ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
COMPREHENSIVE PROJECT REPORT

PROPOSED KABKARA MEDIUM EARTH DAM IRRIGATION PROJECT IN LWANDANYI WARD, BUNGOMA COUNTY, KENYA

G.P.S Coordinates of the Dam: Latitude: 0.722714, Longitude: 34.412371

Proponent
Kabkara Irrigation Water User Association
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February, 2026

PROJECT SUMMARY SHEET

PROJECT INFORMATION SHEET		
Project Title	Proposal for development of Kabkara irrigation project in Lwandanyi Ward, Bungoma County	
Project Duration	2 years	
Main Objective	To develop Kabkara irrigation project for food security and improved livelihood	
Funding Agencies	World Bank, Government of Kenya & County Government of Bungoma	
Implementing Agency	NAVCDP (NPCU), NAVCDP (Bungoma CPCU), KALRO	
Proposing organization	Kabkara Irrigation Water Users Association	
Total land area to be irrigated	46 ha	
Target number of parcels/ beneficiaries	155 parcels each required to irrigate 0.4 ha	
Contact Persons	Chairman Kabkara IWUA	Maurice Onyara Phone no. +254725367442 Email. mauriceaonyara@gmail.com
Key Financier	World Bank, National Government, County Government, Community	
Project Cost (KSHS)	**55,897,548**	

CERTIFICATION

This Environmental Social Impact Assessment (ESIA) report was prepared in compliance with the Environmental Management and Coordination Act (EMCA) 1999 (Revised 2015) and the legal notice 31&32 of (2019).

I, the undersigned, therefore certify that the information contained in this report accurately reflects the ESIA procedure for the proposed small scale irrigation project in Lwandanyi ward.

LEAD ESIA/ EA EXPERT

SILAS O. RAKAMA
NEMA REG. NO. 9976

Sign:  Date: 6th May, 2025

PROPONENT

Chairman Kabkara Irrigation Water User Association (IWUA)
Maurice Asuru Onyara

Signature……  ……

Date ……6th May, 2025……

DETAILED SUMMARY OF THE PROPONENT (KABKARA IRRIGATION WATER USERS' ASSOCIATION (IWUA)

The Kabkara IWUA was established and registered in late 2024 to oversee the management and sustainability of the Kabkara irrigation project. Although the formal registration certificate is still pending issuance, the association is recognized and operational. The IWUA will be strengthened through capacity-building initiatives to enable it to effectively undertake key responsibilities including the day-to-day operation and maintenance of the irrigation system, routine repairs, and the collection and safeguarding of project funds.

In addition to technical and financial management, the IWUA will play a central role in community engagement. This includes organizing regular community meetings, leading monitoring and evaluation activities, promoting information sharing and awareness, and addressing grievances in a timely and transparent manner. The composition of the IWUA include:

a) **Irrigators:** These are all farmers within a given area who are registered members of the IWUA and are served by the same irrigation or drainage facility and are bound together for a common purpose.

b) **Block Leaders:** These are farmers that represent the various blocks of the scheme e.g. farmers served by a sub- main or lateral. The number of group/ block committees will depend on the size of scheme and number of farmers.

c) **Special-tasks Committees:** These are leaders that are elected and assigned specific IWUA tasks for the purpose of distributing responsibilities and to facilitate participation of more members of IWUAs. Each IWUA shall form a Dispute Resolution Committee and other special task sub-committees. These may include O&M, Training, Audit, Safety, Health & Environmental committees etc. The number of special task committees will depend on the size and complexity of the scheme. Source: Kenya Gazette Supplement No. 136 (Acts No.14) (Special edition).

d) **Committee Members:** These are elected leaders, usually representing the interests of the sub-groups and/or special- task committees in the main scheme committee.

e) **Executive committee:** These are the elected officials of the IWUA who are responsible for the overall leadership of the IWUA, that is, they are vested with the overall decision/policy making responsibilities.

f) **General Assembly:** This constitutes the general membership convening for a purpose and is the scheme authority for major/critical decisions on matters affecting the general membership.

The operation of the IWUA is guided by its by-laws. This is a set of rules and regulations that are formulated and mutually agreed by all members to guide, regulate and govern the members in their activities and relationships to ensure smooth operations of the IWUA and to facilitate attainment of their objectives. To be effective by-laws must be well accepted by the IWUA members.

EXPERTS FACT SHEET

The Environmental and Social Impact Assessment of the proposed Kabkara irrigation project was collaborated work done by a multidisciplinary team of experts drawn from the Environment, Social Sciences, Agriculture, Engineering, Water Resources, and Surveying sectors, ensuring a comprehensive and integrated evaluation of the project's potential environmental and social impacts (Table Below presents list of experts who took part in the assessment).

Name	Designation/Title	Qualifications	Role in the Study	Experience/Remarks
Silas Rakama	Lead Expert / NEMA Registered Expert (Reg. No. 9976)	BSc., MSc. in Sustainability Studies	Lead ESIA Expert	Over 12 years of experience in conducting ESIAs across multiple sectors.
Caroline Mwongeli	Social Scientist	BSc. in Sociology	Lead Social Expert	Led the social baseline assessment, community engagement, and social impact analysis.
Elijah Obadha	Environmental Safeguard Compliance Officer, Bungoma County NAVCDP	Environmental Management	Environmental Safeguard Support	Ensured compliance with environmental safeguards in accordance with NAVCDP protocols.
Lenis Marani	Social Safeguard and Gender Mainstreaming Officer, Bungoma County NAVCDP	Social Development, Gender Mainstreaming	Gender and Social Inclusion Support	Provided oversight on gender integration and social inclusion.
Irene Wafula	Water and Fisheries Officer	Water Resource Management, Fisheries	Technical Expert – Aquatic and Water Systems	Contributed technical input on aquatic ecosystems and water use impacts.
Reuben Buchacha	Agricultural and Extension Services Specialist	Agriculture, Extension Services	Agricultural and Land Use Expert	Provided insights into local agricultural practices and land use patterns.
Miss Diana Nambuchi	Social Scientist	Social Sciences	Social Assessment Support	Assisted in social data collection and stakeholder consultations.
Naomi Komol	Environmentalist	Environmental Science	Environmental Assessment Support	Participated in environmental baseline data collection and impact identification.

TABLE OF GENERAL INFORMATION

Project	Proposed medium scale irrigation sub-project
Location	Lwandanyi Ward, Sirisia Sub-county
County	Bungoma
Project objective	To supply water for irrigation to individual farmers to enable them grow high-value crops and multiple harvests annually, leading to improved household income and livelihoods.
Project description	The proposed irrigation sub-project involves the development of infrastructure to support sustainable agricultural production in the Kabkara area. The project entails the abstraction of water from the Kabkara dam, which will be pumped using solar-powered pumping systems. Key components of the infrastructure include the installation of solar kits, a pipeline distribution network, hydrants, and an elevated water storage tank. The elevated tank will enable gravity-fed water delivery to farms, enhancing efficiency and reducing reliance on non-renewable energy sources. This initiative aims to improve water access for irrigation, increase agricultural productivity, and support the livelihoods of local farming communities.
Project classification	medium-risk project
Public participation meeting date	28th – 30th January, 2025

DISCLAIMER

This Environmental and Social Impact Assessment (ESIA) Report for the proposed Kabkara irrigation sub-project has been prepared in accordance with the Environmental Management and Coordination Act (EMCA), Cap 387, and its associated regulations. The findings, assessments, recommendations, and conclusions presented herein are based on information available at the time of the study, including field assessments, stakeholder consultations, expert inputs, and relevant secondary data including project feasibility study report, maps of the irrigation command area, designs and B.O.Q of the proposed sub-project. While all reasonable efforts have been made to ensure the accuracy and reliability of the information provided, the authors accept no responsibility for any errors, omissions, or outcomes resulting from the use of this report for purposes other than its intended regulatory and decision-making function. The report is intended solely for use by the project proponent, relevant authorities, and stakeholders for decision-making and regulatory purposes. Unauthorized reproduction or use of this report without written consent from the authors or the proponent is prohibited.

EXECUTIVE SUMMARY

Project Background

Bungoma County is among 34 counties benefiting from the National Agricultural Value Chain Development Project (NAVCDP), aimed at increasing market participation and value addition for farmers in selected value chains. The project is supported by the Kenyan government, the World Bank, county governments, Kenya Agricultural and Livestock Research Organization, and Savings and Credit Cooperative Organizations. It is structured into components, with Component 2 focusing on Climate-Smart Value Chain Ecosystem Investments. Sub-Component 2.1 focuses on Farmer-Led Irrigation Development (FLID) with key themes such as motivating farmers to access irrigation, developing irrigation-centered FLID forums linking farmers with suppliers and financial institutions, and deploying technical resource persons to coordinate with County. The proposed Kabkara irrigation project is a FLID identified by the community after the rehabilitation of Kabkara dam in order to utilize the water in the dam to grow high value crops. The main economic activity in the project area (Lwandanyi ward) is rain-fed agriculture which is unreliable during dry seasons. The project will address food insecurity in the area by providing water to households around the Kabkara dam catchment in order to grow high value crops for consumption and marketing by irrigating 46ha of land.

Project Scope

The proposed irrigation project aims to enhance agricultural productivity by providing a reliable and sustainable water supply to farmers within the project area. Water will be sourced from the existing Kabkara Earth Dam with a crest of 5m and capacity of 133,480m^3 and pumped using a solar-powered system to an elevated storage tank. From the tank, water will be distributed by gravity through a network of pipes to beneficiary farms, ensuring efficient and cost-effective irrigation. The irrigation sub-project targets 115 beneficiaries and up to 46 ha of land to be irrigated. The project will involve significant construction activities, including excavation works for laying the piping system, installation of the solar pumping unit, and setting up distribution infrastructure to support water delivery. The irrigation system will be designed to optimize water use, minimize wastage, and promote sustainable agricultural practices. Management and oversight of the scheme will be carried out by the Kabkara Irrigation Water Users Association (IWUA), ensuring community participation, proper operation, and long-term sustainability.

Objectives and Justification of the Proposed Project

The Kabkara irrigation project aims to improve farmers' income and livelihoods by enabling them to grow high-value crops and harvest multiple times annually. The Kabkara area, in Sirisia sub-county, experiences unpredictable rainfall patterns and dry seasons. The dam, constructed in 1952, experienced siltation until fully rehabilitated in 2021 by the National Agricultural and Rural Inclusive Growth Project (NARIGP) for the Kabkara Irrigation Water Users Association. The project will ensure continuous farming, regardless of seasonal variations, and provide ample and sustainable water supply, making irrigation feasible and cost-effective. Construction of the scheme will result in farmers being supplied with reliable, stable and adequate water supply for their agricultural production leading to improved productivity and eventual commercialization of their production increasing market participation. Most farming technologies are expensive and therefore unaffordable to most farmers. Low levels of modern technology application and innovation contribute to low productivity.

Justification for ESIA CPR and the Study Methodology

The proposed project, classified as "water supply and distribution infrastructure as well as medium scale irrigation projects," was screened according to Kenyan Legal Notice No. 31 of 2019 and the Second Schedule of EMCA 1999 (Amended 2015). It was recommended to undergo an ESIA comprehensive project report. The project was also screened based on the World Bank Environment and Social Framework (ESF) (ESS. 1) on Environmental Assessment.

The Environmental Impact Assessment (ESIA) study aims to identify significant environmental and social impacts associated with a proposed project's design, construction, operation, and decommissioning. It considers factors such as physical location, sensitive issues, and anticipated impacts. The ESIA study aims to recommend enhancement and mitigation measures for both positive and negative impacts. An Environmental and Social Management and Monitoring Plan was developed, detailing mitigation measures, costing, scheduling, and responsibility. The ESIA's objectives include collecting baseline information on bio-physical, ecological, and socio-economic characteristics, establishing key areas of environmental, health, and safety concern, analyzing impacts, designing an Environmental Management Plan, and developing a comprehensive ESIA report.

The Environmental Impact Assessment (ESIA) process was conducted between January 27th and 31st, 2025, following the Environmental (Impact Assessment and Audit) Regulations, 2003 (Revised 2019). The assessment involved site visits to assess the socio-economic and physical characteristics of the area around the Kabkara dam catchment. The ESIA team reviewed documents related to the project, including hydrological survey reports, Environmental and Social Impact Assessment Report for the Kabkara earth dam, Bungoma County integrated development plan 2023-2027 (CIDP), proposed project feasibility study reports, and case studies of similar projects. Public participation was also conducted through questionnaires, public meetings, and key informant interviews with opinion leaders and relevant lead agencies. The ESIA report was compiled using NEMA guidelines and the NVCDP Environment and Social Management Framework (ESMF, 2023). The consultant ensured constant briefing of the client during the exercise, and description plans and sketches showing various activities are included in the Appendices of the report.

Baseline of the Project Area

Baseline environmental and social information serves as a reference point for predicting potential impacts and monitoring changes during and after project implementation. Key baseline covered in the report include: climate, topography, geology and soil, hydrology and water resources, solar irradiance, biological environment and socioeconomic profile of the project area. Based on the baseline data, most of the agricultural activities in Kabkara are rain-fed, meaning that farmers only plant during the rainy seasons. Dependency on rain-fed agriculture exposes families to instances of food insecurity because of unpredictable weather patterns. The agro-economy of the study area involves crop production and livestock rearing; with maize as the major crop grown. Other important crops are beans, groundnuts, hot pepper and tomatoes.

Policy and Legal Framework

The 2010 Kenyan Constitution serves as the country's supreme law. It guarantees the right to a clean and healthy environment and enshrines environmental preservation in the Bill of Rights. The National Environment Policy (NEP) promotes sustainable development, or balanced growth while preserving the environment. The 2017 National Irrigation Policy focuses on improving agricultural productivity. The Environmental Management and Coordination Act mandates Environmental Impact Assessment and Audit for projects. Section 7 of the HIV and AIDS Prevention and Control Act mandates HIV prevention information for employees. The Sexual Offences Act of 2006 aims to prevent and punish sexual offenses, with penalties like life imprisonment. The Way Leave Act regulates land acquisition and use for infrastructure projects. Relevant World Bank ESF have been reviewed.

Public Participation

To gather the views of potential interested and affected parties, various engagement methods were employed, including public meetings, individual questionnaires, and key informant interviews. Public participation meetings were held on January 28th and 30th, 2025, at a parcel near the Kabkara Dam, bringing together key stakeholders such as the IWUA committee members, local administration, and the Bungoma County Government, particularly agricultural officers from the NAVCDP Project. The meeting was on 28th January 2025 was attended by 60 participants, comprising 40 men and 20 women. The January 30, 2025 meeting saw 64 attendees, including 46 men and 18 women.

Youth and Vulnerable and Marginalized Groups (VMGs) were also well represented. The baraza was organized by the NAVCDP Bungoma County team, in collaboration with village and ward administration offices. Attendance lists, meeting minutes, and filled-in questionnaires are annexed to this report. Major issues raised during the consultation and public participation are presented in Table 1 below.

Table 1: Key issues raised during the public participation

S/No	KEY ISSUES/OPINIONS RAISED	RESPONSES/OPINIONS
1.	The Kabkara IWUA sought clarification on how family members of mapped farms will benefit from the irrigation project, particularly if their own farms were not included.	The farm owner will share water with the other family members through resource-sharing, based on a census for fair distribution. This will ensure efficient water use and support sustainable farming for both parties.
2.	Will all the people living in the marked parcels of land even if they are buyers not the original owners of the land benefit from the proposed project?	Yes, they will benefit from the proposed project
3.	How will the community address conflict on water use?	Conflicts will be managed by the IWUA sub-committee of grievance management, which will create by laws to control disputes. A water metering system will be implemented, with penalty fees for exceeding usage limits, promoting accountability and responsible consumption.
4.	How will the community control pollution which may result from excess use of farm chemicals during operationalization of the project	Through capacity building of the community to use the regulated pesticides. Promoting organic farming and eco-friendly alternatives will further reduce chemical reliance.
5.	What are some of the factors that can cause the closure of the irrigation project?	If the dam's water levels drop and the Kabkara stream's supply is insufficient, along with complete silting. The community should focus on regular dam maintenance and explore alternative livelihoods. This will help reduce reliance on a single water source and ensure long-term economic resilience.

6.	Can the NAVCDP project support those excluded from the irrigation project by establishing fishponds?	The community should join SACCOs to save money and access loans, which will enable them to finance fish pond projects independently. By pooling resources, they can build a sustainable financial base and empower themselves to implement these projects without relying on grants.
7.	How will the payment to the locals be carried out during excavation to lay the water pipes, before work or after a week?	A mutual agreement will be established between the workers and the contractor, with the IWUA committee ensuring that the workers receive payment from the contractor
8.	How will SEAH issues be handled during the construction phase of the project?	The contractor must comply with SEAH conditions outlined in the contract, ensure the use of a dedicated hotline for reporting issues, and cooperate with authorities, including the police gender desk, to address incidents promptly and effectively.
9.	During the operational phase of the project, how will overproduction of farm produce be controlled?	overproduction will be managed through training farmers in value addition, diversifying markets to new towns, and forming cooperatives for collective marketing and bargaining power
10.	Clarity is needed on how a 100ft land needed to build the collection tank will acquire the title deed	The project increased the size of the plot to construct the water tank for collection to ¼ an acre to accommodate the water tank, IWUA office and a SACCO
11.	Give guidance on whether consent letter can replace title deeds in plots that have no title deeds for the construction of the collection tank	Using a consent letter instead of a title deed is not feasible for World Bank-funded projects, as only a title deed or official minutes from the land control board are accepted for compliance
12.	Will the NAVCDP assist the IWUA in purchasing the required plot of land for building the water tank?	It will be discussed by the county project coordinating unit and the IWUA committee once a willing seller among the three marked farms comes forward and agreement is reached
13.	If the collection tank ends up being built at Katomei primary school, will a title deed be required for the plot allocated for the water tank or the IWUA will use the school title deed?	There will be no need to get a title deed for the plot which the collection tank will be constructed however the school can give consent letter and attach it with its title deed or parcel land number since many schools don't have title deeds. However, construction of the collection tank in the school is highly discouraged to avoid conflicts
14.	Why was the number of beneficiaries for the proposed irrigation project reduced from 116 to 42?	The number of beneficiaries remains at 116. However, it is the area of land that will be served by the proposed project that increased to 42 hectares.
15.	Why is the proposed irrigation project excluding farms near the Bungoma-Busia border, claiming they are in Busia County? Is the project being politicized?	On the issues of irrigation project extending to Busia County will not be possible because the proposed irrigation project is for Bungoma county but Busia County can benefit buy watering their livestock
16.	Are there any conflicts between the wards benefiting from Kabkara dam?	There is no conflict between Lwandanyi and East Angurai wards over the proposed irrigation project. The Irrigation Water Users Association (IWUA) supports the decision to focus the project in Bungoma County, acknowledging its benefits will also positively affect neighboring areas.
17.	Can any land issues affect the production of crops under the proposed irrigation project	No, the community is supporting the project
18.	How will the IWUA committee benefit from the fish which is stocked in Kabkara dam?	The IWUA committee struggles with benefiting from the dam's fish due to non-compliance with fish rearing and harvesting protocols. A possible solution is by partnering with the Fisheries Department to ensure proper adherence to responsible fish management practices.
19.	How will conflicts resulting from water shortage be addressed by the IWUA?	communities will be sensitized on water rationing to ensure equitable distribution of resources

Environmental and Social Impacts and Mitigation Measures

The project aims to create short-term employment opportunities for casual workers and semi-skilled labourers in the construction phase of irrigation infrastructure. Enhancement measures include sourcing unskilled or semi-skilled labour from the project area and prioritizing local youths and women. The majority of construction materials will be obtained locally, and local procurement of materials will be encouraged to stimulate the regional economy.

