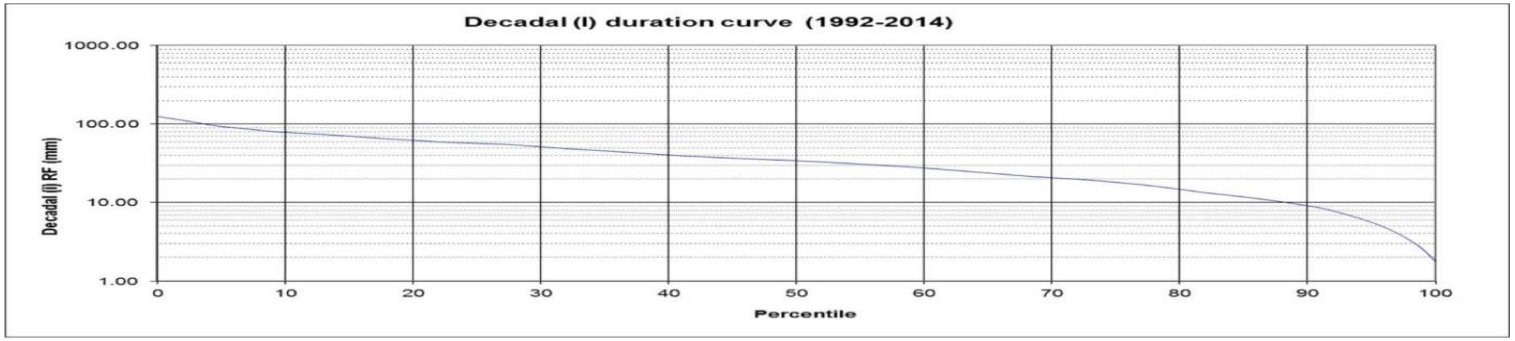
[A] CONSTRUCTION MATERIALS

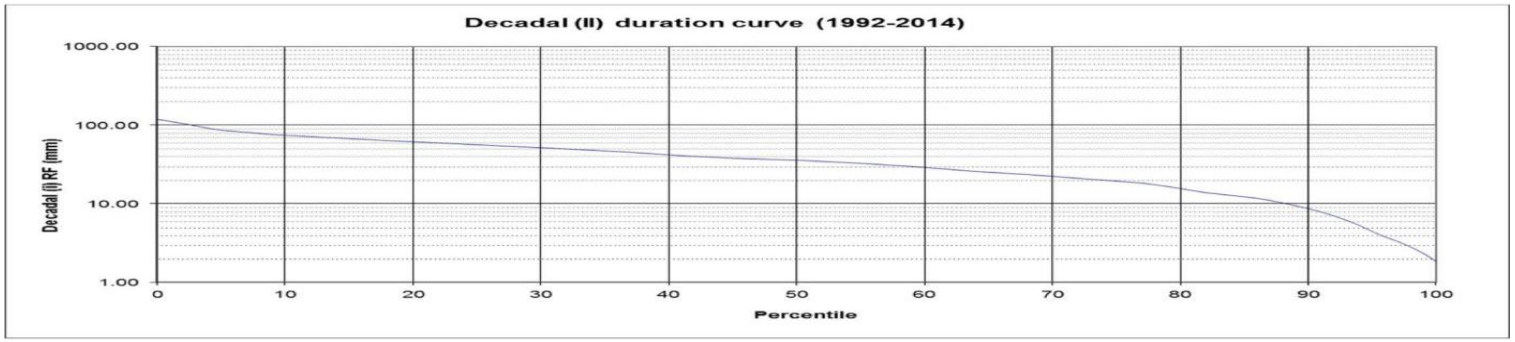
S/N	DISTRICT	S/COUNTY	VILLAGE/ LOCATION	UTME	UTMN	SAMPLING DEPTH	SAMPLE DESCRIPTION	REQUIRED TEST	QUANTITY ESTIMATION
1	Butaleja	Mazimasa	Miyaya	616734	105353	2.5ft	Sand & Gravel Mix	Gradation, Organic content, Mortar making Properties	Vast
2	Butaleja	Mazimasa	Miyaya	616726	105342	4ft	Reddish fine sands	Gradation, Organic content, Mortar making Properties	Vast
3	Mbale	Busiu	Wale Quarry	626270	102492		Aggregates	Aggregates in line with BS requirements	functional Quarry
14	Mbale	Namagumba	Blue stone quarries	634173	127430		Aggregates	Aggregates in line with BS requirements	functional Quarry

