**REPUBLIC OF RWANDA**

**MINISTRY OF ENVIRONMENT**

# ESIA SUMMARY FOR MUVUMBA MULTIPURPOSE DAM DEVELOPMENT PROJECT

## 1. Introduction

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

1.2. The Project aims to increase the productivity and commercialization of agriculture through the implementation of watershed management, water-harvesting in valley dams and hillside irrigation. It will help also to increase water supply as it was observed that in Nyagatare District the quality of domestic water is critical, hence this project will help to increase water uses. Finally this project will contribute to increase the energy by generating hydro power energy. The following are the summarized objectives of this project:

i) Domestic and industrial supply: The residents of Rukomo, Gatunda, Karama, Tabagwe, Nyagatare, Kiyombe, Kabarore, Ngarama, Mimuli Sectors of Nyagatare

and Gatsibo Districts will get water for daily domestic uses which is currently serious problem

ii) Irrigation: The estimated gross command area for this project is 10000ha with 8000ha net, which will be used to grow: Maize, Soya bean, rice, vegetables and fruit trees.

iii) Flood control: The dam project will help to control flooding at downstream of Muvumba river because the excess water will be stored in the reservoir.

iv) Hydro-electric power

v) Soil conservation: In order to control siltation in the reservoir, watershed will be developed hence watershed will be protected against soil erosion.

vi) Pollution control by prevention of salts-water intrusion and by providing dilution water for waste water.



1.3. **Locational Characteristics**: Nyagatare City (Fisher 1992) has a savanna ecosystem which mainly consists of Xerophyte grasslands and wetland vegetations, with partial distributions of patch type Acacia species. The catchment area upstream of the project site, consists of a montane zone in the eastmost boundary of a tropical rainforest (Olsen et al. 2001) and a buffer zone where a montane zone transits to a savanna (B1/B2; Pygeum, Hagenia-Rapanea Moist Montane Forest, Breugel et al. 2011). The catchment area of Rwanda also has both tropical rain forest and savannah (UNEP, 2009). The project area lies between 1o 21' 45''S, 30o 10'30" E; 1o 21' 15''S, 30o 11'0" E in upstream (check dam area) and 1o 22' 45''S, 30o 11'45" E; 1o 21' 0''S, 30o 14'0" E in the downstream (main dam area) 1. A total of 3 sectors, 8 cells and 15 villages are affected by the project.

1.4. **Categorization:** In accordance with **law n°48/2018 of 13/08/2018 on environment in its article 30 and** ministerial order no 001/2019 of 15/04/2019 establishing the list of projects that must undergo environmental impact assessment, instructions, requirements and procedures to conduct environmental impact assessment, in the annexe I list of works, activities and projects that must undergo a full environmental impact assessment, it is clear that Muvumba multipurpose dam falls into no 12° construction of hydro-dams, hydropower plants and electrical lines of high and medium voltage;

1.4.1. **ESIA Requirements:** The developer, whose project is on the list of the projects that require environmental impact assessment listed in Annex I and II of this Order, selects an expert from the list of environmental assessment practitioners published in accordance with relevant laws to conduct the study. The selected expert must not have any direct or indirect interests in that project. The selected environmental impact assessment expert, on behalf of developer, submits an official application for environmental impact assessment of a proposed project to the authorized organ in form of a project brief together with proposed terms of reference for review and approval. The Report was prepared and the certificate of Environment Impact Assessment has been Issued by a competent Authority.

1.4.2. **RAP Requirements:** The construction of Muvumba multipurpose dam will consist of borrowing construction materials (quarry site), construction of dam embankment, the construction of Concrete check dam for sediment control and the inundation area for dam reservoir. All those activities will cause loss of properties in terms of buildings and land. Affected people have been compensated according to the law no N° 32/2015 of 11/06/2015 related to the expropriation in public interest.

1.5. **Scope of the study: The scope of the study included the Direct Impact Zone (DIZ) and the Area of Influence (AI).** Direct Impact Zone (DIZ) - This is the construction area, inundation area and the quarry sites, borrow pits, quarry sites, campsites etc. Immediate Impact Zone (IIZ): These are immediate surrounding areas about 50m on both side of the proposed inundation area. The study has looked also on the upstream and downstream with focus to irrigation scheme.

## 2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1. **Sustainability Triggers:** The National Policy on Environment adopted by the Cabinet in November 2003 is the main policy document governing environmental management in the country. The policy addresses environmental issues as both natural and social concerns, and adopts the key principle of sustainable development. The policy requires ESIA to be mandatory for all development projects which are likely to have significant environmental impacts. The intention is to ensure that the development projects are implemented in an economically sustainable manner while safeguarding environmental and social issues for the benefit of the present and future generations.

2.2. **National Environmental Law:** Chapter V of the Law N°48/2018 of 13/08/2018 on environment in Rwanda regulates the Environmental Assessment studies. **Article 30** states that the list of projects that must undergo an environmental impact assessment before they obtain authorization for their implementation is established by an Order of the Minister. An Order of the Minister also issues instructions and procedures for conducting environmental impact assessment. **Article 31** states that every policy, strategy, plan and programme must undergo a strategic environmental assessment. Procedures for conducting strategic

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

2.3. **National Land Law**

Land ownership in Rwanda is determined by the Organic law N° 08/2005 of 14/07/2005 determining the use and management of Land in Rwanda. It also institutes the principles that are respected on land legal rights accepted on any land in the country as well as all other appendages whether natural or artificial.

The ownership of Land is determined by article 4, which announces that, any person or association with legal personality has the right over the land and to freely exploit it as provided for by this organic law in article 5 and 6.