During the operation phase, the proposed irrigation project aims to increase agricultural productivity, economic growth, and improve livelihoods. It will provide reliable water supply, enabling year-round farming and increased crop yields. The project will also boost household incomes and reduce poverty. The project will also provide a buffer against droughts and erratic rainfall, it will strengthen community cooperation among the irrigation water users.

The adverse environmental and social impacts anticipated from the proposed project is presented in Table 2.

Table 2: Environmental and social impacts and the proposed mitigation measures

Environmental and social impact	Mitigation measures
CONSTRUCTION PHASE	
Removal of vegetation	a) Properly demarcate the project area to be affected by the construction activities to avoid spill over effects to neighbouring areas. b) During the mapping exercise for the proposed project, the piping lines were designed to avoid sensitive biodiversity habitats. c) Support agroforestry tree planting initiatives among local farmers.
Soil erosion	a) Proper planning of site excavation works such that a section is completed and rehabilitated before another section begins. b) Encourage re-use of excavated materials for back-filling which should entail compaction to enhance soil stability.
Incidents and construction work related accidents	a) Warning tapes should be put along the trench line to alert pedestrians on the dangers. b) A fully equipped First Aid Kit shall be provided at the construction site always and manned by trained/qualified persons. c) Depending on OHS hazards anticipated while performing assigned jobs/task(s), workers will require proper fitting PPE to avoid injuries and illnesses. The PPEs will include: working boots, overalls, helmets, goggles, earmuffs, dust masks, and gloves among others that will be deemed necessary. d) Maintain an effective reporting procedure and recording for all accidents. e) The contractor shall have group Insurance Cover for the workers. f) In case of an accident, the injured person should be given first aid and immediately taken to the nearby hospital, an investigation should be initiated immediately to ascertain the cause of the accident and preliminary findings released within 12 hours.

Impact on local roads and related infrastructure	a) Obtain necessary permits and approvals from the county government before construction begins. b) Develop a Traffic Management Plan (TMP) to ensure minimal disruption to road users. c) Mark all underground cables and water pipes using utility locator equipment before excavation. d) Work with the roads department to guide on the depth requirement for irrigation pipes along the major roads to minimize destruction of the pipes by future road expansion or upgrade. Where the irrigation pipes crosses major roads, water marks should be put. e) Use trenchless technology (e.g., horizontal directional drilling) to lay pipes under the road without excavation where possible. f) If excavation is necessary, provide alternative routes and temporary bypasses for vehicles and pedestrians. g) Ensure proper signage and safety measures, including warning signs, barricades, and flagmen. h) Reinstate the road surface to its original condition and Conduct joint inspections with county engineers to ensure road reinstatement meets required standards.
Impact on points of cultural importance	a) Develop and implement a Chance Find Procedure (CFP) as per World Bank standards, ensuring immediate action if cultural artefacts or human remains are discovered during excavations. Include site workers training on how to recognize and handle chance finds. If a grave or cultural artefact is discovered: b) Stop work immediately in the affected area. c) Mark the site and secure it from disturbance. d) Inform the relevant authorities (e.g., National Museums of Kenya, Cultural Heritage Department). e) Engage local elders and cultural representatives to determine appropriate next steps. f) Resume work only after clearance from relevant authorities and cultural leaders. g) If a significant cultural site is found, explore rerouting the pipeline to avoid the area.
Noise and vibration	a) In order to meet noise level requirements, those handling noisy equipment will be equipped with standard noise attenuation devices. b) The construction work will be limited to normal working hours (8am-5pm), unless otherwise, no construction work will be done at night. c) The contractor should establish means for the public to raise their complaints (i.e., provide telephone number, email, etc.) and methods to handle noise complaints.

Effluent from workers sanitary facilities	a) The contractor will enter into a formal agreement with the management of the other premises near the project site for the construction workers to use their toilets during the construction period. b) Open defecation by construction workers should be discouraged at all cost during the construction period.
Solid waste/Debris	a) Store construction materials in designated areas to prevent damage and reduce wastage. b) Excavated soil and rocks should be reuse for backfilling or levelling areas instead of disposal. c) Metal and Plastic Pipes will be collected for re-use and recycling. d) Open burning of waste should be strictly avoided to prevent air pollution.
Dust and air pollution	a) Regularly spray water on dry and exposed soil, particularly during excavation and earthworks, to reduce dust emissions. b) Enforce a speed limit (e.g., 20 km/h) on unpaved roads to minimize dust. c) Provide workers with dust masks, goggles, and respirators in high-risk areas. d) Set up a system where affected communities can report dust-related concerns.
Risk of increased incidences of HIV/ AIDS and STIs	a) Proponent and Contractor(s) to sensitize workers and community members on HIV/ AIDS and STIs as part of the contractor's Health and Safety Management Plan. b) Contractor to partner with nearest Sub County Hospital for provision of VCT services on site to the workers and community at large. c) Contractor to avail condom dispensers at the construction site.
Child labour and abuse	a) The contractor will develop and implement a Children Protection Strategy that will ensure minors are protected against negative impacts associated with the project. b) All staff must sign, committing themselves towards protecting children, a contract which clearly defines what is and is not acceptable behaviour. c) Children under the age of 18 years will not be hired at the site.
Gender-based violence (GBV)/ sexual exploitation, abuse and harassment (SEA/SH)	a) Develop a human resources policy against sexual harassment that is aligned with national law. b) Develop a Code of Conduct with specific provisions on protection from sexual exploitation, abuse and harassment and ensure employees, sub-contractors, sub-consultants, and any personnel thereof engaged in construction works to individually sign and comply with it. c) Sensitise workers as well as have display signage around the project site that signal to workers and the community that the project site is an area where SH/SEA/GBV is prohibited. d) Establish an appropriate GRM to monitor and address SH and GBV in collaboration with the set legal systems and health workers within the locality.

Grievances/conflicts • Worker's grievances • Community grievances	The contractor will ensure adherence to workers policy and occupational and health safety procedures at the company as well as at the site. The contractor shall put in place a mechanism for raising and management of workers grievances. The Kabkara IWUA will establish of site project level grievance committee to be responsible for handling and resolving environmental and social grievances related to the sub project with representation from the office of the national government (Area chief), member of civil society organization, representative from Lwandanyi CDDC- SAIC and community representatives including the youth, men and women. They will be trained and facilitated to handle grievances.
OPERATION PHASE	
Water use related conflicts	a) Install water meter at the intake and at household levels in order to control water usage and form a basis of rationing. b) Establish a water monitoring program to track water levels in the dam and stream. c) Implement controlled water abstraction by regulating pumping schedules. d) Ensure adherence to water abstraction permits to be issued by WRA. e) Strengthen the Irrigation Water User Association (IWUA) to monitor water usage and conflict resolution in the project.
Water logging and soil salinity	a) Conduct regular soil quality analysis help determine mineral deficiency and guide on remedial measures. b) Use proper irrigation method that does not lead to water logging. c) Strictly follow irrigation schedule to prevent an increase in the irrigation hours in one section.
Increase in waterborne diseases	a) Have separate system for domestic and irrigation water. b) Chose an irrigation system that is very efficient and does not cause water logging in the field. c) Design an irrigation schedule and follow it to prevent an increase in the irrigation hours in one section.
Intensification in use of agrochemicals	a) Only use pesticides approved by Pest Control Products Board (PCPB) and KEBS to be used in Kenya. b) Train farmers on integrated pest management (IPM) to reduce chemical use: use combinations of cultural, mechanical, biological and chemical controls in an integrated manner. Implement useful crop pest control methods like Rotating crops, adjusting planting times and ensure that major insect pests either starve or get eaten by their natural predators. c) In case chemicals are used, the application of herbicide should be to treat only in designated areas and the chemicals used must be approved for use. Irrigation water users association (IWUA) should control the use of improper products in the project area.
Child labour in irrigated agriculture	a) Conduct awareness campaigns to educate farmers and communities about the dangers of child labour and the importance of education. b) Strengthen the enforcement of child labour laws and policies through regular inspections and penalties for violators.

Theft of farm yield and vandalism of irrigation infrastructure	a) Farmers can implement fencing, surveillance cameras, and security patrols to protect their farms from theft. b) Establish local security groups involving the office of the area chief and community members to monitor and report theft and vandalism incidents. c) Employ security officer to guard sites of critical irrigation infrastructure such as the solar kits and water pumping infrastructure.
Breakdown of irrigation infrastructure	a) Use durable, high-quality materials when installing irrigation systems to minimize frequent breakdowns. b) Create a fund specifically for urgent repairs to avoid prolonged disruptions in irrigation services. c) Establish a preventive maintenance program to regularly inspect and repair irrigation infrastructure. d) Irrigation infrastructure passing along major roads that experience frequent maintenance should be clearly marked to prevent damages during road maintenance or upgrade.
Management challenges of the Irrigation Water Users Association (IWUA)	a) Train IWUA leaders and members on governance, financial management, and conflict resolution. b) Implement clear financial accountability measures, such as regular audits and public disclosure of financial records. c) Ensure fair representation of all farmers, including smallholder farmers and marginalized groups, in decision-making processes. d) Develop and enforce fair and transparent water distribution policies to avoid conflicts and inefficiencies. e) Strengthen government oversight to provide technical assistance and policy guidance for IWUA management.
Low/lack of return on project investment	a) Establish legally binding agreements with beneficiaries restricting land sales within a specified period (e.g., 5–10 years) unless approved by project authorities. b) Register landowners benefiting from the project in a database to track ownership changes and prevent unauthorized sales. c) Work with land administration offices and local governments to track land transactions and enforce project-related restrictions. d) Improve market access and offer financial support (e.g., low-interest loans) to farmers, reducing their incentive to sell land for quick financial gain. e) Empower the Irrigation Water Users Association to oversee land use compliance and discourage speculative sales.

Conclusions and Recommendations

The Environmental and Social Impact Assessment (ESIA) for the proposed irrigation project has comprehensively evaluated the potential environmental and social impacts associated with its implementation. The identified environmental impacts can be mitigated to a level of minimum or no significance throughout the project cycle. Further, none of the potential impacts would result to permanent irreversible damage on the ecosystem components.

The project should therefore be licensed by NEMA with condition that the proponent implements mitigation measures proposed across the project phases. Some of the key conditions that the proponent should fulfil include:

a) Implement all mitigation measures outlined in the ESMP to minimize adverse environmental and social impacts.

b) Obtain the necessary permits from the Water Resources Authority (WRA) for water abstraction.

c) Ensure that water extraction does not negatively impact downstream users or aquatic ecosystems.

d) Adopt efficient irrigation technologies to minimize water wastage and promote sustainable water use.

e) Restore any disturbed areas after construction, including re-vegetation and stabilization of excavation sites.

f) Ensure the safety of workers by providing personal protective equipment (PPE) and enforcing OHS regulations.

g) Maintain active engagement with local communities and relevant stakeholders throughout the project cycle.

ABBREVIATIONS AND ACRONYMS

BOQ Bills of Quantity

CBO	Community-Based Organization
CAIO	County Agriculture Infrastructure Officer
CGB	County Government of Bungoma
CPCU	County Project Coordinating Unit
CESCO	County Environmental Safeguards Compliance Officer
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment (used when social aspects are not covered separately)
EMCA	Environmental Management and Coordination Act
EMP / ESMP	Environmental (and Social) Management Plan
ESIA	Environmental and Social Impact Assessment
FLID	Farmer led Irrigation Development
GIS	Geographic Information System
GoK	Government of Kenya
GRM	Grievance Redress Mechanism
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
IWUA	Irrigation Water Users' Association
Masl	Meter above sea level
M&E	Monitoring and Evaluation
MWSI	Ministry of Water Sanitation and Irrigation
NAVCDP	National Agriculture Value Chain Development Project
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
NPCU	National Project coordinating Unit
O&M	Operation and Maintenance
PCPB	Pesticide Control Produce Board
PPE	Personal Protective Equipment
SDGs	Sustainable Development Goals
SOP	Standard Operating Procedure
SWM	Solid Waste Management
ToR	Terms of Reference
WB	World Bank

DEFINITION OF TERMS

ESIA (Environmental and Social Impact Assessment): A systematic process for evaluating the potential environmental and social consequences of a proposed project before decisions are made and actions are taken.

Mitigation Measures: Actions designed to avoid, minimize, or offset adverse environmental and social impacts of a project.

Baseline Conditions: The existing environmental and social status of the project area before implementation, used as a reference point for assessing potential impacts.

Stakeholder Engagement: The process of involving individuals, communities, organizations, and authorities affected by or interested in the project in decision-making and feedback.

Cumulative Impacts: Combined effects of the proposed project along with past, present, and foreseeable future activities in the area.

Environmental Management Plan (EMP) or ESMP: A document outlining specific mitigation measures, monitoring activities, responsibilities, and timelines to manage identified impacts during project implementation.

Irrigation Water Users' Association (IWUA): A local group formed by farmers and water users responsible for managing, operating, and maintaining irrigation infrastructure.

Water Abstraction: The process of taking water from a natural source (such as a dam, river, or borehole) for irrigation or other uses.

Grievance Redress Mechanism (GRM): A structured process through which communities and stakeholders can raise concerns or complaints related to the project, and have them addressed fairly and transparently.

Sensitive Receptors: Environmental or social features (e.g., wetlands, schools, health centers) that may be more vulnerable to the impacts of the project.

Solar Pumping System: A renewable energy-driven mechanism used to pump water from the source to the storage or distribution system using solar power.

Hydraulic Infrastructure: The physical structures used for water conveyance and distribution, including pipelines, tanks, pumps, hydrants, and canals.

Erosion and Sedimentation: Natural processes often exacerbated by construction or irrigation activities, involving soil displacement and the settling of particles that can affect water quality and land productivity.

Regulatory Framework: The set of national laws, policies, guidelines, and international standards that govern environmental and social assessment and project compliance.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

1 INTRODUCTION

1.1 Background to the Proposed Project

Bungoma County is among the 34 Counties benefitting from the National Agricultural Value Chain Development Project (NAVCDP). The Project Development Objective of NAVCDP is to increase market participation and value addition for targeted farmers in select value chains in project areas.

The National Agricultural Value Chain Development Project (NAVCDP) is a collaborative initiative supported by Government of Kenya (GoK) through the Ministry of Agriculture and Livestock Development, State Department for Crop Development; The World Bank through the International Development Association (IDA) credit; Participating county governments through counterpart funding and facilitating the implementation of project activities at the local level; Kenya Agricultural and Livestock Research Organization (KALRO) through disseminating Climate-Smart Agricultural Technologies, Innovations, and Management Practices (TIMPs) to farmers and Farmer Producer Organizations (FPOs) and Savings and Credit Cooperative Organizations (SACCOs) through strengthen farmers' capacity in aggregation, value addition, and access to affordable credit, thereby improving their market participation.

NAVCDP is structured into several components, with Component 2 focusing on Climate-Smart Value Chain Ecosystem Investments. Within this component, Sub-Component 2.1 is dedicated to Farmer-Led Irrigation Development (FLID) with the following key themes:

a) Leverage on CIGs/FPOs to motivate farmers access irrigation and use water efficiently.
b) Leverage on CIGs/FPOs to develop irrigation centred FLID forums linking farmers with irrigation suppliers, financial institutions and other key stakeholders.
c) Deployment of technical resource persons to coordinate with County Irrigation Development Units (CIDU) for provision of technical support on water harvesting and accessing irrigation through aggregation and linkage of farmers to high-tech suppliers and financial institutions.

The proposed Kabkara irrigation project is a FLID identified by the community after the rehabilitation of Kabkara dam in order to utilize the water in the dam to grow high value crops. The main economic activity in the project area (Lwandanyi ward) is rain-fed agriculture which is unreliable during dry seasons. The project will address food insecurity in the area by providing water to households around the Kabkara dam catchment in order to grow high value crops for consumption and marketing by irrigating 46ha of land.

1.2 Objectives, Scope and Justification of the Proposed Project

The main objective of the proposed Kabkara irrigation project is to enable farmers to grow high-value crops and multiple harvests annually, leading to improved household income and livelihoods.

Kabkara area in Sirisia sub-county experiences long rains between March and May and short rain season between October and December. The area also experiences dry seasons between January and February, with the effects of climate Change the project area has in recent past

experienced unpredictable rainfall patterns which affected planting seasons and food production in general.

According to the residents of Kabkara, the dam was constructed in 1952 to supply water for livestock, the dam experienced several cases of siltation until 2021 when it was fully rehabilitated by the National Agricultural and Rural Inclusive Growth Project (NARIGP). The hydrological study of the dam shows its potential in supporting irrigation farming.

Given the fact that farmers in the Kabkara area solely depend on rainfall, which is erratic and insufficient for sustainable crop production, renovation of the dam came as a blessing to them as the availability of water for irrigation would ensure continuous farming, regardless of seasonal variations. Kabkara Dam provides an ample and sustainable water supply, making irrigation feasible and cost-effective. Utilizing the dam for irrigation will optimize its economic and social benefits. Irrigation will enable farmers to cultivate high-value crops, generate more income, and create employment opportunities in the agricultural sector.

The proposed irrigation project aligns with national and county government policies on food security, economic empowerment, and rural development. Additionally, the local community around the Kabkara dam catchment have been engaged in the planning process of the proposed irrigation project, they fully support the proposed project through their irrigation water user association (IWUA), this will enhance sustainability and local ownership.