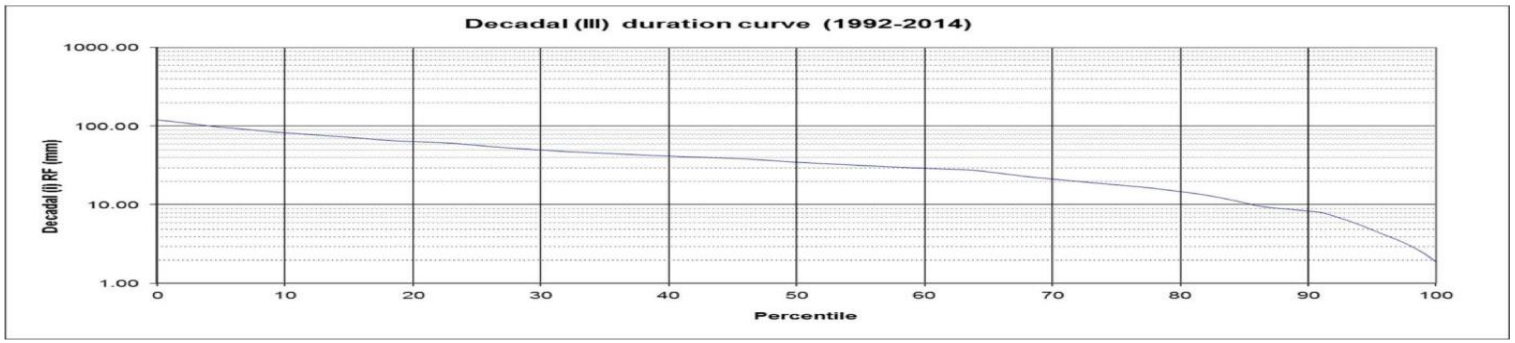
[B] TEST PIT SAMPLES

S/N	IRRIGATION SITE	LOCATION	UTME	UTMN	SAMPLING DEPTH	SAMPLE DESCRIPTION	REQUIRED TEST
15	Doho II	Reservior site	622553	103976	3ft	clay	Gradation, Atterberg Limits - classification

Appendix 5: A Decadal Rainfall Duration Curve of Tororo Meteorological Station







Appendix 6: Runoff for the Manafwa River (m^3/s)

1998	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

	6.65	5.14	5.30	6.59	6.00	5.91	6.57	10.41	8.17	9.40	6.98	5.26
1999	4.71	4.50	4.95	4.91	5.94	8.65	11.31	13.92	8.02	15.31	10.06	9.05
2000	6.65	5.62	5.38	5.87	8.04	6.29	7.59	9.53	7.93	10.99	6.85	5.04
2001	4.56	3.47	4.02	6.06	8.86	8.17	12.23	15.40	9.18	14.34	15.69	6.90
2002	4.76	2.47	4.54	4.54	11.35	8.07	5.80	7.28	7.35	8.29	9.86	5.47
2003	6.21	1.99	1.75	8.17	10.75	12.53	12.57	9.80	13.99	8.90	4.85	2.82
2004	1.87	2.54	2.81	6.50	11.60	4.66	4.00	7.81	7.03	6.24	6.55	3.59
2005	2.56	2.09	4.78	2.74	11.07	6.13	6.14	6.94	9.98	6.00	4.26	2.16
2006	2.14	2.74	2.31	6.77	10.89	33.80	7.84	12.97	7.53	6.45	29.26	12.06
2007	5.04	6.75	3.09	5.54	18.90	16.74	22.86	20.42	14.84	9.00	4.94	2.64
2008	1.82	1.65	3.54	6.94	3.53	5.76	5.92	11.07	8.16	11.66	9.59	3.21
2009	2.41	2.09	1.77	3.14	7.81	3.25	3.68	5.74	4.87	7.79	4.77	7.85
2010	11.90	15.97	19.40	16.06	25.91	12.09	11.72	11.81	11.52	9.39	6.76	5.11
2011	2.50	1.80	2.57	2.12	5.70	7.73	5.86	18.86	12.91	10.49	18.88	10.71
2012	3.85	2.05	1.75	7.40	12.65	8.23	6.55	7.51	8.03	6.64	7.32	3.46
2013	3.34	1.83	3.25	7.97	10.75	3.41	3.65	9.23	9.23	7.32	6.33	4.69
2014	2.38	1.75	1.80	2.47	6.12	7.58	5.55	10.67	15.24	10.28	5.45	5.15
Mean	4.3	3.8	4.3	6.1	10.3	9.4	8.2	11.1	9.6	9.3	9.3	5.6