2.4.**National Gender Policy Final Version, July 2010. Ministry of Gender and Family Protection:** The Rwanda Gender Policy outlines fighting violence against women, the establishment of anti- GBV and Child protection committees from the grassroots level to the national level as achievements. In addition, a law preventing and punishing GBV was promulgated, according to the policy.

The Gender Policy, in section 4.5 in the Good Governance and Justice programme, promotes gender sensitive representation and effective participation of men and women, girls and boys in decision making positions at all levels. Section 4.5.2.5 explicitly states the programmes of the Gender Policy, will 'ensure that adequate measures for effective prevention and response to Gender based violence are undertaken'. The policy then goes further in Section 4.7.2.3, to promise that an 'effective gender sensitive strategy (will be) developed for preparedness in a range of disaster scenarios, e.g. floods, volcanic eruption, drought, mass influx of refugees/returnees / displaced persons' in addition to enacting and enforcing anti-discriminatory laws in the employment field (4.8.2.2.)

2.5. **The socio-economic triggers for this project lie in the National Policy on HIV/AIDS,** which recognizes the linkage between poverty and HIV/AIDS, as the poor communities of the society are very vulnerable. During project implementation of the project influx of people in the project area could accelerate the spread of the disease. In order to contribute towards observing the objectives of the National Policy on HIV/AIDs, the project Contractor will be required to have HIV/AIDs programme aimed at promoting awareness of HIV/AIDs among its service providers and its employees, despite that the HIV/AIDs knowledge is known to most of people. The **National Gender Policy,** requires that project management to ensure that gender issues are given emphasis. It also requires that women and men are given equal employment opportunities in the project, whenever possible. During construction, the contractor will have the obligation to ensure that as much as possible men and women are given equal opportunities during recruitment of construction workers.

2.6. **The project triggers all the Operational Standards in the African Development Bank's Integrated Safeguard Policy** including:

*Operational Safeguard 1*: Environmental and social assessment – The project is Category 1 requiring a full environmental and social assessment.

• *Operational Safeguard 2*: Involuntary resettlement land acquisition, population displacement and compensation – The project will lead to involuntary resettlement and a resettlement action plan has been developed.

• *Operational Safeguard 3*: Biodiversity and ecosystem services – The project location includes water systems, forests and communities, the application of the mitigation hierarchy is key in ensuring the sustainability of the project

• *Operational Safeguard 4*: Pollution prevention and control, hazardous materials and resource efficiency – The project will handle hazardous waste that has to handled well in order to minimize pollution

• *Operational Safeguard 5*: Labor conditions, health and safety – The project is implemented through a contract and workers welfare and safety is key to the successful implementation process.

2.7. **The administrative and institutional arrangements**: The institutional framework for environmental management is currently enshrined in the law N°48/2018 of 13/08/2018 on the environment in Rwanda published in the Official Gazette no. Special of 21/09/2018, particularly in its chapter V relating to the obligations of the state, decentralised entities and local communities with regard to the protection, conservation and promotion of environment

### 2.7.1. **Ministry of Environment (MoE)**

The Ministry of Environment was established to ensure the conservation, protection and development of the environment. It also ensures the safeguard of green and climate resilience for growth of the economy.

The vision of MoE is protecting the environment for the safeguard of a green and climate resilient Rwanda for growth of the economy. the Ministry of Environment (MoE), which has the following main responsibilities:

(i) To develop and disseminate environment and climate change policies, strategies and programs through:

**a)** developing strategies to promote partnership and enhance capacity of the private sector to invest in activities of environment and climate change for sustainable economic development;

**b)** developing laws and regulations to ensure protection of the environment and conservation of natural ecosystems;

**c)** developing institutional and human resources capacities in environment and climate change.

(ii) To monitor and evaluate the implementation and mainstreaming of environment and climate change policies, strategies and programs across all sectors, especially productive sector;

(iii) To oversee and evaluate institutions under its supervision by providing guidance on the implementation of specific programs to be realized by the institutions under its supervision and local government;

(iv) To mobilize the necessary resources for the development, protection and conservation of the environment; for climate change adaptation and mitigation.

### 2.7.2. Rwanda Environment Management Authority (REMA)

In 2002, Rwanda Environment Management Authority (REMA) was established to act as the implementation organ of environment-related policies and laws. REMA is also tasked to coordinate different environmental protection activities undertaken by environmental promotion agencies; to promote the integration of environmental issues in development policies, projects, plans and programmes; to coordinate implementation of Government policies and decisions taken by the Board of Directors and ensure the integration of environmental issues in national planning among concerned departments and institutions within the Government; to advise the Government with regard to the legislation and other measures relating to environmental management or implementation of conventions, treaties and international agreements relevant to the field of environment as and when necessary; to make proposals to the Government in the field of environmental policies and strategies.

### 2.7.3. Rwanda Development Board (RDB)

RDB was created by Organic Law No 53/2008 of 02/09/2008. It has a mission of improving the well-being of all Rwandans by fast-tracking development, catalyzing sustainable economic growth, and creating prosperity for all. According to the restructuring of government institutions including RIEPA, ORTPN, CAPMER, etc, the responsibility for follow- up of environmental impact studies is now under RDB, the department in charge of investment.