1.3 Justification for the ESIA Comprehensive Project Report (CPR)

The proposed project was screened according to the Kenyan Legal Notice No. 31 of 2019 and the Second Schedule of EMCA 1999 (Amended 2015) which lists the projects to undergo EIA. It was also screened using the project screening checklist. An ESIA comprehensive project report was recommended. The proposed project falls under the category described as "water supply and distribution infrastructure as well as medium scale irrigation projects" which is of medium-risk in accordance with the Legal Notice No. 31, Legislative Supplement No. 16 published in the Kenya Gazette Supplement No. 62 on the 30th of April 2019.

The environmental and social assessment will be proportionate to the risks and impacts of the project. It will inform the design of the project, and be used to identify mitigation measures and actions and to improve decision making. The proponent will manage environmental and social risks and impacts of the project throughout the project life cycle in a systematic manner, proportionate to the nature and scale of the project and the potential risks and impacts.

1.4 Objectives and Scope of the ESIA

The scope of the ESIA was determined through environmental screening which assessed different anticipated impacts that the project might have on the environment and well-being of the community. Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

The ESIA study is meant to identify significant environmental and social impacts associated with the design, construction, operation and decommissioning of the proposed project and recommend appropriate enhancement and mitigation measures for the positive and negative impacts respectively.

Through the ESIA study, an Environmental and Social Management and Monitoring Plan will be developed describing in detail the mitigation measures to be carried out, costing, scheduling and responsibility of such measures. The ESIA's specific objectives include;

i. To collect and analyse baseline information on bio-physical, ecological and socio-economic characteristics of the project area and to analyse their relevant to the proposed development;
ii. To analyse the design of the proposed project and related activities that may arise during project implementation;
iii. To Undertake public and stakeholders engagement through interviews with the anticipated project interested and affected parties;
iv. To review national and international legislation, standards, and guidelines and recommend how the proposed project will comply with the specific provisions;
v. To described and analyse alternatives to the proposed project including alternatives to the proposed location, design, technologies, and processes;
vi. To established key areas of environmental, health and safety concern focusing on both the positive and negative effects in relation to how they affect the biophysical, social, economic, and cultural components of the environment;
vii. To analyse impacts and recommended mitigation and enhancement measures for the adverse and positive impacts respectively;
viii. To design an Environmental Management Plan (including cost estimates) and a monitoring framework for the environmental impact of the project;
ix. To develop a comprehensive ESIA report in accordance with the ESIA regulations as outlined in the Environmental (Impact Assessment and Audit) Regulations, 2003 (Revised 2019); fill the project report submission form R6 and submitted the report and necessary soft and hard copies together with the statutory fees to the Authority for approval and/ or further instructions.

1.5 Assessment Methodology

The ESIA process adopted a participatory and collaborative approach in the course of the assignment. The approaches encouraged active involvement of the stakeholders, who had crucial perspectives and knowledge of the areas' conditions, traditions and social structure. It also assisted the ESIA team to acquire reliable data, using a variety of formal and informal techniques that could be employed within a short timescale.

The assessment was carried out in between January 27th and 31st 2025 in accordance with the procedures and protocols in the Environmental (Impact Assessment and Audit) Regulations, 2003 (Revised 2019). The assessment involved:

a) Site visits to physically assess the socio-economic as well as physical characteristics of the area around the Kabkara dam catchment.
b) Screening: In screening, the site of the proposed project, the environmental characteristics of the areas surrounding the proposed site, the activities of the proposed project, the nature of community and expected social issues because of the proposed project were evaluated to confirm whether the proposed project fell within a category that requires an ESIA before commencement.

Screening also determined the level of ESIA to which the proposed project was subjected to. This project is categorized as Medium-Risk in according with the Legal Notice No. 31, Legislative Supplement No. 16 published in the Kenya Gazette Supplement No. 62 on the 30th of April 2019 i.e., Amendment of the Second Schedule which lists the projects to undergo Environmental Impact Assessment (EIA) [Section 58 (1) of EMCA, 1999 (Revised 2015)] and, therefore, requires to be subjected to ESIA.

c) Desktop studies: to understand the project background and its context and legislations relevant to the proposed project, the ESIA team reviewed documents related to the proposed project including the hydrological survey reports, Environmental and Social Impact Assessment Report for the Kabkara earth dam, Bungoma County integrated development plan 2023-2027 (CIDP), proposed project feasibility study reports as well as case studies of similar projects.

d) Public participation: Views of the interested and affected parties were collected through administration of questionnaires to the project neighbouring households, public meeting as well as key informant interviews with opinion leaders and relevant lead agencies. The information gathered was subsequently synthesized and incorporated into the ESIA report.

e) Reporting and documentation: NEMA guidelines through the NEMA legal Notice No. 32 Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019 was used as a guide in compiling this ESIA report. NAVCDP Environment and Social Management Framework (ESMF, 2023) also informed the ESIA study and the structure of the report. The Consultant ensured constant briefing of the client during the exercise. Description plans and sketches showing various activities are part of the Appendices of the report.

1.6 ESIA Team

The assessment included a multidisciplinary team from environment, gender and social services, water and fisheries, engineering and agriculture (Table 3).

Table 3: Team members who undertook the Environmental and Social Impact Assessment of the Proposed Kabkara Irrigation Sub-project

S/N	Name	Role
1.	Silas O. Rakama	Environmental Impact Assessment Lead Expert
2.	Carolyn Mungu	Social Impact Assessment Expert
3.	Elijah Obadha	Bungoma County (NAVCDP) Environmental Safeguard Compliance Officer
4.	Lenis Marani	Bungoma County (NAVCDP) Social Safeguard Officer
5.	Irene Wafula	Fisheries Expert
6.	Diana Nambuchi	Social Safeguard Expert
7.	Naomi Komol	Environmentalist

8.	Reuben Buchacha	Agricultural Extension Officer Bungoma County

1.7 Structure of the Report

The ESIA report has been organized into 9 chapters, chapter one is the introduction chapter, chapter two covers the project design, chapter three covers baseline environmental and socio-economic characteristics of the project area, chapter four covers the legal, policy, institutional and multilateral environmental and social frameworks, chapter 5 covers the analysis of project alternatives, chapter six covers the public participation, chapter seven covers identified environmental and social impacts as well as their mitigation measures, chapter eight covers the environmental and social management plan matrix while chapter nine covers the conclusions and recommendations. Section ten of the report covers the annexes attached in the report.

2 PROJECT DESCRIPTION

2.1 Project Location

The project will be implemented in Lwandanyi ward of Sirisia sub-county, Bungoma County of Kenya. The village units mapped to benefit from the proposed irrigation project include the Kabkara and Katomei units (Figure 1). The irrigation command area is divided into 3 blocks targeting 46ha of land.

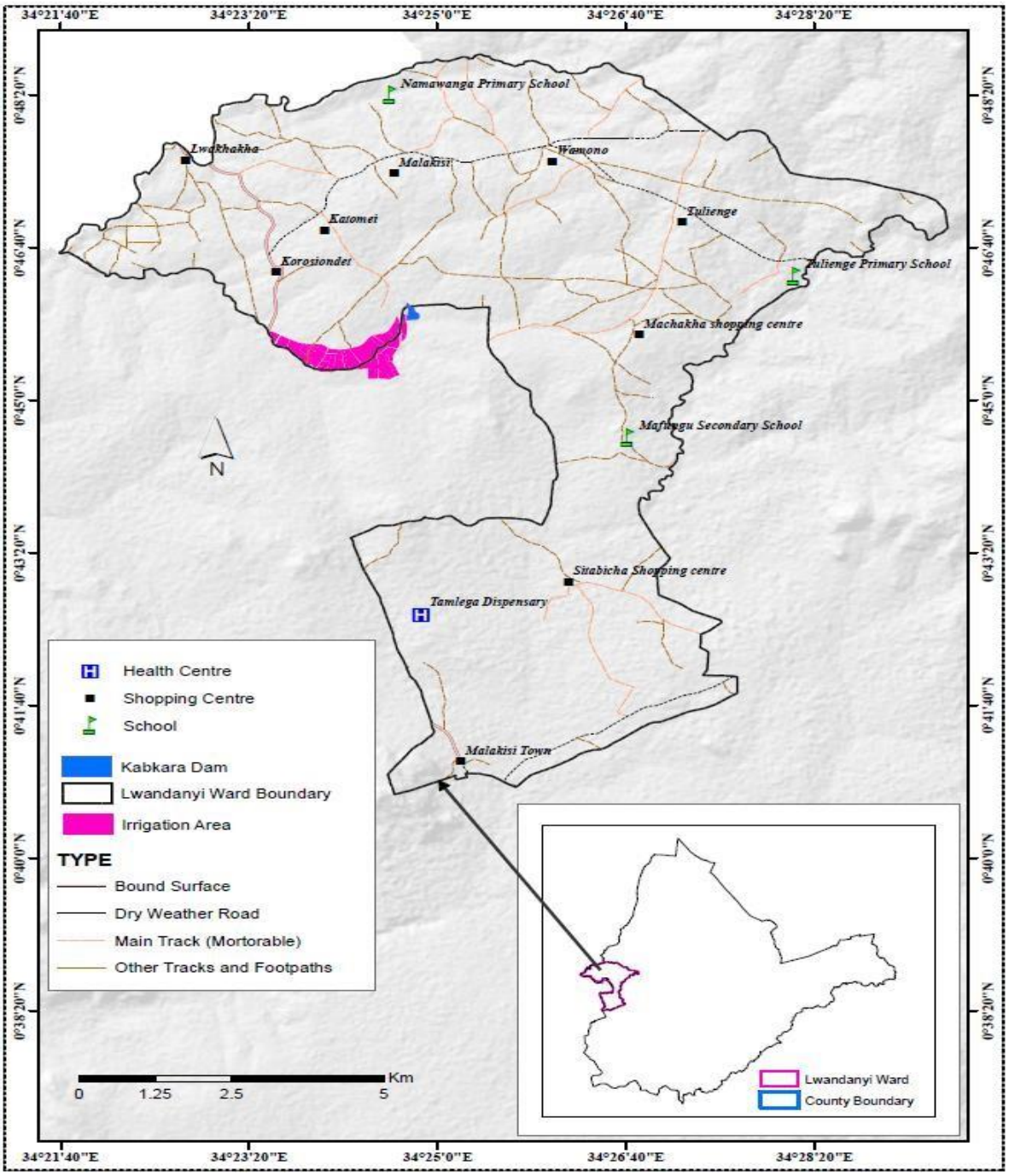

Figure 1: Map of the proposed project area (Source: Bungoma County Government)

2.2 Water Reservoir Yield versus Abstraction

"As built" reservoir Storage capacity of Kabkara dam is 126,650 m^3. Based on the previous hydrological study of the dam done in 2020 and related studies, Kabkara reservoir yield is 257 m^3/day. It is indicated that the only legally allowed abstraction on Kabkara dam is 144 m^3/day; this will not have a substantial impact on the flow regime according to the analysis in the report. In the year 2021, up to 120,080m^3 of silt was removed from the dam to achieve reservoir storage capacity of 133,480 m^3. The Kabkara dam design life is 30 years as per the 2023 resident engineer handing over report, water from the dam is unfit for domestic use but suitable for irrigation and livestock watering purposes. The reservoir characteristics is presented in Table 4.

Table 4: Physical details of the Kabkara Earth Dam (The Reservoir for the proposed Irrigation Sub-project)

Parameter	Value	Remark
Kabkara Dam/Reservoir Land	10.8 ha	LRIM No.470 (Bungoma Lands registry)
Reservoir Impoundment area (ha)	3.0	As built drawing
Storage Capacity (in m3)	126,650	As built drawing
Elevation of Draw off pipe (masl)	1,375.00	Surveyed in Jun 2024
Normal water level (masl)	1,380.20	Surveyed in Nov 2023

2.2.1 Reservoir Safe Yield

Reservoir yield is the amount of water that can be released from a reservoir in a certain interval of time; and varies from time to time depending upon the inflow. In this report, the firm or safe yield is the maximum amount of supply that is guaranteed during the critical anticipated 90-day dry period i.e. December-March based on climate of the sub-project area. In this section, the Kabkara reservoir yield, in a dry period during peak irrigation, is calculate and compared to the project peak operational flow.

The yield of a direct supply impounding reservoir is calculated by the equation 1:

Equation 1

Yield = [Storage + inflow over the Critical drawdown period] / Length of the Critical drawdown period

Where:

Yield (in m^3/day)	
Storage (in m^3)	126,650
Inflow over the critical drawdown period (m^3/day)	Inflow during critical (dry period) of 3 months; corresponding to (environmental flow) = 681 m^3/day (0.00788 m^3/s)
Length of the critical drawdown period (days)	90 days

The Flow in Kabkara stream is presented in Table 5.

Table 5: Stream Flow

Parameter	Unit	Kabkara Stream
Catchment area	km^2	7.92
Flood flow Q50	m^3/s	0.04116
Normal flow Q80	m^3/s	0.02768
Environmental flow Q95	m^3/s	0.00788
Allocatable flow: Q80 minus Q95 (m^3/s)	m^3/s	0.0198

For Direct Supply from Kabkara Reservoir over 90-day Critical dry period

Q95 (environmental flow) = 681 m^3/day

Kabkara Reservoir Yield = [126,650 + 681] / day

= 127, 331 m^3/day

= 5,305 m^3/hour (in 24-hour period)

= 15,916 m^3/hour (in 8-hour period)

Table 6: Reservoir Yield vs Peak Pumping flow

Unit	m^3/day	m^3/hour
Reservoir yield 24-hour	127,331	15,916
Design pumping flow corresponding to Peak GIWR	616	77
Remark	OK	OK

Comparison of reservoir yield and the peak pumping flow rate in an 8-hour sunshine period is given in Table 6; where it is shown that the Kabkara reservoir safe yield (=15,916 m^3/hour) can fulfil the peak pumping flow rate of (77 m3/hour) in an 8-hour sunshine period.

Source: Kabkara Dam Hydrology Report 2020.

2.3 Water Pumping System

A solar-powered pumping system will be installed to pump water from the dam to an elevated storage reservoir, pontoon (floating platform) from which the submersible pumps would be operated from will also be installed. The solar array shall be located to avoid shading and to minimise incidental shading, away from tall vegetation and structures. The array shall be located so as to minimise the length of electrical cabling needed to reach the water pump.

The solar PV array shall be installed on a suitable surface that can adequately support the array. Coordinates of the proposed location are: UTM 36N 657077.78E 84511.22N, the parcel of land for the pumping infrastructure is under the Kabkara dam land, a public land under the custody of Bungoma County Government set aside for water infrastructure. The design of the solar module and support structure is presented in annex 8.

The water pump will be situated so as to minimise pipe lengths and electric cable lengths. The distance between the proposed surface pump and the water source (draw-off pipe) will be adjusted to meet the pump manufacturer's operating specifications. The ground distance between the draw-off pipe at 1375.00 masl and provisional pump house (TBM1) at 1381.35 masl is 97 m.

Input power required to drive the pump to the discharge is given by **equation 2.1, where N = [(Q x H) / (102 x e)]**

Equation 2.2: computation of the input power required to drive the pump

N	=	Input power (kW)
Q	=	Flow (in L/s)
H	=	Pumping head (m)
e	=	Pumping efficiency (in decimals)

Input power is computed to: [(23 x 64) / (102 x 0.6)] = **24.05 kW.**

The energy demand can be calculated using **equation 2.2, where E= (Q×H)/e**

Equation 2.3: Energy demand computation

E	=	kWh per year
Q	=	Pumped quantity of water per day (m^3/day)
H	=	Pumping head (m)
e	=	Pumping efficiency (in decimals)

Energy demand is computed to: {(661×64)/0.6}=117.5kWh, it is assumed that pump motor will be optimally sized at its operating point of 60% wire- to- water efficiency.

Array size

117.5 kW/day=array kWp×77.4%×5.71 kWh/m^2/day, therefore array size= 26.6kWp.

2.4 Water Supply and Distribution System

Water pipes will be used to supply water from the reservoir (Kabkara earth dam) to the storage tank to be placed at high elevation, water pipes will also be used to distribute water to farms for irrigation purposes (Annex 5). The minimum pressure at design flow should be 0.1 Mpa (10 metre water head) in pipe sections to which there may be made farmer

connections and 0.04 Mpa (4m) in other cases. The levels of the surrounding areas to be served from the pipeline were considered when determining the minimum pressure.

The static pressure in pipes with farmers' connections shall be not more than 0.6 Mpa (60m) unless the terrain makes higher pressures unavoidable. Higher pressure than 0.6 MPa will require special fittings, ball valves, stop valves etc. for the farmer connections. The dimensions of water pipes to be used is presented in Table 7.

Table 7: Dimensions and Types of the pipes to be used

Block	Pipe Name	Length (m)	Diameter (mm)	Material	Pressure
	Rising Main				
	RM	1399	150	GI	PN25
		260	150	GI	PN25
	Gravity Mains				
	GM-1	584	150	HDPE	PN6
	GM-2	1224	150	HDPE	PN6
	Sub-mains				
A	SM-A-1	1685	225	HDPE	PN6
B	SM-B-1	156	100	HDPE	PN6
	SM-B-2	1761	150	HDPE	PN6
C	SM-C-1	1200	150	HDPE	PN6
		85	150	HDPE	PN8
	Feeders				
A	F-A-1.1	769	100	HDPE	PN6
	F-A-1.2	541	100	HDPE	PN6
	F-A-1.3	429	110	HDPE	PN6
	F-A-1.4	868	100	HDPE	PN6
B	F-B-1.1	1525	100	HDPE	PN6
	F-B-1.2	462	100	HDPE	PN6
	F-B-2.1	1240	75	HDPE	PN6
		78	75	HDPE	PN8
	F-B-2.2	343	75	HDPE	PN6
	F-B-2.3	496	75	HDPE	PN6
	F-B-2.4	560	75	HDPE	PN6
		369	75	HDPE	PN8

C	F-C-1.1	420	75	HDPE	PN6
		43	75	HDPE	PN8
	F-C-1.2	380	75	HDPE	PN6

2.4.1 Water Supply Schedule

Operational irrigation flow in 20.4 ha net area is 77 m^3/hour or 616 m^3/day (ref to Table 6). Irrigation water would be supplied on a rotational schedule in three blocks by Kabkara IWUA to cover 46 ha area in a 7-day cycle. Every block will be supplied fully for two days in a week (Figure 2).