Appendix 7: Irrigation Planning

Operational	
Days	7
Hr/day	12
Crop data	
Growing period (days)	135
Irrigation Period (days)	120
Pre-Planting Irrigation Data	
1st Irr-Soaking and plowing (mm)	100
2nd Irr- Land preparation & Weeding (mm)	100
3rd Irr- Puddling and Transplanting (mm)	100
CU (mm/day)	7.3
Determination of Irrigation Scheduling Parameters	
A. Pre-Planting Scheduling Parameters	
Actual depth of water subjected to Et in first 2 irrigations	154
Max. number of days to consume 154 mm	21
Net Depth of Water Applied to the Field before Transplanting (mm)	77
Recommended Depth of Standing Water when transplanting (mm)	40

Net Depth of Water Subjected to Et in 3rd Pre-Planting irrigation	37
Number of Days for Puddling and field preparation before transplanting	5.1
Number of days from transplanting to 1st Irrigation	2.1
Total Number of Days from soaking to transplanting	28.1
B. Post Planting Irrigation Scheduling	
Selected Frequency of Irrigation	7
Consumed depth of water in 7 days	51.1
Depth of water to be applied in one irrigation (mm)	66.4
Previous Depth of Standing Water after transplanting and before Ist Irrigation (mm)	25
Total Depth of Water at 1st Irrigation (mm)	91.4
Irrigation System Capacity	
Number of irrigations to be applied in the growing season	17.1
Q for Field (l/s)	55
Irrigation Time (hr)	2.5
Number of fields that can be irrigated in one day	4.8
Area of fields that can be irrigated in one day	3.6
Area irrigated in one cycle	25.1

Appendix 8: 3-B Irrigation System

Details of Irrigation Canals

S.No	Type of Canal	Lining type	Number of Canals	Head Discharge in m^3/s	Length in Km	Net Irrigable area in ha
1	Main Canal (MC-1)	Concrete Lining	1	1.870	1.49	-
2	Secondary Canal (SC-1)	Concrete Lining	1	0.825	3.64	369.5
3	Secondary Canal (SC-2)	Concrete Lining	1	1.045	4.20	447.3
4	Tertiary Canals	Unlined	17	(0.055-0.110)	20.20	-

Details of Canal Structures

S.No	Type of Structure	Main Canal	Secondary Canals	Tertiary Canals	Total
1	Cross & Head Regulator	2	17	244	263
2	Vertical Fall	-	8	1	9
3	Road Crossings	-	2	-	2
		2	27	245	274

Appendix 9: 3-C Drainage System

Details of Drainage Canals

S.No	Type of Canal	Lining type	Number of Canals	Head Discharge in m3/s	Length in Km
1	Collector Drain (ID-1)	Unlined	1	1.646	0.99
2	Secondary Drain (SD-1)	Unlined	1	1.029	5.05
3	Secondary Drain (SD-2)	Unlined	1	1.112	3.74
4	Escape Canal (ESC-1)	Unlined	1	0.110	1.67
5	Escape Canal (ESC-2)	Unlined	1	0.165	0.50