## 3. DESCRIPTION OF PROJECT AND JUSTIFICATION

3.1. **Project location:** The project area is located in Rukomo, Karamaand Gatunda Gatunda Sectors, which is apart 20km from the south-western part of Nyagatare District and is situated on the 2km downstream of intersection between Muvumba River and Cyenkwanzi river. Nyagatare is located in the Eastern Province of Rwanda. Nyagatare occupies the North East extremity of Rwanda. Nyagatare District borders Uganda in the North and West, Tanzania in the East. The project area is located on River Muvumba approximately about

10km from the Ugandan boarder and is centered at approximate coordinates N 524,807.17,E 4,850,389.80 (Sta. 0).

The project will construct a dam of 30.5 m height and 1052m length that will impound 34.9 million cubic meters of water that will serve in domestic water supply, Livestock water supply, Irrigation of 7,380ha of land, generation of 740KW of power and contribute to flood control.

The project will serve Nyagatare sector, Karangazi, Rwempasha, Rukomo, Gatunda , Karama and Tabagwe Sectors.

### 3.2. Design concept of the project:

The major characteristics of the proposed Muvumba multipurpose dam are as follow:

| NO | ITEM | UNIT | DESCRIPTION |
|---|---|---|---|
| | **River system** | - | Muvumba River |
| | Catchment area | km² | 948.6 |
| | Mean annual inflow | $10^6$m³/yr | 196.8 |
| | **Reservoir Maximum water level (MWL)** | EL. m | 1,406.6 |
| | Reservoir Flood water level (FWL) | EL. m | 1405.8 |
| | Reservoir High water level (HWL) | EL. m | 1,405.0 |
| | Reservoir Low water level (LWL) | EL. m | 1,391.0 |
| | Reservoir Total storage capacity | 106m³ | 34.92 |
| | Reservoir Effective storage capacity | 106m³ | 30.20 |
| | **Dam Type** | - | Earth fill dam (ED) |
| | Dam Crest elevation | m | 1,408.5 |
| | Dam Length | m | 1,052 |
| | Dam Height | m | 30.5 |
| | **Spillway Type** | - | Unregulated ogee |
| | Spillway Width | m | 95 |
| | Spillway Weir crest | EL. m | 1,405.0 |
| | Powerhouse Installed capacity | KW | 740(370KW×2Units) |
| | Powerhouse Mean yearly energy production | GWh | 5.719 |

| | | | |
|---|---|---|---|
| | **Check dam type** | - | Concrete gravity dam |
| | Check dam length | m | 233 |
| | Check dam height | m | 7 |
| | Check dam Crest elevation | m | 1430 |
| | Check dam Crest width | m | 2 |
| | Check dam Upstream face slope | V:H | vertical |
| | Check dam Downstream face slope | V:H | 1:0.7 |
| | Check dam Normal high water level | El.m | 1428.5 ( overflow section crest elevation |
| | Check dam total storage | $M^3$ | 261472 |
| | Check dam overflow section type | | Non control type (nn gate type) |
| | Check dam overflow section length | m | 45 |
| | Check dam overflow section height | m | 5.5 |
| | Check dam overflow section design discharge | M3/sec | 133.5 peak outflow under 200 year flood |
| | Check dam overflow section energy dissipater type | | Type II stilling basin 20m length |
| | **Hydropower plant** | | |
| | Rated water level | El.M | 1,402.93m |
| | LWL for power generation | El.m | 1,394.46m |
| | Tail water level | El.m | 1,378.74m |
| | Rated Head | m | 24.19m (rated water level - tailwater level) |
| | Head loss | m | 1.81m |
| | Net head | m | 22.38m (rated lead - head loss) |
| | Plant discharge | $m^3/s$ | 3.930 $m^3/s$ |
| | Project benefits on Water supply | $106 m^3/yr$ | Total water supply : 125.9 |

| | | | |
|---|---|---|---|
| | | | - Domestic water : 8.9<br>- Irrigation water : 78.1<br>- Livestock water : 0.7<br>- Environmental flow : 38.2 |
| | Reliability of water supply | % | 84% |
| | Area of inundation | $km^2$ | 3.7 |

3.3. **Mobilization and Preconstruction (4 months):** This phase entails mobilization of labor force, equipment and construction of offices/campsites. Other activities during this phase include Topographical Survey, Geo-technical Investigation, Soils and Construction Materials Investigation, Land acquisition (If any), material storage and material preparation, Identification sources of material including and source of water.

3.4. **The construction phase of the Project**, which is estimated to take 5 years includes major construction activities such as; Site clearance, diversion works, Extraction and transportation of materials (gravel, sand, hard stones, aggregates, water and soil), Construction of drainage structures, Construction of dam embankment, Installation of monitoring equipment , construction of spillway, construction intakes , construction of check dam, construction of hydropower. The development of the scheme will follow up as phase 2 of the project.

3.5. **Decommissioning Phase:** After completion of dam construction, Engineer's camps and Contractors' camps shall be reverted to the client (Rwanda water and Forestry Authority/Ministry of Environment) who will decide on their future use. We plan to make them be used as offices to the users of the dam for hydropower and the irrigation scheme.

• Demobilization of temporary structures will be done for proper restoration of the site (e.g. removing/spreading top-soils piled along the road, removing all temporary structures, sites offices may be left to the local governments depending on agreements that will be reached during the mobilization phase.

• Other activities include clearance of all sorts of wastes including used oil, sewage, sewage, solid wastes (plastics, wood, metal, papers, etc).

• Deposit all wastes to the sanitary landfill at Nyagatare

• Termination of temporary employment.

3.6. **Required Site Investments:** *The main construction materials* for the dam include soil, clay sand, gravel, hard stones (aggregates), reinforcement iron bars, water and cement. Most of the materials shall be obtained locally (within Rwanda) except some mechanical equipments which shall be imported. Material investigations have been made with the aim of identifying sources for suitable construction materials including borrow pits, sand pits, construction water sources and quarry sites.