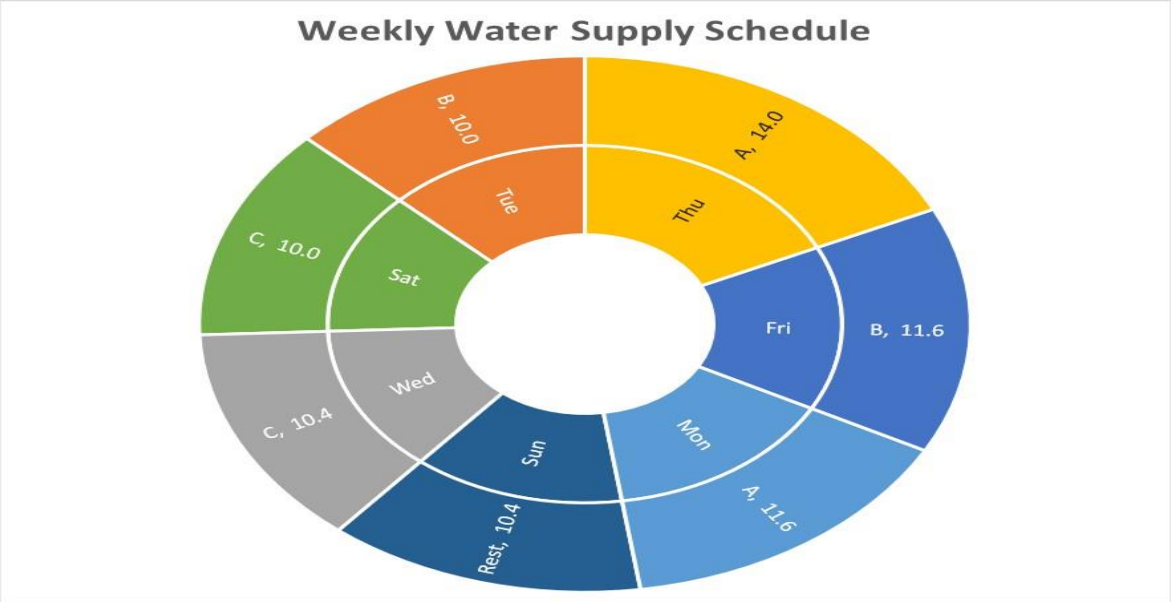

Figure 2: Proposed Water supply schedule for the Kabkara Irrigation Scheme

2.5 Elevated Water Reservoir

Water storage tank of 708 m^3 storage capacity for gravity-feeding the scheme will be located at 1434.32 masl elevation in proximity of location UTM 36N 656168.015N 85156.191E. The point was selected during surveying and mapping of the proposed irrigation scheme, the point is ideal to minimise the head (vertical height) and water-piping distance, while still fulfilling the water delivery requirements. The elevated storage tank will be set-up on plot L.R No. Malakisi/S.Wamono/1047, the land parcel was acquired by the Kabkara IWUA. The proposed project will adopt reinforced concrete tank since it is cheaper than a galvanized steel tank of the same capacity; the MWSI standard masonry wall tank of capacity 225m^3 will be adopted for Kabkara irrigation scheme.

2.6 The Irrigation Command Area

The area to be irrigated is about 46ha net area spread in circular gross area of 3km radius. Although the Kabkara dam catchment transverses to Busia County, preference was given to households in Bungoma County. The irrigation scheme area is in three blocks bound by 1370

masl contour and 1375 masl contour (Figure 3). The irrigation system was geo-referenced using GIS technology to ensure accurate mapping of beneficiaries. The project area is divided into designated land parcels, each assigned a unique identifier for better management and monitoring. It is important to note that during mapping stakeholders agreed that irrigation infrastructure and water supply will only be per household, a total of 115 parcels were mapped to benefit in the project. Households will only be allowed to irrigate up to 0.4 ha of their parcel. Annex 15 shows the details of the GPS coordinates and land registration number of the parcels for the proposed project.

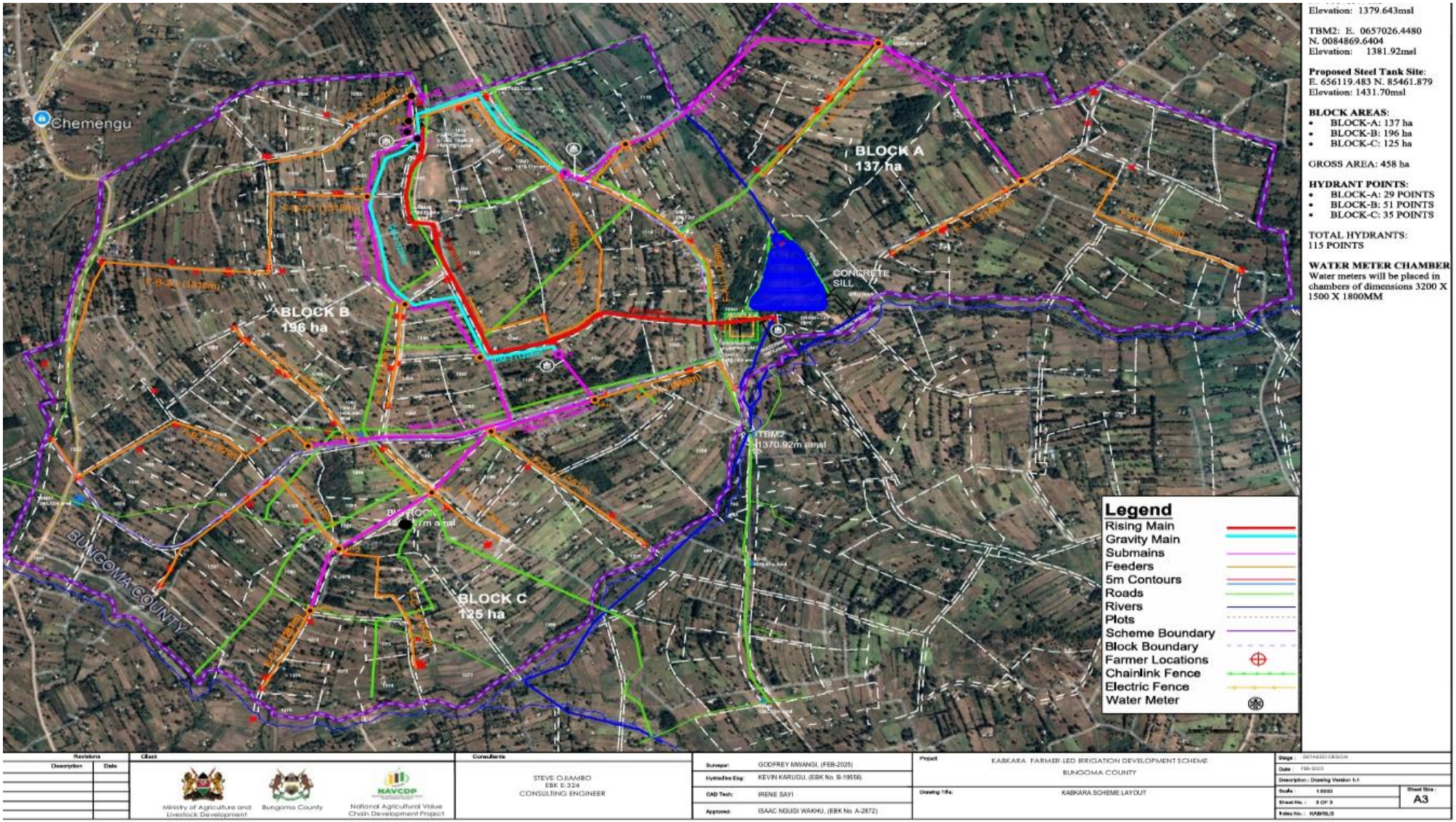

Figure 3: Topographical Map Showing the Kabkara Dam Irrigation Command Area

2.7 Project Activities

2.7.1 Preconstruction Activities

Before the project construction, main activities will include: Land surveying and mapping of the possible suitable locations for the water reservoir, solar pumping system, and pipeline network. This includes mapping out the most efficient gravity-fed routes to maximize water distribution. Environmental and Social Impact Assessment is also done at this stage. Sourcing transportation and storage of materials for the irrigation infrastructure will also be key. At this phase, the construction labour and construction machineries will also be sourced. The materials to be used have to conform to KEBS requirements.

2.7.2 Project Activities during Construction Phase

Construction material storage: The proponent will use a section of public land set aside for the IWUA activities near the Kabkara earth dam, the site has a security officer employed by the county government of Bungoma. Bulky construction materials such as pipes, cement and construction machineries and equipment will be kept temporarily at the site.

a) **Excavation and ground works:** Ground works such as excavation will be carried out to prepare the site for underground piping and related irrigation infrastructure. This may involve the use of machinery such as excavators, and also manual labour.
b) **Installation of the elevated water reservoir:** A reinforced elevated storage tank will be constructed at a strategic height to enable gravity-fed water distribution. This structure must be stable and capable of holding large volumes of water without structural failure.
c) **Solar pump installation:** A solar-powered pumping system will be set up near the existing dam. This includes installing solar panels, inverters, and controllers to ensure a reliable and sustainable energy source for pumping operations. This will also entail designing, fabrication and installation of a pontoon (floating platform) from which the submersible pumps would be operated from.
d) **Pipeline connection and testing as well as installation of control valves and distribution points:** The installed pipes will be connected to the reservoir and tested for efficiency, leaks, and proper water flow rates. Engineers will conduct pressure tests and flushing exercises to remove any debris from the pipelines.
   Control valves, hydrants, and outlets are installed at strategic points along the pipeline network to regulate water flow and allow farmers to access irrigation water efficiently.
e) **Back-filling, soil stabilization and erosion control measures**: To prevent erosion and damage to the surrounding ecosystem, back-filled soils will be stabilized through compaction, silt traps will be set-up in areas along the construction line that are prone to erosion.

2.7.3 Project Activities during Operation Phase

Once construction is complete, the project transitions into the operation phase, during which the system is actively used to deliver water to farms. Key activities include:

a) **Pumping and water distribution:** The solar-powered pump will extract water from the dam to the elevated reservoir, from which it will be distributed to farms through gravity-fed pipes. Proper scheduling should be implemented to ensure equitable water distribution.
b) **Farming by irrigation:** project beneficiaries will use water from the irrigation system to farm high value crops. Farming will entail use of fertilizer and agro-chemicals at some point.
c) **Monitoring water flow and system performance:** Regular inspections will be conducted to assess water pressure, identify leaks, and ensure that the pipeline system functions efficiently. The project proponent and the contractor is advised to consider installing sensors and flow meters to track water consumption and detect inefficiencies.
d) **Maintenance and repairs:** Routine maintenance, such as cleaning solar panels, checking for pipe leaks, and servicing valves will be done to keep the system in optimal working condition, the Kabkara IWUA will be responsible for the maintenance work.

2.8 Operational Irrigation Flow

Computation of operational peak irrigation flow is given in Table 8.

Table 8: Operational Peak Irrigation Flow

Irrigation Block	A	B	C	Total	Remark
Nr. of Irrigators	29	51	35	115	
Individual plot size (ha)	0.40	0.40	0.40	0.40	
Net irrigable area (ha)	11.6	20.4	14.0	**46.0**	
Net irrigable area (acre)	28.7	50.4	34.6	**113.6**	
Peak NIWR (L/s/ha)	0.25	0.25	0.25	**0.25**	
Conveyance efficiency	0.95	0.95	0.95	**0.95**	
Distribution efficiency	0.95	0.95	0.95	**0.95**	
Field Application efficiency	0.80	0.80	0.80	**0.80**	
Overall Project Efficiency	0.72	0.72	0.72	**0.72**	
Peak GIWR (L/s/ha)	0.35	0.35	0.35	**0.35**	
Peak flow (L/s)	4.0	7.1	4.8	**15.9**	Continous (24 hr) flow
in m^3/s	0.004	0.007	0.005	**0.016**	Continous (24 hr) flow
in m^3/hour	14	25	17	**57**	Continous (24 hr) flow
in m^3/day	347	610	419	**1,376**	GIWR in a 24-hr duration
Operational Criteria					

Peak Supply flow (m3/day)	347	616	419	**1,376**	
in m3/hour	43	77	52	**172**	To satisfy (24-hr) demand in 8-hr sunshine period
in m3/s	0.012	0.022	0.015	**0.048**	

The pump and distribution pipe network is sized based on the largest block (i.e. Block B), As such the design peak pumping flow is Q = 77 m3/hour.

2.9 Waste to be Generated and Methods of Disposal

During the construction phase of the proposed irrigation sub-project, various types of solid and liquid waste will be generated. These include construction debris such as cement bags, metal scraps, plastic packaging, broken masonry pieces, and surplus soil from excavation works for laying the pipeline and constructing the elevated masonry tank. Additionally, domestic waste from construction workers, such as food wrappers and organic waste, is expected. All non-hazardous construction waste will be collected and transported to designate and approved waste disposal sites by a licensed waste handler, while recyclable materials such as metal and plastic will be separated at source and sent to appropriate recycling facilities. Sanitation facilities (e.g., mobile toilets) will be provided on-site, and sewage waste will be managed through licensed service providers.

During the operation phase, waste generation will be minimal and primarily consist of routine maintenance waste such as worn-out parts (e.g., pipeline fittings, solar pump components), small quantities of packaging materials for replacement parts, and possible sediment or sludge accumulation at water intake points. These wastes will be managed through proper maintenance protocols, with reusable or recyclable components directed to appropriate recycling channels and non-recyclable waste collected and disposed of in accordance with local waste management regulations. Farmers will be trained on integrated waste and pest management to reduce environmental pollution during project operation.

2.10 Project Cost

The cost estimates of the proposed project was based on the conceptual design of the Kabkara FLID and therefore reflects the information available at the time of estimation. The cost has factored in the main pipes, sub-main pipes, fitting and lateral pipes. Infield system cost has not been factored because it will be paid for by beneficiary farmer. Based on the bills of quantity (BOQ attached) the project implementation is estimated to cost Ksh 55,897,548.

2.11 Project Out-put/Return on Investment

It is envisaged that the development of this project agricultural benefits would be fully attained 3 years after project completion. The supply of inputs and extension supports for the planned irrigation farming will be sufficient and the reliability & sufficiency of irrigation water supply doubtless. Optimum yield is planned to be achieved at the three years.

The years before these are left to smooth any draw backs that might impede the adoption of improved technology associated with the project. Onion, tomatoes, water melon, kales, tissue culture bananas, cucumber, cabbages and black nightshade are the major crops proposed for

the dry season based on the agronomic, and economic factors. These agricultural benefits are based on a net irrigated area of 46 ha. It is anticipated that the project beneficiaries sign an M.O.U with NAVCDP to ensure that no other activity/sale of land for the project will be done before the realization of return on project investment.

3 BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

Baseline environmental and social information serves as a reference point for predicting potential impacts and monitoring changes during and after project implementation.

3.1 Physical Environment

3.1.1 Climate

The proposed project area is in Sirisia Sub-County in Bungoma County in western Kenya, the area experiences a climate characterized by distinct wet and dry seasons, influenced by its proximity to the Mount Elgon highlands. The region benefits from two primary rainfall periods: the long rains occurring between March and April and the short rains from August through October. These precipitation patterns contribute to the area's high agricultural potential, supporting the cultivation of various crops.

Temperature variations in Sirisia are relatively moderate, with annual high temperatures averaging around 27.9°C (82.3°F) and lows averaging 16.7°C (62.1°F). However, the region faces climatic challenges, including moisture stress, unpredictable rainfall patterns, and elevated temperatures, which can adversely affect agricultural productivity. Sirisia sub-county experiences water scarcity issues, primarily stemming from inadequate planning and management of water infrastructure.

In recent years, Sirisia has encountered climate-related challenges such as moisture stress, variations in planting seasons, excessive and unpredictable rainfall, and higher temperatures. These factors pose significant threats to agricultural value chains within the sub-county.

3.1.2 Topography

The altitude of the County ranges from over 4,321m (Mt. Elgon) to 1200m above sea level (CGB 2018). Nearer the project site, the altitude ranges from 1,116 m a.s.l in the south and central parts to about 1,400 m in the central and northern regions. Generally, the Kabkara basin is part of the undulating plateau, consisting of hills from the foot hills of Mt. Elgon and Amukura inselbergs (CGB 2020). The County has only one gazetted forest, the Mt. Elgon Forest reserve which measures 618.2Km^2, and one National Park, which measures 50.683 Km^2. There is no National Park or forest within the vicinity of the proposed project. Apart from Mt. Elgon region, the rest of the County is underlain by granite, which forms the basement system. Mt Elgon forest ecosystems support life systems through the hydrological cycle and plant production through the pollination process. The forested areas also provide soil nutrients through the decomposition of biomass, consequently supporting both soil and terrestrial species. Sirisia is semi – arid owed to the water challenges in most parts of the constituency. The topography of the sub county exhibits vast lands with rich lands and volcanic loam soils that can sustain crop farming owed to bordering the Mt. Elgon highlands. The climate allows short rains from October through to December and long rains come in March to July. Besides livestock keeping there is subsistence horticulture practiced in pockets across Sirisia constituency (Bungoma County CIDP).