Details of Drain Structures

S.No	Type of Structure	Escape canal & Collector Drain	Secondary Drain	Tertiary Drain	Total
1	Outfall	2	2	17	21
2	Vertical Fall	5	15	1	21
3	Road Crossings	-	2	239	241

Details of Flood Protection Dykes

S.No	Flood protection Dykes	Length in Km
1	Dyke-1	5.60

Appendix 10: Materials Specifications & Standards

A list of materials, their specifications and applicable standards, considered in the design of gate equipment is given hereunder.

Material Specifications

Structural Steel

For skin plate, main componentsGate leaf, stop logs.				ASTM-A36, "Specification for Structural Steel".	
for embedded parts (except seal bearing plates and guide plates and rails which are of CRES) and supports etc				ASTM-A36, "Specification for Structural Steel".	
b. Corrosion-Resisting(or Corrosion Resistant)					
			Steel	ASTM-A276, "Specification for Stainless and Heat Resisting Steel Bars and Shapes, "Type: Series 316L.	
(Bars, bolts, nuts, and washers, etc.) (Symbol: "GP - CRES").					
c.	Corrosion-Resisting				
(or	Corrosion	Resistant)	Steel		
(pins and rods) (Symbol: "CRES")				ASTM-A276, "Specification for Stainless and Heat Resisting	
d. Stainless Steel (plate, sheet				Steel Bars and Shapes," Type: Series 403 or 410.	
	and strip)			ASTM-A240, "Specification for Resisting Chromium and	
				Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.	
e. Corrosion-Resisting Steel				ASTM-A743, "Specification for Corrosion Resisting Iron-	
	Castings			Chromium - Nickel Alloy Casting for General Applications"	

				Grade CA-15 and CF-8.	
f.	Cast Steel Wheels			ASTM-A583, "Specification for Cast Steel Wheels for Railway	
				Service."	
g.	Steel Shafting			ASTM-A29, "Specification for Steel Bars Carbon and Alloy, Hot	
				Rolled, Cold Finished"	
				ASTM-A307, "Specification for Low-carbon Steel Externally	
h.	Steel Bolts and Nuts			and Internally Threaded Standard Fasteners," and ASTM-	
				A325. "Specifications for High- Strength Bolts for Structural	
				Steel Joints Including Suitable Nuts and Plain Hardened	
				Washers".	
i.	Lock Washers			Spring steel, SAE proportions, regular series.	

J.	Forged Steel		ASTM-A668, "Specification for Steel Forgings, Carbon and Alloy, General Industrial Use".
K.	Round Wire Rope		ASTM-A492 "Specification for Stainless and Heat Resisting Steel Wire Rope and U.S. Fed. Spec. RR-W-410b. "Wire Rope and Strand".
l.	Wire Rope Fittings		Contractor's standard fittings for the type of rope used.
M. Permanent self-lubricating bearings and washers with rated coefficient of friction less than 0.15.			"Lubrite" A cast bronze alloy (ASTM-B22, "Specification for Bronze Castings for Bridges and Turntables," Alloy E) with self- lubricating inserts.
N.	Expansion Anchors		According to manufacturer's published data.
O.	Concrete Anchor Studs		According to manufacturer's published data.
P.	Rubber Seals		The rubber seals are molded and the material is compounded of natural rubber or copolymer of butadiene