3.7. **Water:** the water to be used in construction activities will be coming from Muvumba river. However the connection to WASAC pipe network will be required to have clean water for portable use on site.

3.8. **Other site investments will include** fuel storage tanks; storage facilities for construction materials (cement, bitumen, paints, steel, timber etc.); Mechanical workshop for repair and maintenance of construction machinery, equipment, and vehicles and Accommodation and offices for the Contractor and Engineer (Engineer) key and support staff.

## 4. DESCRIPTION OF PROJECT ENVIRONMENT

**4.1. Vegetation & Flora:** The actual vegetation in the project area mainly consists of arable lands, grasslands, eucalyptus vegetation forests, with a partial distribution of patch type secondary forests. No distribution of either natural or gallery forest was observed. In the arable land which mostly dominates the catchment area, tropical and subtropical crops (bananas, sugar canes) as well as beans, corns, sweet potatoes, tomatoes, and avocados are cultivated. No protected species were confirmed during the environmental impact assessment. Confirmed major species are: herbaceous plants (Euphorbia tirucalli, Euphorbia

conderablum, Acacia sieberana, A. Albia, albizzia gummifera) and wood plants (Euphorbia tirucalli, Euphorbia conderablum, Acacia sieberana, A. Albia, albizzia gummifera).

4.2.**Fauna**: The grey crowned crane, which is included in the IUCN Red List (endangered), was confirmed as a major animal species during the environmental impact assessment. Additionally, birds such as Ciconia ciconia, Ardea cinerea, ducks, Black-head weavers, and one clarias species were observed in the Muvumba River.

4.3.**Water Environment:** It was observed during the environmental impact assessment that the Muvumba River mostly fulfilled Rwanda's water quality standards. However, contents of iron(Fe), manganese(Mn), copper(Cu), fecal coli forms, as well as the water turbidity, all exceeded the drinking-water standard (RBS). The causes were found to be gushouts of heavy metals contained in rocks and soil, soil erosion from cultivated lands or bare grounds, night soil from dwellings and livestock. Especially, the water turbidity was high throughout the year (182.5NTU during the dry season and 279.5NTU during the wet season). The mainstream flowing from the upstream area (including the catchment area within the submerged land) was extremely turbid even from visual observation.

**4.4.Environmental Impacts & Mitigation Measures**

4.4.1. **Topography & Geology (Soil):** It is expected that the original landscape would be affected by excavations and embankments for the dam, the auxiliary facilities, construction equipment, and the access roads. Further, the fault zones and the bedrocks would be also affected by excavations for the dam body.

It is also likely that impounding of the artificial lake would create shores and submerged lands. Spoils would be produced by civil works such as excavating and quarrying, thereby requires mitigation measures. It is expected that spoils would be produced by civil works such as excavation of the dam body. Appropriate mitigation measures are required to prevent soil erosion when spoils are piled inside the project site. Soil erosion and its subsequent impacts on the downstream area are expected due to civil works, Soil erosion from the spoil banks (spoils, fertile soils) during heavy rainfall, Soil erosion from excessive water spraying at the construction

roads and the workshops. Also, it is expected that soil would be degraded (soil contamination and lower rain water permeability) due to drilling mud, oil leakage, heavy equipment, etc.

**4.4.2. Quarry Development:** The followings may occur due to changes in the landscape caused by quarry Development: Adverse impacts on local residents (insect pests) and negligent accidents due to abandoned puddles**,** Loss or deformation of geologically valuable area as well as loss of cultural assesses that may be buried beneath.

**4.4.3. Mitigation Measures:** Curtain grouting and consolidation grouting will be applied in order to mitigate the impacts of the construction (main dam and check dam) on the fault zones. A temporary spoil bank will be installed downstream of the dam in order to pile and utilize spoils produced from excavations. The spoil bank will be provided with a dustproof cover and two settling basins in order to minimize dust scattering and soil erosion. Soil erosion causes increase in turbidity of river water and degradation of soil quality. It can be reduced by the following measures: Execution of civil works during dry seasons if possible**,** Installation of fifteen settling basins in the vicinity of locations where civil works will be executed or turbid water will be produced**;** Installation of waterproof/dustproof cover when piling spoil or fertile soil at the Site; Prevention of soil stamping by minimizing unnecessary damages to the topography and vegetation; Utilization of fertile soil acquired from the site as materials for slope worksn (e.g. spillway) Induction of recruitment of native plants by germination of buried seeds; Complete collection of wastes produced from drilling. Provision of adsorption to prevent oil leakage; Development and restoration measures for material source are as follow: Puddles shall be promptly refilled in order to prevent waterborne diseases and insect vectors; The grounds of material sources outside the submerged area shall be flattened; Native species as well as socially/culturally valuable species shall be planted when establishing a vegetation restoration plan; Priority species: Umuko, Umuvumu, etc.; Academically valuable geologies or cultural assets shall be reported immediately to the relevant authority up on discovery.