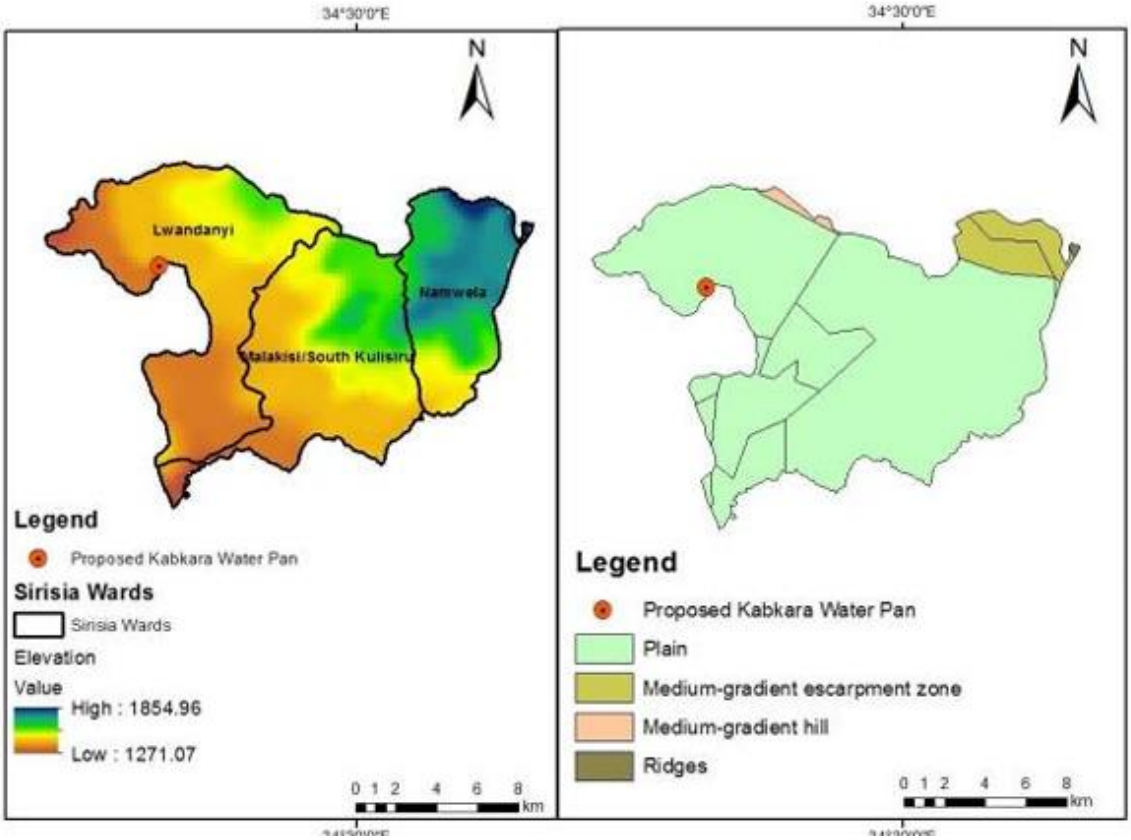

Figure 4: Topography of the project area (Sirisia sub-county)

3.1.3 Geology and Soil

Kabkara area features a geological landscape shaped by its proximity to the Mount Elgon highlands. The region's topography is characterized by expansive plains interspersed with gentle undulations, underlain by volcanic formations that have significantly influenced soil development. The soils in Kabkara are predominantly deep, well-drained, and exhibit a dark red to strong brown hue, indicative of Nitisols and Acrisols. These soil types are rather strongly weathered clays, known for their fertility and suitability for agriculture.

Despite the inherent fertility of these soils, Kabkara faces challenges related to soil erosion. Evidence of gully formation has been observed on farms within Kabkara (B) village unit during the ESIA study (plate 3.1). This erosion not only degrades the soil but also contributes to sedimentation in low-lying areas and along riverbanks, impacting water quality and aquatic ecosystems.

Plate 3.1: An area in Kabkara B village unit prone to erosion

3.1.4 Hydrology and Water Resources

Sirisia Sub-county is traversed by several small rivers and streams that originate from the Mount Elgon catchment area. These watercourses play a crucial role in providing water for domestic use, agriculture, and livestock. Major rivers in the area include river Malakisi and Lwakhakha, the major stream that feeds Kabkara dam is the Kabkara stream which adopts different names as it flows to river Lwakhakha. Major threat to the small streams in the project area is the plantation of eucalyptus trees along the river line, farmers and landowners should therefore be educated about the risks of planting eucalyptus near water bodies and promote alternative tree species like bamboo or indigenous trees.

3.1.4.1 The Kabkara Earth Dam

Kabkara reservoir storage capacity is126650 m^3. It is indicated that the only legally allowed abstraction on Kabkara dam is 144 m^3/day; this will not have a substantial impact on the flow regime according to the analysis in the hydrological report by the Water Resources Authority, Lake Victoria North Catchment Area dated December 2020. Water quality of Kabkara reservoir is contaminated and is not suitable for human consumption without treatment. However, it is suitable for irrigation.

3.1.4.2 Downstream Water Users

The Aterite River which feeds Kabkara dam is also depended by the downstream community. The environmental flow and the spillway of the dam allow water back to the Aterite stream. If water abstraction for irrigation reduces downstream flow, it could lead to water shortages, affecting crop production and household water needs. To ensure equitable water access, it is essential that the irrigation project incorporates sustainable water management strategies, such as regulated water release, stakeholder engagement, and compliance with Water Resources Authority (WRA) guidelines. Proper planning and community consultations are necessary to balance the needs of irrigation farmers' upstream and dependent users' downstream, ensuring fair and sustainable water distribution along River Aterite.

3.1.5 Solar Irradiance

Areas within Sirisia Sub-county experience climate conducive to significant solar energy potential. The region benefits from substantial solar irradiance, making it suitable for solar energy applications.

Kenya, as a whole, receives an average of approximately 6.5 sunshine hours per day throughout the year. This consistent solar exposure translates to an average daily solar insolation of about 5 kWh/m²/day across approximately 70% of the country's land area.

In Sirisia, the solar irradiance levels are influenced by factors such as altitude, atmospheric transmissivity, and topography. The region's elevation and relatively clear skies contribute to favourable conditions for solar energy generation. These factors collectively result in a high potential for photovoltaic (PV) solar energy installations. Given the fact most villages in Kabkara are not connected to grid electricity, solar powered water pump can be a viable option to pump water for irrigation to and at household level.

3.1.6 Air Quality and Noise Levels

According to AccuWeather, the air quality in Sirisia is generally rated as "Fair" to "Excellent," indicating that the levels of common pollutants such as particulate matter (PM), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2) are within acceptable ranges.

Nationally, Kenya's average PM2.5 concentration in 2023 was reported to be 2.1 times higher than the World Health Organization's annual air quality guideline value, with an average Air Quality Index (AQI) of 44, categorized as "Good."

Given Sirisia's rural setting, it is plausible that local air quality is better than the national average, owing to lower industrial activity and vehicular emissions.

The project area is in rural setting where noise sources include agricultural activities, local traffic, and community events. These are generally less intense compared to urban centers.

3.2 Biological Environment

Based on physiographic characterization within the proposed project area, six main vegetation categories were identified; Riverine thickets, bushed grassland, Marshland, Crop land, Settlements with alien species and Plantation. On farms there are agricultural activities going on through planting of maize, beans, sugar cane, sukuma wiki and tobacco.

Among the key flora observed during the study include: Mango tree (*Mangifera indica*), Creeping fig (*Ficus pumila)*, Peacock flower (*Caesalpinia pulcherrima*), White sapote (*Casimiroa edulis*), Empress tree (*paulownia tomentosa*), White leadtree (*Leucaena leucocephala),* Common lantana *(Lantana camara),* Guava (*Psidium guajava*), African tulip tree (*Spathodea campanulata*) and *Dichrostachys cinerea*. The area surrounding Kabkara dam is rich in flora species indigenous and native thus the need to ensure conservation measures are put in place.

During the study, there was evidence of local traditional medicine men/women sourcing their medicines from the plants around Kabkara dam, this explains the significance of the biodiversity in socio-economic and cultural well-being of the local community. The area has small mammals e.g., African hare, squirrel, and rodents.

3.3 Socio-Economic & Cultural Environment

3.3.1 Demographic Profile

Sirisia sub county has a population of 119,857 (58,225 males and 61,649 females), with 2.6 percent (of the population aged 5 years and above) been persons living with various disabilities (KNBS 2019D).

Table 9: the population of the project area which is in Sirisia Sub-County

		Sex			Households	Land Area	Density
Administrative Area	Total	Male	Female	Total	Conventional	Sq. Km	Persons per Sq. Km
Bungoma West Sub County	119,875	58,225	61,649	25,172	25,166	211	568
Namubila Location	17,046	8,306	8,740	3,441	3,441	34	502
Wamono Sub Location	11,089	5,427	5,662	2,231	2,231	22.8	487

The project site sub location has a population of 11,089 as per table 9 above, with an almost equal gender ratio.

3.3.1 Agriculture Situation

Most of the agricultural activities in Kabkara are rain-fed, meaning that farmers only plant during the rainy seasons. Dependency on rain-fed agriculture exposes families to instances of food insecurity because of unpredictable weather patterns. The agro-economy of the study area involves crop production and livestock rearing; with maize as the major crop grown (Table 10). Other important crops are beans, groundnuts, hot pepper and tomatoes. Main livestock rearing activities comprise of dairy cow, poultry, pig, sheep and goat, bee and rabbit rearing.

Table 10: Major crops grown in the project area (Sirisia Sub-County)

Crop	Category	Purpose	Notes
Maize	Staple Crop	Food Security, Market	Widely cultivated, main staple food
Beans	Staple Crop	Food Security, Market	Often intercropped with maize
Sugarcane	Cash Crop	Commercial Use	Grown for sugar processing
Tobacco	Cash Crop	Commercial Use	Historically important, declining production
Cotton	Cash Crop	Commercial Use	Previously significant, efforts to revive farming
Tomatoes	Horticultural Crop	Local Market, Consumption	Popular vegetable, high demand
Cabbages	Horticultural Crop	Local Market, Consumption	Grown in small-scale farms
Kales (Sukuma Wiki)	Horticultural Crop	Local Market, Consumption	Common vegetable, grown widely

Crop	Category	Purpose	Notes
Potatoes (Irish & Sweet)	Root Crop	Consumption, Market	Grown in suitable areas
Peas	Legume	Food Security, Market	Contributes to soil fertility
Groundnuts	Legume	Market, Consumption	Grown in scattered farms

Population pressure is a major constraint, contributing to decline in agricultural productivity due to fragmentation of land into small units. Although the national land use policy provides a framework to address land fragmentation and instances of unutilized arable land, there is insufficient control over land fragmentation and enforcement of agrarian zone policies in Bungoma County.

Most farmers are over-reliant on rainfall, which can be unreliable and erratic. Rainfall and temperature fluctuations have led to the emergence and increased incidence of pests and diseases, such as fall armyworms and locusts, which in turn contribute to low crop yields and post-harvest losses.

Most farming technologies are expensive and therefore unaffordable to most farmers. Low levels of modern technology application and innovation contribute to low productivity (Plate 3.2) depicts some farming practices employed at household level.

Plate 3.2: A farm in the project area prepared awaiting rainy season, a seed bed for cabbage prepared with water sourced from borehole 700 metres away

3.3.2 Land Tenure and Average Size

Land tenure in Sirisia Sub-County, as part of Bungoma County, is characterized by a mix of private ownership and ancestral holdings. Approximately 34.1% of land parcels in the county possess title deeds, while the remaining 65.9% are ancestral lands without official documentation.

In Sirisia Sub-County, the majority of farmers are small-scale operators, with land holdings typically ranging from 1 to 5 acres. This limited land size often leads to intensive farming practices to maximize productivity.

Land fragmentation is a notable concern in the region, resulting in decreasing plot sizes over time. This trend poses challenges for sustainable agriculture and economic development, necessitating the promotion of sustainable land-use practices and measures to control further fragmentation.

Development of Kabkara FLID scheme will not require changes in land tenure and it is observed that the proposed development is compatible with the prevailing local socioeconomic conditions.

3.3.3 Market Access

Market access in Sirisia Sub-County, Bungoma County, is facilitated through several local markets that serve as hubs for trade and commerce. These markets provide platforms for farmers and traders to sell agricultural produce and other goods, contributing to the local economy.

Key markets include the Namwela, Malakisi, Chwele and Sirisia market, despite the presence of these markets, Sirisia Sub-County faces several challenges that impact market access. They include: poor road network and overreliance on subsistence farming and a limited entrepreneurial spirit among the residents, which affects the diversification and expansion of market activities.

To enhance market access and stimulate economic growth, strategic plans have been proposed by the county government of Bungoma, focusing on improving road networks to facilitate better transportation of goods and services; encouraging the adoption of agribusiness practices to increase productivity and market participation as well as modernizing markets and creating conducive environments for trade to thrive.

3.3.4 Employment

Given that only 14 percent of the residents in the county work for pay, and 50.3 percent of the residents are employed in family agricultural holdings (CGB 2018), the proposed project is critical in enhancing employment status for residents in the catchment area.

3.3.5 Culture and Religion

Majority of the Wamono sub location residents are Bukusus, Sabaot and the Tesos and there is no presence of indigenous people in the area. With the advent of religion majority of the residents of the area practice Christianity as is evident in the area with churches. Some practice Islam as there is a mosque in Katomei.

3.3.6 Poverty, Gender and Inequality

In Bungoma County, the poverty incidence stands at 47.3%. The poverty gap, which measures the intensity of poverty, is 11.7%, and the poverty severity index is 3.9%. The county's Gini coefficient, indicating income inequality, is 0.43, suggesting a moderate level of inequality.

The gender inequality index for the county is 0.66 against a national average of 0.55. Gender disparities are evident in various aspects of life in Sirisia. Women often face challenges such as limited access to property ownership, economic opportunities, and education. Cultural practices and economic constraints contribute to lower enrolment, retention, and completion rates for girls in educational institutions. Early marriages and pregnancies further exacerbate this issue, leading to higher dropout rates among girls.

Addressing these challenges requires comprehensive strategies, including implementing policies to promote gender equality in property ownership and economic participation, providing educational support to enhance girl child education, and facilitating access to affordable credit facilities for marginalized groups to promote entrepreneurship.

3.3.7 Tourism

Tourism in the project area is still underdeveloped despite being closer to the Mt. Elgon National Park and cultural events such as the traditional Bukusu circumcision ceremony.
However, the Bungoma County government has recognized the importance of tourism and is actively working on developing tourism circuits, marketing local attractions, and conserving natural resources. These initiatives aim to enhance the tourism infrastructure and promote Sirisia as a viable destination for travellers seeking off-the-beaten-path experiences. The Kabkara dam has equally a potential to promote local and international tourism through water related activities such as boat riding and related activities.

3.3.8 Major Industries

Historically, Sirisia was home to thriving industries cantered around cash crops such as cotton, tobacco, coffee, and sunflower. The Malakisi area, in particular, was notable for its vibrant cotton industry, hosting a ginnery and related firms producing bar soaps, animal feeds, oil, and cotton wool. However, these industries have faced significant decline due to factors like mismanagement, leading to the collapse of the once-bustling Malakisi ginnery.

The collapse of key industries has left agriculture as the predominant economic activity. Efforts to revitalize these sectors have been hindered by challenges such as inadequate infrastructure, and poor returns on farmers' investments. Addressing these issues is crucial for fostering economic growth and diversifying income sources for the residents of Sirisia.

3.3.9 Road Infrastructure

Major road that was recently upgraded to bitumen standard in Sirisia sub-county is the Chwele-Lwakhakha road. Other essential roads, including the Mayanja–Bisunu–Sirisia and the Sirisia–Malakisi roads, have also been described as being in unpalatable states. This inadequate road network has hindered meaningful development, limiting access to markets, healthcare, and educational facilities, and impeding economic activities within the region.

The reliance on motorbikes and bicycles as primary modes of transport underscores the need for continued investment in infrastructure to promote sustainable development and improve the quality of life for the local population.

3.3.10 Financial Institutions and Cooperative Societies

Major banking facilities operating in Sirisia sub-county include the Kenya Commercial Bank (KCB), Co-operative Bank, Ushirika Cooperative and Kenya Women Finance Trust. Major cooperative societies in Sirisia sub-county are coffee based and include:

a) Menu Farmers Co-operative Society Ltd**:** Situated in Menu village near Namwela market, this cooperative was officially registered in 1958 and boasts a membership of approximately 3,000 active smallholder farmers. The cooperative manages a total area of 602,808 hectares under coffee cultivation, covering regions such as Masaba, Kaptanai, Changeywo, Namwela, Malinda, Menu, and Namutokholo. In the 2022/2023 season, the cooperative produced 1,171,490 kilograms of coffee cherries.
b) Kikai Rural Sacco**:** This cooperative has been active in encouraging residents to invest in cooperative societies to enhance their economic well-being. During a cherry payment event in Namwela, a director from Kikai Rural Sacco emphasized the importance of investment, especially in light of economic challenges exacerbated by the COVID-19 pandemic.

These cooperatives aim to improve the livelihoods of rural households by providing access to markets, financial services, and collective bargaining power. However, challenges such as administrative inefficiencies and sustainability issues have been noted, necessitating ongoing efforts to strengthen cooperative governance and operations.

3.3.11 Education Institutions

Sirisia sub-county is home to 151 primary and 39 secondary schools, both public and private, serving as foundational institutions for early education. The nearest schools to the proposed irrigation scheme sites are Katomei primary and secondary, Kabkara Secondary and Wamono primary schools. For post-secondary education, the Sirisia Technical and Vocational College stands out as a significant institution. Located along the Chwele-Lwakhakha Road near Sirisia Sub-County Hospital, it offers various technical and vocational courses aimed at equipping students with practical skills for the job market.

Despite the presence of these educational institutions, challenges persist, particularly in terms of infrastructure. Many public schools in Sirisia lack essential physical facilities, which can hinder the delivery of quality education. The government, through initiatives like the National Government Constituencies Development Fund (NG-CDF), has been working to improve these facilities to ensure a conducive learning environment.

3.3.12 Energy Access

Despite the national grid going through the three main roads of Chwele – Sirisia – Lwakhaka, Sirisia – Malakisi – Changare – Korsiandeti and the Mayanja – Bisunu – Sirisia, electricity use in the sub county is low at 12% (KNBS 2019B). The most common sources for lighting energy are solar (38%), paraffin lanterns/tin lamps (37%), torch/ Spotlight-Solar Charged (9%). Most of the population uses firewood (88%) and charcoal (7%) for cooking energy.

3.3.13 Solid and Human Waste Disposal

92% of the Sirisia sub county population use open or covered latrines to dispose human waste. These numbers are way higher than the overall national, rural and urban average, probably due to the area been predominantly rural and lacking any sewer connections. However, open defecation is still practiced by at least 2% of the population (KNBS 2019B) thus posing risks of possible water contamination. The immediate water catchment area of the Kabkara dam has households with pit latrines. On the other hand, solid waste mechanisms are largely split between composting (58%), dumping in the compound (15%) and burning in the open (14) (ibid). Of the three, only composting is environmentally sustainable.

3.3.14 Access to Drinking Water

Sirisia/Bungoma West sub county ranks low in the number of households using piped water at 1% of the total households, compared to the national (20%) or even Bungoma County itself (8%). Majority of the households rely on stream/river (12%), protected springs (19%), protected well (16%), Borehole (24%), and unprotected well (10%) (KNBS 2019B).

Despite the availability of water from River Malakisi and Ndakalu, many households and public amenities still suffer water shortage owed to limited utilization of the resources available. Being a region, whose main economic activities are agriculture, horticulture and livestock farming, water is a priority area for investment.

The project area is not served with piped water except boreholes in the neighboring schools. (Katomei secondary and primary schools).