		and styrene or a blend of both. The compound contains not less than 70% by volume of the basic polymer and the remainder consists of reinforcing carbon black, zinc oxide, accelerators, anti- oxidants, vulcanizing agents, and plasticizers.	
Painting Schedule			
The painting is as per schedule given below:			
	Surface	**Surfaces**	**Coates**
		Preparation	
1.	Ferrous Metal Subject to Continuous Immersion in Water.	SSPC -SP10, Near White Blast Cleaning	Two coats in workshop of Zinc RichPrimer Epoxy paint with minimum dry film thickness 75 microns. Two coats at site of Epoxy Paint, each coat minimum 200 micron dry film thickness.
2.	Ferrous Metal subject to intermittent immersion and splash, exposed to favourable atmosphere or humid environment.	SSPC -SP10, Near White Blast.	Two coats in workshop of Pigmented Epoxy Paint with total dry film thickness of 50 micron. Two coats at Site of Epoxy Paint, each coat minimum 200 micron dry film thickness
3.	Ferrous Metal Expected not to Come in Contact with Water.	SSPC -SP10, Near White Blast Cleaning except galvanized surfaces.	Two coats of Silicone. Aluminum Paint, total dry film thickness not less than 30 Micron.
4.	Ferrous Metal Embedded in Concrete, Welding (erection) pads, erection studs: embedded parts surfaces in contact with concrete.	Clean	None
5.	Corrosion Resistant Steel Surfaces.		

		Surface	Surfaces	Coates

			Preparation	
	a.	Seal Plates	Clean thoroughly,	None
			and grind smooth, if	
			required	
	b.	Other	Clean	None
6.	Galvanized surfaces		ASTM A 123	Galvanize per ASTM
			& A 153	A 123 & A 153

Appendix 11: SITE DAILY INSPECTION CHECKLIST

Date ……..

Project Sub-component	Time of Inspection	Environmental/social issues	Applied mitigation measures	Comments
	7:00am to			
	8:00am			
	8:00am			
	9:00am			
	9:00am			
	10:00am			
	10:00am			
	11:00am			
	Etc			

Contractor's Name…… Consultant's Name……

Signature……..……Signature……..

NB: Environmental issues to be monitored include; dust pollution, debris mgt, garbage/solid waste management, PPEs, traffic mgt, EHS-meetings, manual handling, open excavation mgt, oil spillage, soils erosion, drainage systems, water ponding, cut spoil mgt, vegetation protection, water resources management, noise pollution, private property damage, social issues, site inspections, waste water management, labour employment, fuelling, servicing of machines and others as will be specified.

Appendix 12: DAILY WORKING CONDITIONS ASSESSMENT REPORT

Project Name……..

Date …….. Report No……

Section…… Department……..

<table>
<tr><td colspan="3">ENVIRONMENT, SAFETY AND HEALTH MONITORING ON SITE(tick where applicable)</td></tr>
<tr><td rowspan="2"><u>CLIMATE</u>
Wet
Dry
Hot
Cold
Windy
Others
(specify)</td><td><u>LIGHTING</u>
Good
Poor
Natural
Artificial</td><td><u>WORKING SURFACE</u>
Even
Uneven
Slippery
Rough</td></tr>
<tr><td><u>SITE ACCESSIBILITY</u>
Access Limit
Easily accessible</td><td><u>SURFACE CONTAMINATED BY</u>
Water
Oil/Bitumen
Dust
Paint
Sludge
Cement
Primer
Fuel
Solid Wastes
Sewage</td></tr>
<tr><td colspan="3">POTENTIAL SAFETY HAZARDS</td></tr>
<tr><td colspan="3">Traffic Visibility
Falling debris Fall
Suffocation Disease outbreak
Fire Outbreak Skin irritation</td></tr>
<tr><td colspan="3">Others (specify)</td></tr>
<tr><td colspan="3">ENVIRONMENTAL ISSUES</td></tr>
</table>

Dust	Consultation with PAPs
Temporary access roads	Borrow pit management
Soil erosion	Dump site management
Uncovered vehicles with dry materials	Mobile toilets on site
Cut to spoil management	Manual Handling
Open excavation	Temporary side drain
Stagnant water on site	Tidiness of the site

Cleanliness at the camp Information sign post on site Changing rooms for workers Drinking water Site arrangement	Workers by Gender on site	
	Male	
	Female	

Other environment and social issues (specify)

PERSONNEL PROTECTIVE GEAR

Overall	Safety footwear
Helmet	Gloves
Dust mask	Reflector Jacket

Others (specify)