**4.4.4. Water Quality:** The construction is likely to cause adverse impacts on the water quality Continuously while it progresses: Impacts on the water quality are expected due to production of turbid water from the following works in case of heavy rainfall: Civil works- Excavation of the dam body, the temporary site, excavated slopes for the construction roads; Changes in the

topography: Development of the material sources, removal of soil cover inside the project area; - Material piling: Piling of rocks, fertile soil, and spoil in the catchment area; Wastewater will be produced from the facilities in the project site and will cause adverse impacts on the water quality when directly released to the river; washing of aggregates; Production of alkali wastewater from cleaning of rock mass during excavation of the dam foundation, boring leakage water, residual water from grouting; Production of sewage water from residing personnel in the project area Occurrence of inconvenient use of water resources (drinking/domestic water) and health issues for the local residents; Adverse impacts in case of oil leakage from equipment, etc; Adverse impacts on underground wells and underground water due to excavation and drilling of the dam body Once the dam is operational, it would have relatively positive impacts on the water supply and the quality of surface water due to increased water body. Also the
Irrigation system would provide better accessibility and utility of the water resources
to the local residents than before operation.
However, the following adverse impacts are also expected due to stagnant water flow, as well as inflow of turbid water, heavy metals and night soil caused by the catchment area characteristics:
Inflow of turbid water, nutrient salts and contaminants during heavy rainfall
; Suspension and deposition of sediment inflow from cultivated lands, bare grounds, roads, grasslands; Possible inflow from exhausted mines, abandoned quarries, etc. in the upstream outside the project area; Inflow of night soil, agricultural chemicals, fertilizer; Oil leakage from oil storage and transports; Reduced water resources for the local resident in the downstream area due to impoundment Expected production of sewage water from management personnel and visitors; Possible algal blooming due to rising of water temperature and stagnant water
flow after excessive eutrophication during the wet season;

**Mitigation Measures:** The following mitigation measures have been established for adverse impacts of the construction on the water quality. Soil erosion mitigation Installation of fifteen settling basins and a diversion conduit at excavated slopes and major civil work locations; Execution of dredging/inspection and installation of safety fence for sediment deposition inside the diversion conduit or the settling basins, River diversion by upstream and downstream cofferdams for the construction of the dam body Installation of a silt protector in the downstream of the dam site (removed in case of heavy rainfall) Installation of silt protectors in the

downstream areas of the main dam and the check dam; Wastewater treatment; Installation of a wastewater facility in the site and recycling of treated water (not released); Installation of a movable wastewater treatment facility when carrying out the works for the dam body; Ultimately released through the temporary settling basin after the water has been treated and checked; Hazardous materials such as acid neutralizing chemical (sulfuric acid, etc.) shall be stored at the designated location by a person in charge (maintaining below pH 8.5, RBS); Sewage water treatment; Installation of three sewage water treatment facilities at the site camps; (owner's camp, contractor's camp, temporary site); (Less than 10mg/L from each of BOD and SS should be released. Releasing
standards to be discussed with REMA and relevant authorities if necessary); Installation of movable type restrooms in the workshops (main dam, check dam, construction facilities); Installation of an oil fence (Bushara Bridge) and provision of absorbent papers (cloths) to prevent oil leakage at the site; Minimization of inconvenient water uses by the local residents
- Provision of the construction water from the underground well to the local residents who are affected by the construction if necessary (detailed location to be discussed in the construction stage); Provision of sufficient flow in the downstream by river diversion; Active establishment of countermeasures in case of abnormality in underground wells by perform investigations prior to construction
During Operation, the water quality needs to be protected by continued management of the Catchment area. Therefore, the following long-term management measures have been established: mitigation measures for inflow of turbid water, nutrient salts, and contaminant, Installation of a check dam upstream of the main dam, and execution of periodical dredging of sediment deposition (once every six months), 50%; Protection of the water quality by releasing environmental flow; Removal of algal blooms with scoop nets, etc.

4.4.5. **Air pollution** :Impacts of the construction on air quality are expected as follow: Adverse impacts on air quality due to dust scattering Air contaminants (fine dusts, NOx) from site preparation, foundation excavation, civil works, equipment operation; Dust scattering by traveling of construction vehicles and long-term piling of soils; Dust scattering (stone dusts) ; Occurrences of bare grounds due to material source development; Impacts of dust scattering on

human bodies and crops; Adverse impacts on the local residents' and the workers' respiratory organs; Adverse impacts on the crops and the vegetations in the vicinity of the
project area.

**Mitigation Measures:** During Construction the following mitigation measures have been established for air pollution during construction: Water sprinkler or spraying during the works (rock blasting) where an excessive dust scattering occurs**;** Installation water storage type wheel washing facilities with high-pressure water spraying equipment at four locations**;** Considering that the roads in the project area and its vicinity are unpaved, an automatic wheel washing facility is unlikely to effective. A water storage type wheel washing facility with a high-pressure water spraying equipment would be more effective; - Periodical removal of soils and replacement of wheel washing water Determination of effective locations of the wheel washing facilities by the contractor in conjunction with the settling basins prior to construction;

hydropower plant.

**4.4.6. Waste Management:** During construction, it is expected that the construction would cause the following impacts on waste production, its storage and management**:** Production and storage of waste oil and hazardous waste**;** Inevitable storage of waste lubricant oil and wasted oil. Possible soil contamination by negligent storage or transport**;** Possible fire outbreak during storage of oil or inflammable materials at the site**;** Occurrence of medical wastes due to injuries or diseases of the workers**;** Production of construction waste from the works**;** Waste wood materials and cement sacks**;** Broken stones from processed rock materials, and sludges from the wheel washing facilities and the settling basins**;** Production of daily wastes and night soil from the workers**;** Daily wastes from meals and snacks for the workers**;** Night soil from the workers**;** Waste trees from tree removals within the main dam and submerged area. During Operation
It is expected that residential wastes would be mainly produced from resident management personnel and visitors. Inflows of dead plants and domestic wastes from the upstream aquatic ecosystem are also expected. Oil contamination may occur in case of an oil-related storing/selling/transport facility installed in the vicinity of the project area.