3.3.15 Health Facilities

The nearest health facilities to the site are Lwandanyi dispensary (3 kilometres), Malakisi Health Centre (4.8km) and Sirisia Sub-County hospital (16 Kilometres away). Other health facilities in the sub-county include: Bukokholo dispensary, Chwele Friends dispensary, Kaptanai dispensary, Kolani dispensary, Lwakhakha dispensary, Machakha dispensary, Tamlega dispensary and Tulienge dispensary

Sirisia Sub-County faces several health challenges. The life expectancy is approximately 56 years, with an infant mortality rate of 43.1 per 1,000 live births and an under-five mortality rate of 83 per 1,000. The bed occupancy rate stands at 115%, and the nurse-to-patient ratio is 1:900, which is below the World Health Organization's recommended ratio of 1:400.

3.3.16 Security, Law and Order

The project area has offices of the Chief and Assistant chief and two Police posts (Lwandanyi and Tulienge police posts) thus there is adequate security installation. Sirisia sub-county has a police division with the directorate of criminal investigation department. The area is served by the Bungoma prisons.

4 RELEVANT POLICY, LEGISLATIVE, REGULATORY AND INSTITUTIONAL FRAMEWORK

This section reviews relevant county, national and World Bank policies and regulations governing environmental and social aspects involved in the irrigation and agriculture sector. The section also reviewed relevant institutions involved in the monitoring, regulation and enforcement of the environment and social safeguards for the proposed medium scale irrigation project.

4.1 Relevant County and National Policies and Economic Blue-prints

Relevant Bungoma County as well as national government policies are presented in Table 11.

Table 11: Relevant national and county policies and economic blue-prints

No	Policy	Description	Relevance to the project/compliance
1.	National Irrigation Policy (2017)	This policy emphasizes the development and management of irrigation infrastructure to increase agricultural productivity. It advocates for the establishment and strengthening of Irrigation Water Users' Associations (IWUAs) to empower farmers in irrigation management. The policy also proposes the creation of County Irrigation Development Units (CIDUs) responsible for irrigation activities at the county level.	*The proposed project is spearheaded by the Kabkara IWUA. The proponent will work with CIDU to empower farmers in irrigation management.*
2.	Agricultural Sector Transformation and Growth Strategy (ASTGS) 2019–2029	The ASTGS outlines a ten-year plan to transform Kenya's agriculture by promoting market-driven approaches and sustainable practices. It highlights the importance of irrigation in achieving food security and encourages investments in modern irrigation technologies.	*The proposed project is an irrigation project meant to support households increase food production for consumption as well as for market. The proponent will work with agriculture based SACCOs to support marketing of farm produce from the irrigation scheme.*
3.	National Environment policy 2013	The Policy sets out important provisions relating to the management of ecosystems and the sustainable use of natural resources. The policy seeks to develop an integrated approach	*This ESIA study has developed an ESMP to mitigate the impacts that may result during all phases of the proposed project. The preparation of this ESIA report*

		to environmental management, strengthening the legal and institutional framework for effective coordination, promoting environmental management tools. The Policy recognizes ESIA as a tool for environmental management.	*is in accordance with the requirements of this Policy which the proponent has abided by.*
4.	National Land Use Policy, Sessional Paper No. of 2017	This Policy recognizes the central place of land in the production chain and addresses issues that relate directly to the use of land, its resources, and the perceptions held towards land. It incorporates measures and principles to guide all activities, whether proposed or ongoing, that may have a direct or indirect impact on the use of land and its resources. This Policy upholds the values of economic productivity, environmental sustainability, and the conservation of culture; and seeks to facilitate their protection and optimal use. The policy provides actions for addressing environmental problems such as the degradation of natural resources, soil erosion, and pollution. For the management of the urban environment, it provides guidelines to prohibit the discharge of untreated waste into water sources by industries and local authorities; it also recommends appropriate waste management systems and procedures, including waste and wastewater treatment, reuse, and recycling.	*The proponent shall take cognizance of the land use and its resources within the project area to ensure the project is environmentally and socio-economically sustainable.*
5.	The Kenya national climate change response strategy 2010	The purpose of this strategy is to put in place robust measures needed to address most of the challenges posed by climate variability and change through thorough impact assessments and monitoring of various projects. According to Climate Change Projections, the country is likely to experience hotter drier sunny seasons, warmer wetter rainy seasons, rise in sea levels and an increase in extreme weather events.	*To proposed irrigation project is a viable strategy to mitigate against climate variability particularly the long dry period.*

6.	Bungoma County CIDP 2023-2027	The Bungoma County Integrated Development Plan (CIDP) 2023–2027 outlines several strategies to promote irrigation and enhance agricultural productivity, they include: (a) Developing and enforcing policies and regulations that support irrigation initiatives. (b) Encouraging the adoption of small-scale irrigation methods at the household level to boost crop production. (c) Investing in the construction and maintenance of irrigation systems to ensure efficient water delivery to farms.	*The proposed project is one of the irrigation initiates supported by the Bungoma County Government..*
7.	Kenya Vision 2030	This is Kenya's economic development blueprint covering the period 2008 – 2030 which aims at making Kenya a newly industrializing middle-income country providing high quality life for all its citizens by the year 2030. The vision is based on three "pillars" i.e., Economic, Social, and Political pillars. The Economic Pillar aims at providing prosperity of all Kenyans through an economic development programme aimed at achieving an average GDP growth rate of 10 % per annum for the next 25 years. The Social Pillar seeks to build "a just and cohesive society with social equity in a clean and secure environment." The Political Pillar aims at realising a democratic political system founded on issue-based politics that respects the rule of law, and protects the rights and freedoms of every individual in the Kenyan society.	The planned project will contribute to the nation's economic growth by promoting households' income.

4.2 Legislative Frameworks

There are national environmental management statutes and regulations, and it is the legal and social responsibility of the proponent and his subjects to ensure that the proposed irrigation project is implemented in a way that does not jeopardise the status of natural resources, environmental resources, the socio-cultural context, or the project's economic potential for the neighbourhood.

The numerous national legislation that are pertinent to the proposed project's environmental management are listed in detail in Table 12. The Environmental Management and Coordination Act (EMCA 1999), as revised in 2015, will supersede any contradicting regulation at all times.

Table 12: The national legislations pertinent to the proposed project's environmental and socio-economic management

No	Legislation	Description	Applicability/compliance in the proposed project
1.	The Constitution of Kenya 2010	The Constitution of Kenya is the supreme law of the Republic and binds all persons and all state organ at all levels of government. It provides a broad framework regulating all existence and development aspects of interest to the people of Kenya, and along which all national and sectoral legislative documents are drawn. Article 42 of the chapter 4, "The Bill of Rights", confers to every person the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generation through legislative measures, particularly those contemplated in Article 69, and to have obligations relating to the environment fulfilled under Article 70.	*The proponent of the project will ensure that every activity from construction to operation of the irrigation scheme is in tandem with the constitutional provision of adherence to the right of every individual to a clean and healthy environment, protect and conserve the environment and ensure sustainable developments. This is be achieved by developing and adhering to the spelt out environmental management plan to curb probable adverse effects of the proposed project.*
2.	Environmental Management and Coordination	The Act introduces two important aspects of environmental management, which are directly related to the proposed project: Environmental Impact Assessment (EIA) and Environmental Audit (EA). Section 58 (1) has underscored that any person being a Proponent of a project, shall, before financing, commencing or	*The proponent has complied with the EMCA Act by undertaking an Environmental Impact Assessment of the proposed project.*

	Act, 1999 (Revised 2015)	proceeding, submit an EIA report to the National Environmental Management Authority (NEMA) of Kenya. Section 68 (1) gives NEMA the mandate for carrying out all environmental audits of all activities that are likely to have significant impacts on the environment. It authorizes environmental inspectors, as appointed by NEMA to enter any development and determine how far the activities carried out conform to statements in the EIA study.	
3.	Irrigation Act (2019)	Building upon the 2017 policy, the Irrigation Act provides a legal framework for irrigation development and management. It underscores a collaborative approach involving national and county governments, private sector participants, and local communities to ensure sustainable irrigation practices. The Act establishes the National Irrigation Authority. The Act emphasizes sustainable irrigation practices and compliance with environmental standards, ensuring that irrigation projects align with environmental conservation principles.	*The proposed project is a partnership between the national and county governments and local community in Kabkara, to ensure sustainable irrigation project, this ESIA report has proposed mitigation measures for the anticipated adverse impacts likely to arise during project implementation.*
4.	Public Health Act (cap. 242) (Revised,2017)	**Section 118** addresses nuisances, including stagnant water and conditions that promote the breeding of mosquitoes and other disease vectors, which are critical concerns in irrigation projects. **Section 129** mandates the protection of public water sources from pollution, ensuring that irrigation activities do not contaminate drinking water supplies. Additionally, **Section 136** empowers public health officials to inspect and regulate water use to prevent health hazards, such as waterborne diseases resulting from poor irrigation drainage. The Act also emphasizes proper waste management, particularly in sections that address the disposal of agricultural	*The proponent will comply with these provisions to prevent malaria, cholera, and other waterborne diseases.*

		chemicals and effluents, ensuring that pesticides and fertilizers used in irrigation do not pose health risks to surrounding communities.	
5.	The land Act 2012	**Section 8** of the Act mandates that public land required for development projects, such as irrigation schemes, be allocated and planned in a manner that ensures sustainable use. **Section 111** outlines the procedures for **compulsory acquisition of land** by the government for public purposes, ensuring that affected landowners receive fair compensation before an irrigation project is implemented. Additionally, **Section 19** requires that land use planning incorporate environmental sustainability, meaning that irrigation projects must adhere to proper soil and water conservation practices to prevent land degradation. **Section 28** recognizes **customary land rights**, ensuring that communities using land for traditional agricultural activities are considered in irrigation planning. **Section 152** addresses eviction and resettlement procedures, requiring that any displacement of land users for irrigation development follow due process and provide resettlement or compensation. The Act also includes provisions for **dispute resolution mechanisms** under **Section 87**, which help address conflicts over water access, land boundaries, and community interests in irrigation schemes.	*The proposed project factored in the customary land rights during planning and identification of project beneficiaries.*
6.	County Government Act No. 17 of 2012 (amended 2016)	Part II of the Act elaborate on the functions and powers of the county government. The Act gives county the responsibility of planning and co-coordinating all developments within their areas of jurisdiction. Under the Fourth Schedule of the Constitution of Kenya (2010), counties are responsible for agriculture, irrigation, and water services (except for national water resources).	*The county government of Bungoma through the department of agriculture has provided and will continue to provide extension services and training to the IWUA members for the sustainability of the proposed irrigation project.*

		County governments are mandated to facilitate the implementation of national irrigation projects within their jurisdictions, ensuring they align with local needs.	
7.	The Water Act, 2016	The Act establishes the Water Resources Authority (WRA), which is responsible for regulating the use, conservation, and protection of water resources. Section 36 of the Act mandates that any person or entity intending to abstract water for commercial purposes (including irrigation) must apply for a water permit. The permit ensures that the project does not overexploit water resources, affecting downstream users and ecosystems. The Act recognizes water user associations (WUAs), which allow farmers and local communities to participate in decision-making on water use and management.	*Before abstraction, the project proponent will apply for the water abstraction permit from the WRA as per the Act.*
8.	Physical and land use planning (no. 13 of 2019)	The Physical and Land Use Planning Act, 2019 (PLUPA) of Kenya provides the legal framework for regulating land use, development, and planning at national and county levels. The Act stipulates that once in every ten years, a county government shall prepare a county physical and land use development plan for that county. Each county physical and land use development plan shall be in conformity with the National Physical and Land Use Development Plan and any relevant Inter-County Physical and Land Use Development Plan. Section 57 of PLUPA requires developers of irrigation projects to obtain development permission from county governments. If an irrigation project involves change of land use, an application must be submitted to the County Executive Committee Member in charge of planning.	*The proposed irrigation project is of medium scale and does not entail change of land use, the project area is an agricultural area thus compatible with the proposed irrigation land use.*

9.	Occupational safety and health Act (no. 15 of 2007)	This Act provides for the safety, health and welfare of workers and all persons lawfully present at workplaces where any person is at work, whether temporarily or permanently. Part II of the Act on General Duties states the following: • **Section 6 (1)** that, "Every occupier shall ensure the safety, health and welfare at work of all persons working in his workplace". • **Section 6 (2) (b)** "Arrangements for ensuring safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances". • **Section 6 (2) (c)** "The provision of such information, instruction, training and supervision as is necessary to ensure the safety and health at work of every person employed". **Section 13**: Workers must adhere to safety guidelines and report unsafe conditions. **Section 16**: Employers must provide clean drinking water, toilets, and first aid stations. Section 18: Proper shoring and barricading of trenches deeper than 1.5 meters. **Section 55**: All construction machines must be well-maintained and used by trained personnel. Non-compliance can result in fines, project shutdowns, or legal action.	*The contractor(s) and the Proponent will ensure the safety and health of those employed during construction of irrigation infrastructure. The ESMP provides measures to be implemented by the Proponent and the contractor(s) to ensure health and safety at all project phases.*
10.	Work injury benefits (no. 13 of 2007)	This Act provides for compensation for employees on work related injuries and diseases contacted in the course of employment and for connected purposes. The Act includes compulsory insurance for	*The contractor(s) will provide appropriate PPE to the project workers to prevent injuries. The contractor will provide group insurance cover to all*

		employees. The Act defines an employee as any worker on contract of service with employer.	*the workers engaged during the construction phase of the irrigation infrastructure.*
11.	Employment Act No. 11 of 2007 (Amended 2022)	**Section 5:** Employers cannot discriminate based on gender, age, disability, or race. Workplace harassment and abuse are prohibited. **Section 9**: Every contract lasting more than three months must be in writing and workers must receive clear employment terms, including wages, working hours, benefits, and condition. **Section 17**: Employers must pay wages on time, at least once a month. **Section 27**: Normal working hours should not exceed 8 hours a day or 48 hours per week. Employees working beyond 52 hours per week (or 60 hours for farm workers) are entitled to overtime payment. **Section 35:** Employers must provide notice before termination or pay compensation. **Section 40:** Redundancies (e.g., after construction is completed) require prior notice, severance pay, and consultation with affected employees. **Section 53:** Employment of children under 13 is strictly prohibited. Children aged 13–16 can only do light work that doesn't interfere with education. Children under 18 cannot work in hazardous conditions.	*Throughout the project phases, the contractor and the proponent should comply with the provisions of the employment Act.*
12.	Children Act (No. 29 of 2022)	The Act provides a comprehensive legal framework for the protection and welfare of children**.** The Act upholds children's right to health, education, and a safe environment**.** Section 8 guarantees a child's right to clean and safe water, making it essential for irrigation projects to ensure equitable water distribution without depriving communities, schools, and health facilities downstream of essential	*The contractor and the project proponent should abide by the provisions of the act during project construction as well as operational phase.*

		water resources. Additionally, Section 15 protects children from hazardous labour, meaning that irrigation projects must not engage minors in physically demanding tasks such as digging canals, carrying water, or operating heavy equipment. The Act also prohibits exploitation and exposure to environmental hazards, requiring that irrigation-related activities, such as pesticide use and water management, prioritize children's health by preventing contamination of water sources.	
13.	HIV and AIDS prevention and control (no. 14 of 2006)	**Section 7** of the Act mandates the government to ensure the provision of basic information and instruction on HIV and AIDS prevention and control to employees in both public and private sectors. This includes promoting awareness about causes, transmission modes, consequences, and prevention methods. Unless the employer can demonstrate to a tribunal that the employment needs a specific state of health or medical or clinical condition, **Section 31** forbids any form of discrimination against qualified personnel based on real, perceived, or suspected HIV status.	*In the context of the proposed irrigation projects, the contractor should work with relevant government departments to implement educational programs to inform workers about HIV/AIDS, fostering a safe and informed working environment.*
14.	Sustainable waste management (no. 31 of 2022)	Sub-section 12 (1) states that all public and private sector entities shall segregate non-hazardous waste into organic and non-organic fractions. Sub-section 12 (2) requires the segregated waste to be placed in properly labelled and colour coded receptacles, bins, containers, and bags.	*During construction phase, the contractor will provide labelled waste collection bins at each collection point to separate wastes into appropriate sorts.*
15.	The Energy Act, 2019	The Energy Act of 2019 was passed in response to calls to, among other things, control midstream and downstream petroleum and coal industries, promote renewable energy, and encourage the discovery, recovery, and commercial use of geothermal energy.	*Solar powered pump will be used to pump water as opposed to fossil fuel.*