Number of workers on site……	With reflector	Helmet	Dusk Musk	Gloves	Safety footwear	Gaggles

COMPLIANCE TO ENVIRONMENT HEALTH, SAFETY MEASURES AND STANDARDS

Lay out of traffic management tools (e.g. sign posts, traffic cones)

Availability of trained flag personnel and first aiders

Accessibility to first aid facilities

Availability of firefighting equipment Accessibility of community properties Dust free environment (watering 3x a day) Availability of solid waste collecting materials Availability of drainage channels Manual handling not beyond 25kgs Accessibility of ESMP and EMP, OHSMP TMP. Dumping of cut to spoil at designated site Covered trucks No contamination of soils and water
OTHERS Specify
Any accident or arising Environment and Social issue
General Remarks
Section Head……. Environment/Safety Officer……. Signature …… Signature …… Supervising Engineer…….. Signature ……..

Appendix 13: ENVIRONMENTAL MONITORING CHECKLIST

(NC=NON-COMPLIANCE, C= COMPLIANCE, NA= NOT APPLICABLE)	
Environmental issues	**Rating**
Vehicular movement of construction vehicles	
Vegetation Clearing	
Protection of Fauna	
Soil Erosion control	
Slope protection	
Leveling	
Dumping of wastes to designated dumping sites	
Servicing and refueling of construction vehicles	
Liquid waste management	
Fire fighting	
Dust control	
Community sensitization	
Employing local personnel	
OSH meetings	
HIV/AIDS testing and counseling	
De-silting of drainage channels	
Protection of water bodies from pollution	
Disposal of solid wastes	
Flood control measures	
Traffic management	
Slope protection	
Compensation	
Drinking water for workers and visitors	
On call doctor	
Emergency contacts displayed	
Gender balance	
Induction of workers	
PPEs issued	

Workers in PPEs	
EMP displayed	
Compound talk	
No alcohol and smoking	
Dump site management	
Site cleanup and rehabilitation	
OTHERS	

Remedial Action on non-compliance (Action and time)	
Contractor's comment	Consultant comment
Contractor Name …….. Date Signature ……	Consultant Name …….. Date Signature …….

Appendix 14: ENVIRONMENTAL INDUCTION REGISTER

Employee Name		Date		
Designation				
Department/Section				
Contact Number		Trained by		
Reporting to				
TOPICS COVERED				
No.	Details			
1	Name and scope of the project			
2	Site environmental and safety chart			
3	Site Environmental Health and Safety rules and regulations			
4	Work related hazards, risks and control measures			
5	Contractor's EMP			
6	PPEs importance and usage			
7	Un safe acts and Unsafe conditions			
8	ESMP trainings			
9	Tool Box talks			
10	Site cleanup and good house keeping			
11	Drugs and alcohol Abuse			
12	Company Environmental Policies, mission and vision			
13	Company organizational structure			
14	Client and consultant			
	SELF-DECLARATION			

	I have clearly understood the environmental health and safety requirements of the project and			
	I shall abide to all EHS rules. I am responsible for all consequences arising from my failure.			
Employee Signature		Site In charge		

15 WASTE REGISTER

Project Name:						
Date:						
Report Number:						
Site where wastes are to be disposed:						
Carrier:						
Types of wastes generated	Re-used		Recycled		Deposited	
	On site	Off site	On site	Off site	Land fill/ dump site	Off Land fill/ dump site
Inert						

Non-hazardous						
Hazardous						

16 PERSONAL PROTECTIVE EQUIPMENT ISSUE REGISTER

SAFETY GEAR ISSUER……..

EMPLOYEE NAME……

DATE…….

No.	Department	PPE type	1st issue	2nd issue	Receiver signature	In charge signature	Remarks

17 ACCIDENT REPORT FORM

To: Environment and Safety Officer

ATSGSL Date:_____

Accident No._____ Vehicle Reg. No……

Description of incident (Additional sheet may be attached if required) include the location

_____

_____ _____
Find comments and recommendation of Manager, OHS Name ……signature …… date……. Attach the photos

Appendix 18: Code of Conduct and Ethics

Introduction

This code of conduct applies to all workers at the construction site. Ethical behaviour and conduct is important in providing a safe environment and enjoyable experience for everyone at work place.