**Mitigation Measures:** waste management measures during the construction have been established as follow: Management of hazardous wastes (waste oil, etc.)**;** Prohibition of

treatment inside the project area. To be stored legally until periodically collected by a professional waste management company**;** Installation of an oil/waste oil storage facility**;** With concrete floor and waterproof wall**;** Stored only up to 2/3 of the capacity. To be collected by the waste management company once the limit is reached**;** Contaminated soil should be treated with absorbent papers and/or cloths, stored separately until collected by the waste management company**;** Provision of fire extinguishers (water bucket, sands) in the vicinity**;** Compliance with Rwanda's regulations on hazardous waste management**;** Gloves, cloths, etc. contaminated by oil should be separately stored from conventional wastes until collected by the waste management company**;** Allowance of oil replacement and vehicle maintenance only in the designated Area; Prohibition of waste oil container, oil container, vehicle parts stored inside the project area; Medical wastes to be handled in compliance with REMA's regulations on

hazardous waste management; Construction wastes from the sites should be treated legally according to the following procedure: Installation of skips; Collected by a permitted solid waste management company Ultimately treated at a landfill in compliance with REMA and RURA's wastemanagement regulations; Active recycling of the construction wastes from the sites (Scrap timbers,cement sacks, etc.)

-

During Operation, waste management measures during the operation have been established as follow: Installation of waste bins with lids at frequently visited areas; Indoor storage of daily wastes. Operation of skips with lids in order to prevent the contained wastes from blown by win; Installation of recycling bins and collection by a professional recycling company (papers, cardboards, plastics); Wastes that cannot be recycled should be collected by a permitted solid waste management company and then ultimately treated at a landfill in compliance with REMA and RURA's waste management regulations

## 5. SUMMARY OF PUBLIC AND STAKEHOLDER CONSULTATIONS

Muvumba dam is a multipurpose project that will call upon different institutions to work together. MINAGRI will be working on Irrigation, WASAC on water supply, REG on power generation and MoE /RWFA will be working on overall water management and flood control. All concerned institutions have been consulted during feasibility and detailed design.

For implementing RAP and ESIA, local government will be involved and will be leading all mobilization and sensitization activities.

The public consultation on behalf of the Environmental Impact assessment of this project was conducted and involved key stakeholders that represented among other MINAGRI, MoE, RWFA, REMA, RDB, Eastern Provive, Nyagatare District and Officers working at Sector and cell levels.

## 6. **POTENTIAL ENVIRONMENT AND SOCIAL IMPACTS AND MITIGATION MEASURES**

| Location | Activity | Adverse impacts | Mitigation measures | Implementation time frame | Responsibility | Frequency |
|---|---|---|---|---|---|---|
| Submerged area of the main dam & check dam | Civil works | · Increased turbidity in the downstream | · Installation of adequately sized settling basins / Dredging of sediment deposition / Maintenance works / Safety measures (drowning prevention) | Before/during const | Contractor | Cont |
| | | · Spreading of exotic plants due to soil transport and changed topography | · Management/removal of harmful exotic organisms / Eichornia Crassipes: Puddle refilling Lantana camara(poisonous): Weeding (w/o use of chemicals) | Civil works | Owner, contractor | Once each season |
| | Blasting, equipment operation | · Habitats of endangered species | · Confirmation of crey crowned crane in the project area / Abort blasting / Minimal equipment noises Report to RDB / Establishment of countermeasures after monitored by a professional / Injured species: Report to RDB or the rehabilitation project team at Akagera National Park<br>· Establishment of countermeasures when other endangered species are discovered in the project area | During const | Owner, contractor | Cont |
| | | · Tranquility facilities in the vicinity | · Establishment of installation plan for temporary dustproof meshes and temp soundproof panel / Execution of test blasting | During const | Owner, contractor | When required |
| | Equipment operation, manpower | · Surface/underground water | - Legal management and treatment of waste/lubricating oil / Stored and treated in compliance with REMA/RURA's regulations | During const | Contractor | When required |
| | | | - Establishment of management and treatment measures for construction/domestic wastes / Provision of waste skips and recycling bin at the workshops and site camps / Collected by a professional company approved by REMA/RURA. Finally treated/recycled at the designated landfill | During const | Contractor | Every week |
| | Excavation, workshop operation | · Inconvenient use of water resource for the local residents | - Installation of water tank on the left & right abutments of the dam body | During const | Contractor | Cont |
| | | | · Periodic confirmation/management/countermeasures for the water level/quantity of the existing underground well | Before const | Owner, contractor | Cont |

| Location | Activity | Adverse impacts | Mitigation measures | Implementation time frame | Responsibility | Frequency |
|---|---|---|---|---|---|---|
| Temp facilities | Facilities operation | - Contamination of surface water due to wastewater | · Installation of wastewater facilities and measurement of wastewater quality (treated water not to be released)<br>· Rock mass excavation of the dam body: Installation of movable wastewater treatment facilities and pH measurement of the released water<br>· Periodic maintenance and safety management of the facilities | During const | Contractor | Cont |
| Site camp | Residing personnel | - Contamination of surface water due to sewage water | · Installation/operation of sewage water treatment facilities in the site camps<br>· Quality measurement of released water from the sewage water treatment facilities (pH, BOD, SS)<br>· Periodic maintenance and management of the facilities | During const | Contractor | ·Cont<br>·Once a month<br>·Cont |
| Material source (quarry) | Excavation, civil works | · Change in topography / Safety of residents | · Acquisition of permit from and submission of restoration plan to the relevant authorities before development of a material source, and execution of IEE if required | Before const | Owner, contractor | - |