16.	Way leave Act (Cap 292) Revised 2010	The Act governs the acquisition and use of land for infrastructure projects, such as power lines, water pipelines, and communication cables. It provides a legal framework for the government, utility companies, and other entities to access private or public land for the installation, maintenance, and operation of such infrastructure. **Section 3** of the Act allows the government, county authorities, or any authorized entity to enter private or public land to survey and mark out land required for way leave purposes. **Section 4** of the Act requires that the affected landowners and occupiers be given prior written notice before a way leave is established. **Section 6** of the Act provides for compensation if a landowner suffers damage due to the establishment of a way leave. **Section 7** of the Act states that once a way leave is granted, landowners cannot obstruct or interfere with the infrastructure. **Section 8** of the Act states that if the way leave is no longer needed, it can be revoked. **Section 10** states that If there is a disagreement between landowners and the government or project implementers regarding way leave rights, compensation, or environmental impact, the dispute can be resolved through the courts or alternative dispute resolution (ADR).	*The proposed irrigation system has been designed to minimize way leave, water piping system has been designed to pass along the roads and to some extend along the farms for the project beneficiaries.* *The construction of irrigation infrastructure will not lead to loss of land value, crop destruction, or relocation.* *During construction works for the irrigation pipeline infrastructure, the contractor should ensure compensation in the event that any land owner suffers damage as a result of way leave.*
17.	National Construction Authority (2011)	The National Construction Authority Act, Number 41 of 2011, modernizes, reforms, and controls the Kenyan construction sector. Each and every contractor needs to register with the Authority. Any building activity that is done without first registering with the Authority is illegal. The Act includes provisions pertaining to the safety and quality requirements for any construction activities.	*During construction, the contractor will engage qualified and registered contractors and engineers.*
18.	Climate Change Act, 2016	The Act provide for a regulatory framework for enhanced response to climate change; to provide for mechanism and measures to achieve	*The proposed project is meant to enhance climate change resilience by promoting agriculture through irrigation as opposed to rain-*

		low carbon climate development, enhance climate change resilience and for sustainable development of Kenya.	*fed which is irregular as a result of climate change.*
19.	Environment and Land Court Act, 2011	The Environment and Land Court Act (No. 19 of 2011) establishes the Environment and Land Court (ELC) in Kenya, a specialized court that handles disputes related to land use, environment, and natural resources. The Act provides the court with jurisdiction to hear and determine cases involving land ownership, leases, compulsory land acquisition, environmental conservation, and matters arising from violations of environmental laws. **(Section 4 & 13)** – The ELC has exclusive jurisdiction to hear cases on land disputes, environmental degradation, and compensation claims related to irrigation projects. It can also issue orders such as injunctions, compensation, and environmental restoration directives.	*The ELC will handle cases that may escalate from the project implementation.*
20.	Sexual Offences Act 2006	The **Sexual Offences Act (No. 3 of 2006)** of Kenya is a law designed to prevent and punish sexual offenses, protect victims, and ensure justice for survivors of sexual violence. The Act defines various **sexual offenses**, including **rape (Section 3), defilement (Section 8), sexual harassment (Section 23), indecent acts (Section 11), and sexual exploitation (Section 15)**, among others. It provides strict penalties, including life imprisonment for defilement involving minors under 11 years and up to 20 years for rape. The Act also criminalizes offenses such as **sexual assault (Section 5)**, which includes forced sexual acts without consent, and **gang rape (Section 10)**, which applies when multiple perpetrators are involved. It addresses **child pornography (Section 14)** and **trafficking for sexual exploitation (Section 13)**, ensuring	*As part of the Contractor-ESMP (C-ESMP), an accountability and response framework will be developed. The SEA action plan will adhere to national SEA policies and regulations as well as the World Bank's Good Practice Note for Addressing Gender-based Violence in Investment Project Financing involving Major Civil Works (September 2018). In addition to incorporating SEA into employment contracts, the contractor will engage with the County to raise awareness among employees and other site personnel. Any violation will be reported and dealt with legally.*

		protection against exploitation through digital or physical means. The law emphasizes informed consent, recognizing that coerced or manipulated consent is invalid. The Act also applies to workplaces and institutions, prohibiting sexual harassment and abuse of power for sexual favours. It establishes mandatory reporting obligations, especially for cases involving minors, ensuring that authorities intervene promptly. By enforcing strict penalties and providing legal protection, the Sexual Offences Act aims to reduce sexual violence, promote justice, and safeguard the dignity of all individuals in Kenya.	
21.	The Standards Act Cap 496	In order to protect public health and safety, this Act encourages the standardisation of commodity specifications and establishes standards for both commodities and codes of practice. It creates the Kenya Bureau of Standards (KEBS), whose duties include: promoting industry and commercial standardisation; and arranging for or providing facilities for the testing and calibration of scientific apparatus, gauges, and precision instruments in order to assess their accuracy by comparing them to standards that the Minister has approved based on the Council's recommendation and to issue certificates in relation to those standards.	*The contractor, working under the county engineer's direction, will guarantee that all materials used on the job site meet the strictest requirements.*
22.	The National Museums and Heritage Act 2006	An Act of Parliament to repeal the National Museums Act and the Antiquities and Monuments Act (Cap. 215), to establish, control, manage, and develop national museums, and to identify, protect, conserve, and transmit Kenya's cultural and natural heritage, while also consolidating the laws pertaining to national museums and heritage.	*In the event that the project comes across such materials, this act and World Bank ESS8 on Physical Cultural Resources will be cited; chance find procedures are included in this report. The National Museums of Kenya (NMK) are primarily responsible for enforcing the Act's requirements.*

4.3 Relevant Regulations as per EMCA (1999) Revised 2015

The Acts has several regulations that aid in its implementation; the relevant regulations to the proposed project are highlighted in the Table 13 below.

Table 13: Relevant regulations as per the EMCA (1999) reviewed 2015

No	Regulation	Description	Relevance to the project
1	The Environmental (Impact Assessment and Audit) Regulations, 2003 and Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2016, 2019	These Regulations stipulate the importance of conducting an ESIA as well as the procedure necessary. The ESIA study will be conducted before the implementation of the proposed development; and the reports will be subject to approval by NEMA, which will provide a license after its review. The regulations also call for Environmental auditing and monitoring that will be carried out during the construction or operation of the irrigation infrastructure.	*The proponent has undertaken an environmental impact assessment for the proposed project before commencement which has been accomplished by this ESIA report. The report meets the requirement of CPR as stipulated in the 2019 Amendment vide legal notice 32.*
2	The Environmental Management and Coordination (Water Quality) Regulations, 2006 Legal Notice No. 120	These Regulations were published in the Kenya Gazette Supplement No. 68, Legislative Supplement No. 36, and Legal Notice No. 120 on 29th September 2006. The Regulations provide for sustainable management of water resources including prevention of water pollution and protection of water sources such as lakes, rivers, streams, springs, wells, and other water sources. It is an offense under Regulation No. 4 (2), for any person to throw or cause to flow into or near a water resource any liquid, solid or gaseous substance or deposit any such substance in or near it, as to cause pollution. Regulation No. 11 further makes it an offense for any person to discharge or apply any poison, toxic, noxious, or obstructing matter, radioactive waste, or other pollutants or permit the dumping or discharge of such matter into the aquatic environment unless such discharge, poison, toxic, noxious or obstructing matter, radioactive waste or pollutant complies with the standards for effluent discharge into the environment.	*The proponent shall ensure that agricultural activities cause minimal pollution of water bodies through reducing or proper use of agrochemicals.*

3	The Environmental Management and Coordination (Waste Management) Regulations, 2006 Legal Notice No. 121	These Regulations provide details on the management (handling, storage, transportation, treatment, and disposal) of various waste streams including domestic waste; Industrial; hazardous, and toxic waste; pesticides and toxic substances; biomedical wastes; and radioactive waste. Regulation No. 4 (1) makes it an offense for any person to dispose of any waste on a public highway, street, road, recreational area, or in any public place except in a designated waste receptacle. Regulation 5 requires waste generators to segregate waste by separating hazardous waste from non-hazardous waste for appropriate disposal. Regulation 6 (1) provides categories of cleaner production methods that should be adopted by waste generators in order to minimize the amount of waste generated	*The proposed project, during the construction and operation phases, will generate wastes that will need to be disposed of as per the guidelines in the regulations. The proponent will have to meet the requirements of the regulations, by providing solid waste sorting and transportation using a licensed transporter who will dispose of the waste to the designated receptacle.*
4	The EMCA (Noise and Excessive Vibration Pollution Control) Regulations, 2009	The regulations provide definitions for various terms such as noise, excessive vibrations, noise pollution, and vibration pollution. Regulation 14 (3) provides that the contractor shall ensure that the vibration levels do not exceed 0.5 centimeters per second beyond any source property boundary or 30 meters from any moving source. The implementation of these regulations involves coordination between NEMA, local authorities, law enforcement agencies, and the public. NEMA has the authority to enforce the regulations, including issuing stop orders, seizing equipment, and prosecuting offenders.	*Where some of the construction activities are bound to make some level of noise, the contractor will make plans to minimize adverse construction, noise, or vibration impacts generated from construction machinery in line with the guidelines provided in these regulations. This includes undertaking construction works between 8:00 A.M and 5:00 P.M.*
5	The Environmental Management and Coordination (Air Quality) Regulations, 2014	These regulations aim to ensure clean and healthy ambient air by providing for the prevention, control, and abatement of air pollution. According to the general prohibitions, no one is allowed to cause the emission of air pollutants listed under the First Schedule (Priority air pollutants) to exceed the ambient air quality levels as required by the Second Schedule (Ambient air quality tolerance limits) and the Seventh Schedule (Emission limits for controlled and non-controlled facilities).	*In order to prevent air pollution, particularly during the construction phase, the contractor must put the mitigation measures outlined in the ESMP into practice.*

4.4 World Bank Environmental and Social Framework

The World Bank Environmental and Social Framework (ESF) is a set of policies that governs how the World Bank addresses environmental and social risks in projects it finances. It came into effect on October 1, 2018, replacing the earlier Safeguard Policies. Table 14 shows the applicability of World Bank Environment and Social Framework to the proposed project.

Table 14: Some of the World Bank (ESF) likely to be triggered by the proposed project

Operational policy	Policy Description	Relevance
ESS1: Assessment and Management of Environmental and Social Risks and Impacts	Requires projects to identify, assess, and manage potential environmental and social risks through an Environmental and Social Impact Assessment (ESIA) and risk mitigation measures.	After screening, the proposed Kabkara irrigation project impacts are site-specific and, for the most part, standard mitigation measures are easier to implement. The Environmental and Social Impact Assessment requirement is being met by this ESIA. The WB policy framework on best practices must be followed when implementing the project.
ESS2: Labour and Working Conditions	The framework ensures safe, fair, and healthy working conditions, including protection against forced labour and child labour, fair wages, and grievance mechanisms for workers.	The project proponent must ensure safe and fair working conditions for construction and agricultural workers, including compliance with labour laws, fair wages, occupational health and safety measures, and access to a grievance redress mechanism for workers.
ESS3: Resource Efficiency and Pollution Prevention and Management	The framework promotes efficient use of resources (water, energy, raw materials) and prevents pollution (air, water, and soil contamination).	Efficient use of water resources is crucial in irrigation projects. The proponent must put in place measures to prevent water wastage, minimize chemical runoff from fertilizers and pesticides, and reduce greenhouse gas emissions from pumps and machinery.

ESS4: Community Health and Safety	Requires projects to protect local communities from health and safety risks, including traffic hazards, exposure to chemicals, and emergency response planning.	Irrigation projects may expose local communities to waterborne diseases (e.g., malaria from stagnant water), increased traffic accidents from construction, and potential dam failures. The project proponent must establish safety measures, early warning systems, and community awareness programs. The impact of excavation for the irrigation water pipeline infrastructure will be short-lived. The main pipeline infrastructure has been designed to pass along the road side with minimum intersections across farms.
ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.	The framework ensure protection of ecosystems, wildlife, and natural resources by ensuring sustainable project practices.	Irrigation can affect wetlands, rivers, and aquatic ecosystems by altering natural water flow. The project proponent must ensure sustainable water extraction, avoid harm to critical habitats, and support agro-ecological practices that preserve biodiversity.
ESS8: Cultural Heritage	The framework ensure protection of cultural heritage, including historical and archaeological sites, from project-related damage.	Excavation and land development could impact historical sites, sacred grounds, or cultural heritage. An archaeological impact assessment must be conducted, and a chance-find procedure must be in place to guide the contractor in case of any discoveries.

ESS10: Stakeholder Engagement and Information Disclosure	Requires consultation with affected communities, transparency, and grievance mechanisms.	The project proponent must engage farmers, local communities, government agencies, and civil society to ensure transparency, address concerns, and establish a grievance mechanism for affected stakeholders.

4.5 Institutional Framework

EMCA 1999 which was updated in 2015, essentially outlines environmental management in Kenya. Several institutions tasked with regulating and monitoring the environment have been formed by the Act. The Ministry of Environment and Natural Resources is in charge of providing general environmental management guidance. The proposed irrigation project will involve other lead agencies during construction as well as operation (Table 15).

Table 15: Lead agencies/institutions responsible for the implementation of the proposed irrigation project

Institution	Role During Construction Phase	Role During Operation Phase
National Environment Management Authority (NEMA)	- Reviews and approves the Environmental and Social Impact Assessment (ESIA). - Issues the Environmental Impact Assessment (EIA) license for the project. - Monitors compliance with environmental regulations during construction. - Enforces mitigation measures outlined in the Environmental and Social Management Plan (ESMP).	- Conducts periodic environmental audits to ensure compliance with regulations. - Addresses any environmental concerns arising from irrigation operations. - Ensures adherence to pollution control and water quality standards.
National Environmental Tribunal (NET)	- Handles disputes arising from NEMA decisions, such as project approval or environmental violations. - Reviews appeals against EIA license issuance or rejection.	- Resolves disputes related to environmental violations or complaints from affected communities.

Institution	Role During Construction Phase	Role During Operation Phase
		- Reviews cases of non-compliance raised during project operations.
Environment and Lands Court (ELC)	- Provides legal adjudication for disputes over land acquisition, compensation, and environmental matters before project implementation. - Handles cases involving grievances over land tenure and resettlement.	- Resolves conflicts related to land and water use that may arise during irrigation operations. - Provides legal redress for disputes regarding environmental degradation caused by irrigation activities.
Directorate of Occupational Health and Safety (DOHS)	- Ensures compliance with the Occupational Safety and Health Act (OSHA) during construction. - Conducts inspections to enforce worker safety regulations (e.g., use of PPE, safe working conditions). - Investigates accidents and hazards at the construction site.	- Conducts periodic inspections of irrigation infrastructure to ensure continued worker safety. - Monitors compliance with workplace health and safety regulations for irrigation workers and operators. - Investigates any occupational health risks for farmers using the irrigation system.
Kabkara Irrigation Water Users Association (IWUA)	- Participates in the design and planning of the irrigation scheme to ensure local needs are met. - Mobilizes farmers and educates them on irrigation water management.	- Manages the operation and maintenance of the irrigation system. - Collects water user fees to fund repairs and maintenance. - Ensures equitable water distribution among farmers. - Mediates conflicts between water users.
Bungoma County Government	- Co-implements the project with NAVCDP. - Provides land and infrastructure support for the irrigation scheme. - Mobilizes farmers and community stakeholders for project success.	- Provides agricultural extension services to farmers using the irrigation system. - Conducts routine monitoring and evaluation of the irrigation scheme. - Supports local water governance and dispute

Institution	Role During Construction Phase	Role During Operation Phase
	- Ensures adherence to county-level environmental and agricultural policies.	resolution. - Collaborates with NEMA and the WRA to ensure environmental compliance.
Water Resources Authority (WRA)	- Issues water abstraction permits for irrigation projects. - Ensures the irrigation project aligns with national water allocation plans. - Monitors water source sustainability before project initiation.	- Conducts regular water quality monitoring to ensure no pollution occurs. - Enforces compliance with water use regulations. - Reviews water allocation and ensures efficient water management.
National Irrigation Authority (NIA)	Provides technical support in the design, planning, and supervision of irrigation infrastructure to ensure compliance with national standards and best practices. Supports capacity-building of Irrigation Water Users Associations (IWUAs), to promote ownership and sustainability.	Offers technical backstopping to IWUAs in water management, maintenance planning, and agronomic advisory services.

5 ANALYSIS OF PROJECT ALTERNATIVES

Legal notice 32 specifies the basic content of an Environmental Impact Assessment Report subsequent to which, subsection (i) requires an analysis of alternatives including Site, design, technology and processes. The purpose of this section is to examine feasible alternatives to the project. The benefits of the proposed project will be considered against any potential environmental cost. The general principle involved in identifying alternative option(s) to a proposed development is to ensure that the option chosen would result in optimal social, environmental, and capital benefits not only for the developer, but also for the environment and stakeholders in the area. For the proposed Kabkara irrigation sub-project, the alternatives analysed in this ESIA report was based on the technical designs of the project, baseline study of the project area as well as potential environmental and social impacts analysed for the proposed project.

5.1 The No Project Alternative Option

Under this scenario, the project would not be implemented, leaving the targeted households without access to irrigation water. This would result in continued reliance on rain-fed agriculture, which is vulnerable to seasonal variability and climate change impacts. The no-project alternative would likely lead to reduced agricultural productivity, food insecurity, and economic hardships for local farmers. Additionally, the potential socio-economic benefits, such as job creation and improved livelihoods, would not be realized.

5.2 Project Site Alternative

This option means looking for alternative site for the project. The selection of the beneficiaries for the irrigation scheme was done after a feasibility study which informed the sustainability of the project design and coverage. The alternative sites viable for the proposed project are in Busia thus likely to pose administrative challenges for the project as the project is implemented through the county government of Bungoma.

5.3 Alternative Water Sources

This alternative considers sourcing irrigation water from alternative sources such as underground wells, nearby rivers, or rainwater harvesting systems as opposed to the current Kabkara dam. However, groundwater extraction may not be sustainable due to potential depletion of the aquifer, while nearby rivers do not have sufficient flow to support irrigation needs. Rainwater harvesting, although sustainable, would require significant infrastructure investments and large storage capacities to ensure water availability throughout the dry seasons. Kabkara dam therefore remains a viable source of water for the proposed project. The dam is fed by a river and as well allows environmental flow and spill way to flow back into the river.

5.4 Alternative Materials of the Balancing/ Elevated Water Distribution Tank

For the elevated water distribution tank, two primary options were considered: steel tanks and concrete masonry tanks.

Steel tanks offer the advantages of faster installation, factory-standard quality control, and relatively lighter weight, which may be beneficial in areas with poor access. They are also modular and can be relocated or expanded with relative ease. However, steel tanks are prone to corrosion, particularly in humid or acidic environments, and require regular maintenance, including protective coatings or galvanization, to ensure durability. They also tend to be more expensive both in initial procurement and in long-term maintenance.

In many cases, concrete tanks offer a lower initial cost compared to steel tanks. The materials used in the construction of concrete tanks can be more cost-effective than the steel required for steel tanks. However, the installation process is often more laborious. Transportation costs are higher if the tank is to be installed in a remote location such as Kabkara. Concrete tanks are renowned for their durability and longevity. When properly designed, constructed, and maintained, concrete tanks can provide reliable storage solutions for several decades.

Concrete tanks require regular inspection and maintenance to ensure maximum lifespan is achieved. Cracks and leaking are recurring issues, especially if the tank is exposed to vibrations and ground movement.

After evaluating these factors, the proponent opted for a 225m^3 Capacity concrete masonry tank due to its durability, lower life-cycle cost, and suitability for permanent, ground-mounted installations typical in rural irrigation schemes.

5.5 Alternative Water Pumping and Supply Mechanism

5.5.1 Use of Diesel or Electric Pumps vs. Solar pump

Instead of the proposed solar-powered water pump, diesel or electric-powered pumps could be used. Diesel pumps, however, would have higher operational costs due to fuel requirements and contribute to greenhouse gas emissions. Electric pumps would require grid electricity, which is not reliable in the project area. The solar-powered pump remains the most sustainable choice, offering long-term cost savings and environmental benefits.

5.5.2 Direct Distribution without an Elevated Water Tank vs. use of Elevation Tank

This option would involve direct pumping from the dam to the irrigation sites without using an elevated storage system. However, this would require continuous energy input, making it less efficient compared to the proposed gravity-fed system that reduces energy dependency once the water reaches the elevated storage tank.