A. Core values

As part of the assignment, the number of contracted labourforce and contractor(s) should work together to uphold their values. This will drive decision making, behaviour and how to work and interact with each other for a common goal.

B. Workforce Expectations

People who will work at the proposed scheme in the respective sub-counties are entitled to expect a working environment in which they will:

- Be treated fairly, with respect and without discrimination;
- Be provided with a safe work environment;

Work in a harmonious and productive environment.

- Have their professional expertise respected by their co-workers;
- Be provided with opportunities to learn and develop in their roles. Receive open, inclusive and honest communication.

Be treated in a professional, helpful and courteous manner.

C. Personal responsibilities

The contracted company has a responsibility to provide its workers with access to rules and regulation procedures that they are required to comply with.

As a member of staff you (worker) have a responsibility to familiarize yourself with these rules and regulation procedures and to cooperate in implementing them. You also have a responsibility to make enquiries on your own behalf if you are unsure about what actions to take. You must act in a way that promotes your trust and confidence in whatever you're doing. You need to be aware that your reputation can be affected by your actions at work and, in certain circumstances, by your conduct outside the workplace.

You are required to:

- Behave in a lawful manner;
- Conduct yourself in a professional and ethical manner at all times while at work and in the public;
- Ensure you present an image of professionalism for instance what you wear to work is suitable for your duties on the site;

- ❖ Be prepared to take personal responsibility and be accountable for your own conduct, actions or omissions;
- ❖ Disclose to your manager or supervisor any challenges that may impact on your capacity to carry out your duties (e.g. lack of PPE, salary issues).

D. Manager and supervisor responsibilities

An essential function of all managers and supervisors is the fair and effective management of their staff.

If you are a manager or supervisor you are expected to demonstrate ethical conduct, fairness and equity, and to lead by good example. You are required to:

Be accountable for your own actions or omissions.

- ❖ Carry out activities in ways that are lawful, fair, ethical, reasonable and professional;
- ❖ Ensure your staff is held properly accountable for their conduct and performance;
- ❖ Be aware of acts or omissions that are sufficiently serious, repeated, or widespread enough that you should have been aware of and corrected them.

Be fully informed about the matters you deal with.

- ❖ Record and give reasons for your decisions and actions to those people who are affected;
- ❖ Ensure your staff is informed of their duties and responsibilities, and receive adequate information, instruction and training to perform them effectively, efficiently and safely.

E. Respect for each other

The contractor should be committed to create an environment where all workers can enjoy rewarding and fulfilling professional working relationships and where differences are respected.

The decisions should be based on sound management principles and on respect for each other. As a staff member you are required to:-

- ❖ Respect the professional expertise of other staff member;
- ❖ Ensure you do not discriminate against, harass, intimidate, bully or threaten any of the staff members;
- ❖ Commit to resolving personal or work-related disputes or differences in a constructive, co-operative and timely manner;

- Be sensitive to and respect the ethnic and culture of any of the staff member;

Harassment or discrimination on the grounds of sex, marital status, pregnancy, age, race, social origin, careers' responsibility, religion, disability or illness, political opinion, transgender status (actual or presumed), or sexual preference (actual or presumed) may be an offence and might lead to dismissal. In addition, staff must not harass or discriminate against others on the grounds of political or religious conviction. Report instances of discrimination, intimidation, victimization, harassment or workplace bullying to the respect supervisors.

I have read, understood and agree to comply with this code of conduct. I understand that if I do not meet the standards outlined in this code of conduct, the following may happen:

- ✓ *I may be subject to disciplinary action appropriate to the situation;*
- ✓ *My employment or services as a worker may be terminated and I may be asked to leave the workplace or campsite immediately.*

Management

Name:……..

Signature:…….

Date:……