Note) The owner and the contractor shall comply with the environmental management & monitoring measures specified in the above and the EIA Report.

| Location | Activity | Adverse impacts | Mitigation measures | Implementation time frame | Responsibility | Frequency |
|---|---|---|---|---|---|---|
| Main dam & artificial lake | Impoundment of the artificial lake | • Eutrophication & stagnat water flow after wetland construction | · Management and removal of harmful exotic organisms / Prompt removal of Eichornia crassipes in wetlands, puddles, etc. | During operation | Owner, | When required |
| | | • Inflow of contaminants during heavy rainfall | · Provision of a silt trap zone to mitigate soil erosion / Inducement and management of ecological succession of native plants, shrubs, chaplain, exotic plants, etc. / Transplantation if required / Minimization of cultivating within the vegetation belt with cooperation from the local government and residents<br>· Long-term basin management with neighboring countries in order to mitigate water turbidity | During operation | Owner, Nyagatare City, Eastern Province | Cont |
| | | | · Investigation of distributed pollution sources in the upstream basin (abandoned mines/quarries, etc.)<br>· Execution of monitoring works afterward (water quality, residents' health, etc.) | During operation | Owner, | Once a year |
| Check dam | Operation | • Sediment deposition | • Periodic dredging / Utilization of the dredged soils as soil addition materials by supplying to farms | During operation | Owner, | Once every six month |
| Management building | Visitors, residing manager | • Sewage water | • Retention of the sewage treatment facilities at the owner's camp | During operation | Owner, | Cont |

Note) The owner and the contractor shall comply with the environmental management & monitoring measures specified in the above and the EIA Report

## 6.1. **Summary of impacts**

| Category | Conditions |
|---|---|
| Physical environmental impact management | • The road network in the vicinity of the project area shall not be either interfered or closed<br>• Excavated wastes shall be treated within the jurisdiction<br>• Land compaction in the project area shall be minimized |
| Solid wastes & wastewater management | • Management measures for sludges, solid wastes, and all forms of wastes produced from the dam construction and its relevant facilities shall be established/implemented by RNRA with consultants<br>• The following management measures shall be established/implemented before commencing the project:<br>- Design & installation of wastewater treatment facilities<br>- Wastes shall be distinguished/separated at point and non-point sources<br>- Establishment of sludge minimization measures and waste monitoring plan for construction and operation<br>- Minimization of wastes from site preparation or construction |
| Public health & safety | • Protective gears shall be provided to all workers during construction<br>• Systematic investigation on wastewater quality to prevent bad odor<br>• Periodic sensitization of the local residents and the workers<br>• Establishment/implementation of disaster mitigation measures |
| Monitoring & evaluation | • Continued periodic inspection of the pipes and water quality considering lifespan of the wastewater treatment facilities and water tanks |
| Wastewater & rainwater management | • Wastewater and rainwater produced from the facilities shall be effectively treated in order to prevent impacts on the ecosystem and the surround land |

# 7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This Section addresses mitigation measures, monitoring and institutional arrangements for the environmental and social management of Muvumba multipurpose dam

## 7.1.Proposed Environmental and Social Management Plan (ESMP)

The Environmental & Social Management Plan (ESMP) aims to make the implementation of Muvumba dam project in conformity with the applicable Rwanda environmental legal requirements and also to help stakeholders in the project find their role and responsibility in the environmental preservation. The Environmental & Social Management Plan (ESMP) described in Table 6 provides a way forward for implementation of the identified mitigation measures. The project developer shall be responsible for overall implementation of the ESMP. The project Environmental and social safeguards officer shall be designated to make day-to-day follow -up (e.g. supervision and liaising with stakeholders). The estimated costs for implementation of the mitigation measures are just indicative.

Table: **Environnemental Management Plan (EMP)**

| Environmental impacts | Mitigation measures | Location | Budget ('000RWF ) | Responsible | Monitoring |
|---|---|---|---|---|---|
| **Land acquisition** | Inform in time the affected persons and give them required time to harvest their crops. This will require radio and other costs of mobilization even if there is no compensation. The system could also be identified to assist and link affected individuals' access support to enable them start afresh.<br>• Give priority to the affected persons during the recruitment of workers | Project site (Zone) | 3 600 000 | Developer and/or construction company | Nyagatre District |
| **Noise pollution** | • Planning activities in consultation with local communities so that activities with the greatest potential to generate noise are planned during periods of the day that will result in least disturbance<br>Using noise control devices, such as temporary noise<br>• Avoiding or minimizing project transportation through community areas | Project zone | Included in the project cost | Developer and/or construction company | -Local authorities,<br>-REMA |
| **Risks of sexually-transmitted diseases (STDs)** | • Providing surveillance and active screening and treatment of workers,<br>• Preventing illness among workers in local communities by:<br>• Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use. This can include provision of condoms / condom vendors, to be accessed by both community members and workers.<br>• Training health workers in disease treatment and dissemination of awareness in the process treating clients, as well as conducting outreaches to the communities, even | Project zone | 5,000 | Developer and/or construction company<br>-Local authorities | MINISANTE, Nyagatare district |

| | | | | | |
|---|---|---|---|---|---|
| | before the project starts,<br>Conducting immunization programs for workers and community members in local communities to improve health and guard against infection.<br>• Providing health services,<br>• Providing treatment through standard case management in on-site or community health care facilities.<br>• Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers<br>• Promoting collaboration with local authorities to enhance access of workers' families and the community to public health services and promote immunization | | | | |
| **Construction accident/ injuries** | • Providing all workers with appropriate personnel protecting equipment (PPE) e.g. dust masks, gumboots, gloves, safety glasses and helmets.<br>• Training the workers and make sure they always use the PPE<br>• A functional first aid box should be kept on site with someone available to dispense support and a standby ambulance in place to rush any injured to the nearby health units. Community volunteers should be trained in first aid to support response to emergencies and make the project zone less hazardous | Project site | Included in the project budget (additional costs 500) | Developer and/or construction company | -MIFOTRA,<br>-REMA,<br>-Nyagatare District |
| **Solid wastes management** | ***Waste Prevention***<br>• Substituting raw materials or inputs with less hazardous or toxic materials<br>• Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials<br>• Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the commingling of | Project zone | 1,500 | Developer and/or construction company | MoE<br>-REMA,<br>- RWFA<br>-Nyagatare District |

| | | | | | |
|---|---|---|---|---|---|
| | non-hazardous and hazardous waste to be managed<br><br>***Recycling and Reuse***<br>• Implementation of recycling plans. All the solid waste should be collected; the biodegradable organic material composted properly on site for manure production and the non-biodegradable disposed of in a public landfill. | | | | |
| **Soil erosion and sediment loads** | • Excavated earth should be held on locations of the site not susceptible to storm water runoff. The earth removed for external disposal should be deposited carefully on selected sites without the risk of being washed away during heavy rains and where such deposits will not compromise other land use activities in the areas affected; and<br>• Re-vegetation of exposed areas around the site should be carried out rapidly, involving community members, through sensitization and actual participation in order to mitigate erosion of soil through surface water runoff and wind erosion<br>• Construction of silt trap structures like terraces and check dams upstream should be undertaken, again with the involvement of communities, so as to support sustainability and maintenance of these activities. | Project zone | 2,500,000 | Developer and/or construction company | MoE -REMA, - RWFA -Nyagatare District |
| **Air quality management** | • Minimizing dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content,<br>• Personal protective equipment (PPE) such as dust masks must be worn in the immediate vicinity of the operations during quarrying and handling of cement. Additional protective masks should be worn at the vicinity of drill sites;<br>• The stockpiles of earth generated during construction works should be suppressed by spraying water or water based mixtures. Spraying should also be carried out on unpaved road accesses regularly and at handling sites for cement; | Project zone | 1,000 | Developer and/or construction | MoE -REMA, - RWFA |

| | | | | | |
|---|---|---|---|---|---|
| | • Controlling the suspension of dust drilling and blasting by sequential blasting, covering shielding or enclosing the area;<br>• Working order to ensure minimum emissions including carbon monoxide, oxides of Nitrogen and Sulphur, as well as suspended particulate matter;<br>• Drivers of construction vehicles and delivery trucks should be cautioned to drive slowly near the site to avoid creating dusty conditions;<br>• Construction trucks removing soils from the site, delivering sand and cement to the site should be covered to minimize dust blowing into the surrounding neighborhood;<br>• No burning of any materials whatsoever should be permitted at the site; and<br>• • Drivers of construction vehicles and delivery trucks must be supervised so that they do not leave vehicles idling and limit their speeds so that dust levels are lowered. | | | | |
| **Water Quality management** | • Avoid construction materials, which are not in accordance with requirements, codes of practice or with current accepted building practice at the time of specification or construction.<br>• The prevention of downstream contamination from pollutants resulting from construction and operation and maintenance activities can be achieved by proper storage and ensuring all storage containers are well closed to prevent accidental leaks and spills; and<br>• Proper management of oil spill and diligence on the part of the contractor during construction, refurbishment, fixing, installation and drilling shall reduce the risk of water contamination. | Project zone | 1,500 | Developer and/or construction company | MoE<br>-REMA,<br>- RWFA<br>-Nyagatare District<br>-Sector authorities |

## 8. Conclusion and recommendations

### 8.1.Conclusion

The project of construction of Muvumba multipurpose dam has many environmental and socio-economic benefits. The social and environmental impact assessment process carried out has indicated the existence of a number of negative social and environmental impacts that may arise from implementation of this project. These have guided the formulation of the proposed management plan as reported above.

The mitigation measures for different negative impacts have been proposed and an environmental and social management plan has been established. Therefore, implementation of this project will be a success if the environmental and social management plan proposed is followed by all stakeholders directly or indirectly involved.

The project is viable and no fatal flaws were identified. The identified impacts can be mitigated through the implementation of the proposed Environmental and Social Management Plan.

### 8.2. Recommendations

Based on the nature of the project activities, biophysical conditions of the project area and the potential negative impacts, it is imperative that the following be given serious consideration and attention in order to preserve the environment:

- Environmental monitoring programs for this project should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during construction and operation phases. Speedy and appropriate actions must be taken on any issues arising through the monitoring results.
- Occupational health and safety performance should be evaluated against national /or international standards.
- Policies on and mechanisms to detect and address SGBV should be set in place at the onset of the project and all parties inducted in their role and use as well as linkages to relevant policies, legal sanctions and penalties.
- Organizational policies in labour laws should reflect the national policies on child protection and set in place and indicate the sanctions that will be applied in case of the breach of law labour prohibitions.
- The developer should try to reduce the number of accidents among project workers (whether directly employed or subcontracted) to a rate of zero, especially accidents that could result in lost work time, different levels of disability, or even fatalities.
- The working environment should be monitored for occupational hazards relevant to this project.
- The developer of this project is recommended to implement the environmental and social management plan proposed in this report, that will ensure environmental compliance of the operations and also to maintain high quality standards.