5.6 Alternative Irrigation Methods

Several irrigation techniques are viable for the proposed scheme, including:

a) **Drip Irrigation:** This method is highly efficient, reduce water wastage and maximize usage efficiency. However, it requires significant investment in infrastructure and technical expertise.

b) **Sprinkler Irrigation:** This method ensures even water distribution but has high initial costs and potential water loss due to evaporation and wind drift.

c) **Simple Surface Irrigation (Proposed Option):** The selected option involves basic furrow or basin irrigation, which is cost-effective, easy to implement, and requires minimal maintenance, making it suitable for the benefiting households.

5.7 Alternative Pipe materials and Installation Methods

a) **Above-Ground Pipes:** While this option would reduce excavation and installation costs, it may lead to pipe exposure to environmental damage and vandalism.

b) **Underground Pipes (Proposed Option):** This method involves excavating trenches for pipe installation, which provides protection from external damage and minimizes interference with land use activities. Despite higher initial costs, it ensures long-term durability and reduced maintenance.

c) **Galvanized Iron pipes:** Galvanized iron pipes are known for their strength and durability, making them suitable for high-pressure zones, exposed sections, or areas vulnerable to mechanical damage. They are resistant to external impact and UV degradation, which makes them ideal for specific locations such as river crossings, intake structures, or steep terrain where reinforcement is critical. However, GI pipes are heavy, expensive, prone to internal corrosion over time (especially with water containing sediments or chemicals), and more difficult to install due to the need for welding or threaded joints.

d) **Plastic and rubber Pipes:** plastic pipes, such as high-density polyethylene (HDPE) or PVC, offer significant advantages in terms of cost, ease of installation, flexibility, and resistance to internal corrosion. They are lightweight and can be joined easily through welding or couplings, making them highly suitable for long pipeline stretches in farmlands or along gentle slopes. Their flexibility also allows them to adapt to terrain changes without the need for numerous fittings. However, plastic pipes are more vulnerable to damage from sharp objects, high pressure, or prolonged UV exposure when not properly buried.

Given these considerations, the proponent adopted a mixed approach: plastic pipes will predominantly be used for the distribution network due to their cost-effectiveness and ease of handling, while galvanized iron pipes will strategically be installed at structurally sensitive points such as the intake zone and critical junctions to enhance durability and protect against physical damage.

5.8 Conclusion

Following a comprehensive evaluation of the alternatives, the proposed project utilizing solar-powered water pumps, an elevated storage tank, underground pipe distribution, and simple irrigation methods was determined to be the most sustainable, cost-effective, and environmentally friendly solution. This approach minimizes negative environmental and social impacts while ensuring the long-term viability of the irrigation scheme for benefiting households.

6 CONSULTATION AND PUBLIC PARTICIPATION

6.1 Introduction

Public participation is a key component while conducting an ESIA study for any development project as it ensures that the views, suggestions, opinions and objections of the neighboring people to any proposed project are sort and incorporated within the project phases. Reference is made to Section 17 of the Environmental (Impact Assessment and Audit) Regulations, 2003, Legal notices 31 & 32 of 2019, which states that the proponent shall in consultation with the authority, seek the views of persons who may be affected by the project. This chapter outlines the key issues/concerns raised during the public consultations exercise. The proposed mitigation measures suggested by the public and other stakeholders that the proponent should incorporate to minimize environmental degradation and promote good working relationship with the community has been integrated in this chapter.

6.2 Objectives of the Public Participation

The ESIA for the proposed Kabkara irrigation project involved public participation to ensure the views and concerns from the members of the public are adequately taken into consideration in the decision-making process.

The specific objectives of public participation were to:

1. Ensure transparency and manage expectations of the community and their leaders.
2. Provide information about the project and to tap stakeholder information on key environmental and social baseline information in the project area.
3. Help manage risks, concerns and public expectations through ongoing dialogue with stakeholders.
4. Solicit the stakeholders' views on the project and discuss their involvement in the various project activities.
5. Share the results of the ESIA (impacts), and seek stakeholders' views / additional information on the impacts and proposed measures. Specifically, to discern the attitudes of the community and their leaders towards the project so that their views and proposals are taken into consideration in the formulation of mitigation and benefit enhancement measures.
6. Improve decision-making and build understanding by actively involving key project stakeholders in two-way communication. Through this process, the project better understands the concerns and expectations of stakeholders and the opportunities to increase project value to the local community.
7. Obtain options and suggestions directly from the affected communities on their preferred mitigation measures.

6.3 Stakeholders Consulted

The Environmental and Social Impact Assessment (ESIA) team conducted key informant interviews and public barazas with various stakeholders and community members to gather

their views on different aspects of the proposed project. These consultations were aimed at ensuring transparency and inclusivity in the decision-making process.

Table 16 presents the different categories of stakeholders who participated in the public consultations. A total of 64 individuals, comprising 46 men and 18 women, attended the public baraza held adjacent to the Kabkara Dam on January 30, 2025. The minutes of the proceedings and the attendance list are provided under appendices.

Table 16: Categories of stakeholders consulted

S/No	Category of Stakeholder	Stakeholder consulted
1.	County government of Bungoma	NAVCDP county team, officers from the department of agriculture and fisheries
2.	NEMA/Environmental lead agency	NEMA environmental officer Bungoma county office
3.	Kabkara dam Irrigation and water Users Association	IWUA chairman and his officials as well as the other members of the committee
4.	Kabkara dam security team	Local security of Kabkara Dam
5.	National government	Area DCC, OCPD, DCI local chief, sub-chief and village elders
6.	General members of the public	Women Representatives, Youth Representatives, Persons Living with Disabilities Representatives, Vulnerable and Marginalized Groups (VMGs), and Project Neighbors
7.	Local leadership	Representative from ward and sub county administrator.

6.4 Questionnaire Design

Before the community public participation meeting, the consultant developed a questionnaire to gather stakeholder views. This questionnaire was reviewed and approved by the NAVCDP project office in Bungoma before being distributed to the community one day prior to the community public participation meeting.

To ensure clarity and understanding, ESIA experts thoroughly explained the questionnaire's purpose and contents to stakeholders. Respondents were then given time to complete the questionnaire, with the ESIA team available to assist anyone needing support.

A total of 19 questionnaires were administered to community members, comprising 11 male and 8 female respondents. Additionally, a Key Informant Interview (KII) questionnaire was developed and distributed to key stakeholders with significant influence over the proposed project. This included representatives from the Agriculture, Public Works, and Fisheries departments in Bungoma County.

Plate 6.1: ESIA study team taking a respondent through a questionnaire for the study

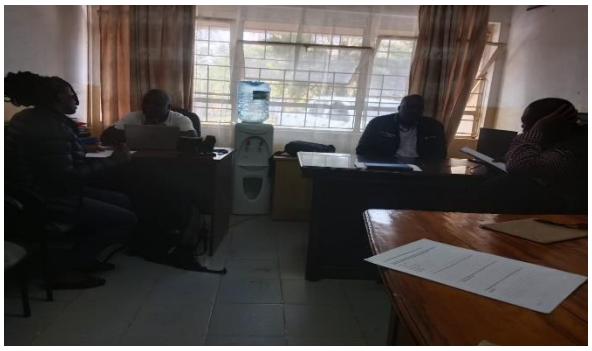

Plate 6.2: Key informant interview session with stakeholders from the Agriculture and Irrigation sector in Bungoma County

6.5 Public Meetings

Public participation meetings were held on January 28th and 30th, 2025, at a parcel near the Kabkara Dam, bringing together key stakeholders such as the IWUA committee members, local administration, and the Bungoma County Government, particularly agricultural officers from the NAVCDP Project. The meeting was on 28th January 2025 was attended by 60 participants, comprising 40 men and 20 women. The January 30, 2025 meeting saw 64 attendees, including 46 men and 18 women.

Youth and Vulnerable and Marginalized Groups (VMGs) were also well represented. The baraza was organized by the NAVCDP Bungoma County team, in collaboration with village and ward administration offices. Attendance lists, meeting minutes, and filled-in questionnaires are annexed to this report.

The Environmental and Social Impact Assessment (ESIA) team, which included two experts from the NAVCDP National Panel of Experts specializing in environmental and social safeguards (an environmentalist and a sociologist), led the engagement sessions.

The environmentalist opened the meetings by explaining the importance of public participation and emphasizing the necessity of stakeholder engagement for the proposed

project. The CESCO Bungoma County representative then provided an overview of the project, outlining its objectives and scope. The ESIA team further elaborated on:

- The project's design and planned activities during the construction and operational phases.
- The importance, benefits, and legal requirements of public consultation.
- Potential positive and negative impacts of the project.

Stakeholders actively participated in focused group discussions, raising questions and concerns regarding the project's environmental, social, health, and economic implications. They were also encouraged to propose mitigation measures and necessary actions to be implemented during the construction and operational phases. All stakeholder feedback was documented for reference (Minutes attached as appendices).

Plate 6.3: Ongoing stakeholders meeting in progress with the DCC and Security team from Sirisia introducing themselves

Plate 6.4: Ongoing open discussion session between the lead ESIA expert and the members of the Kabkara IWUA

Plate 6.5: The ward admin giving contributions during the engagement forum with the community

6.6 Public Participation Outcomes

Table 17 summarizes the expectations, concerns and the mitigation measures that were discussed during the key informant interviews, stakeholders' consultations and public participation meeting. The table includes questions asked by the stakeholders and the responses given.

Table 17: Summary of the issues raised by different stakeholders and responses

S/No	KEY ISSUES/OPINIONS RAISED	RESPONSES/OPINIONS
Issues Raised by Men		
1.	The Kabkara IWUA member sought clarification on how family members of mapped farms will benefit from the irrigation project, particularly if their own farms were not included.	The farm owner will share water with the other family members through resource-sharing, based on a census for fair distribution. This will ensure efficient water use and support sustainable farming for both parties.
2.	Will all the people living in the marked parcels of land even if they are buyers not the original owners of the land benefit from the proposed project?	Yes, they will benefit from the proposed project
3.	How will the community address conflict on water use?	Conflicts will be managed by the IWUA sub-committee of grievance management, which will create by laws to control disputes. A water metering system will be implemented, with penalty fees for exceeding usage limits, promoting accountability and responsible consumption.
4.	If the collection tank ends up being built at Katomei primary	There will be no need to get a title deed for the plot which the collection tank will be constructed however

	school, will a title deed be required for the plot allocated for the water tank or the IWUA will use the school title deed?	the school can give consent letter and attach it with its title deed or parcel land number since many schools don't have title deeds. However, construction of the collection tank in the school is highly discouraged to avoid conflicts
5.	Why is the proposed irrigation project excluding farms near the Bungoma-Busia border, claiming they are in Busia County? Is the project being politicized?	On the issues of irrigation project extending to Busia County will not be possible because the proposed irrigation project is for Bungoma county but Busia County can benefit buy watering their livestock
6.	Why was the number of beneficiaries for the proposed irrigation project reduced from 116 to 42?	The number of beneficiaries remains at 116. However, it is the area of land that will be served by the proposed project that increased to 42 hectares.
7.	Clarity is needed on how a 100ft land needed to build the collection tank will acquire the title deed	The project increased the size of the plot to construct the water tank for collection to ¼ an acre to accommodate the water tank, IWUA office and a SACCO
8.	How will the payment to the locals be carried out during excavation to lay the water pipes, before work or after a week?	A mutual agreement will be established between the workers and the contractor, with the IWUA committee ensuring that the workers receive payment from the contractor
9.	What are some of the factors that can cause the closure of the irrigation project?	If the dam's water levels drop and the Kabkara stream's supply is insufficient, along with complete silting. The community should focus on regular dam maintenance and explore alternative livelihoods. This will help reduce reliance on a single water source and ensure long-term economic resilience.
Issues Raised by Women		
1.	How will the community control pollution which may result from excess use of farm chemicals during operationalization of the project	Through capacity building of the community to use the regulated pesticides. Promoting organic farming and eco-friendly alternatives will further reduce chemical reliance.
2.	How will SEAH issues be handled during the construction phase of the project?	The contractor must comply with SEAH conditions outlined in the contract, ensure the use of a dedicated hotline for reporting issues, and cooperate with authorities, including the police gender desk, to address incidents promptly and effectively.
3.	During the operational phase of the project, how will	overproduction will be managed through training farmers in value addition, diversifying markets to new

	overproduction of farm produce be controlled?	towns, and forming cooperatives for collective marketing and bargaining power
4.	Give guidance on whether consent letter can replace title deeds in plots that have no title deeds for the construction of the collection tank	Using a consent letter instead of a title deed is not feasible for World Bank-funded projects, as only a title deed or official minutes from the land control board are accepted for compliance
5.	Will the NAVCDP assist the IWUA in purchasing the required plot of land for building the water tank?	It will be discussed by the county project coordinating unit and the IWUA committee once a willing seller among the three marked farms comes forward and agreement is reached
Issues Raised by youth		
1.	Are there any conflicts between the wards benefiting from Kabkara dam?	There is no conflict between Lwandanyi and East Angurai wards over the proposed irrigation project. The Irrigation Water Users Association (IWUA) supports the decision to focus the project in Bungoma County, acknowledging its benefits will also positively affect neighboring areas.
2.	Can any land issues affect the production of crops under the proposed irrigation project	No, the community is supporting the project
3.	How will the IWUA committee benefit from the fish which is stocked in Kabkara dam?	The IWUA committee struggles with benefiting from the dam's fish due to non-compliance with fish rearing and harvesting protocols. A possible solution is by partnering with the Fisheries Department to ensure proper adherence to responsible fish management practices.
4.	How will conflicts resulting from water shortage be addressed by the IWUA?	communities will be sensitized on water rationing to ensure equitable distribution of resources

6.7 Stakeholder views and concerns raised through the questionnaire

After explaining the questionnaire to the stakeholders, the ESIA team administered it and remained on standby to assist respondents in understanding the questions. A total of nineteen (19) respondents participated, comprising eleven (11) males and eight (8) females.

The first section of the questionnaire gathered personal details and assessed respondents' understanding of the proposed project. Participants were then asked to identify potential

environmental impacts of the project during both the construction and operational phases. Additionally, they were invited to share their perspectives on how the project might affect them socially, economically, and health-wise.
Furthermore, respondents were asked to suggest possible mitigation measures to minimize or eliminate any negative impacts. Their insights have been summarized and integrated into the next chapter (Chapter 7), which provides a detailed discussion on the environmental and social impacts of the proposed project, along with feasible mitigation measures. Additionally, stakeholder input has been incorporated into the Environmental and Social Management Plan (ESMP) in Chapter 8.

6.8 Approval of the proposed project by the stakeholders

After the ESIA team and the project proponent provided a detailed explanation of the proposed project to the stakeholders, the stakeholders were given the opportunity to express their approval or concerns. During the public meeting, no objections were raised, provided that the concerns highlighted by the stakeholders would be adequately addressed.
Additionally, a questionnaire was distributed to gather individual opinions on the project. The results indicated unanimous support, with all 19 respondents (100%) approving the proposed project and agreeing that it should proceed.

6.9 Grievance Management Mechanism

The Kabkara IWUA has established a dispute resolution committee which will be tasked with the management of grievances across the different phases of the proposed sub-project. The committee members are elected by the IWUA members and constitute other key stakeholders including Office of National Government (represented by chief and or assistant chief), Community representatives (youth, women, men), representative of the county government, Representative from a Civil Society Organization (active in the area in the field of public health, agriculture, water) etc.

For non-sensitive complaint which is related to NAVCDP, the committee will follow the steps provided in the Project's GM, they will need capacity building on the NAVCDP GM framework. NAVCDP maintains a structured grievance raising platforms, including a toll-free hotline and digital platforms which the stakeholders will be informed of.

For sensitive grievances, the committee will be advised to escalate to relevant government of Kenya departments/ law enforcement agencies.

7 ANTICIPATED ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

The baseline information collected, and the project characteristics discussed form the basis for impact identification and evaluation. The proposed project will bring about both positive and negative environmental and social impacts.

7.1 Positive Environmental and Socio-Economic Impacts during Construction Phase

The anticipated positive impacts during the project construction include the following:

7.1.1 Creation of Employment Opportunities

During the construction phase the project will create short-term direct and indirect job opportunities. The direct beneficiaries will be the casual workers and semi-skilled labourers who will do the excavations, plumping and fitting works of the irrigation infrastructure. The indirect beneficiaries will be those selling food and other services to those putting up the irrigation infrastructure.

Proposed enhancement measures

a) The unskilled or semi-skilled labour force should be sourced from the project area.
b) Local youths, both male and female and local women who form the bulk of local labour force to be given utmost priority when sourcing labour force during project construction.

7.1.2 The availability of market for construction supplies

Large amounts of construction materials will be needed for the project; the majority will be obtained locally. For those who supply building supplies, such as cement, water pipes among other construction materials, there will be ready market.

Proposed enhancement measures

a) Encourage local procurement of materials to stimulate the regional economy.

7.2 Anticipated negative environmental and social impacts during the construction phase

7.2.1 Removal of vegetation

The proposed project will entail excavation work to fit water pipes and related irrigation infrastructure. Impacts on vegetation will be from excavation works and compactions. Most of these impacts are short-lived and localized. Plants at the proposed site which is mainly grass will be cleared to pave way for the construction activities.

Mitigation measures

a) Properly demarcate the project area to be affected by the construction activities to avoid spill-over effects to neighbouring areas.
b) During the mapping exercise for the proposed project, the piping lines were designed to avoid sensitive biodiversity habitats.

7.2.2 Soil erosion

Excavations if not well managed will result into loose soil which is prone to both water and wind erosion. The source of loose soil will be form excavation work for the irrigation infrastructure. Loose soil generated during excavation works may lead to increased soil erosion and dust at the project site and neighbourhood. This may lead to release of sediment into surface water drainages within the project area hence siltation and water pollution of local rivers and dams.

Mitigation measures

a) Proper planning of site excavation works such that a section is completed and rehabilitated before another section begins.
b) Encourage re-use of excavated materials for back-filling which should entail compaction to enhance soil stability.

7.2.3 Incidents and construction work related accidents

Public and construction worker safety can be jeopardised during civil works projects by a variety of construction-related activities, including deep excavations, the operation and movement of large machinery and trucks, injuries from falling materials and the failure to wear personal protective equipment (PPE).

Mitigation measures

a) Warning tapes should be put along the trench line to alert pedestrians on the dangers.
b) A fully equipped First Aid Kit shall be provided at the construction site always and manned by trained/qualified persons.
c) Depending on OHS hazards anticipated while performing assigned jobs/task(s), workers will require proper fitting PPE to avoid injuries and illnesses. The PPEs will include: working boots, overalls, helmets, goggles, earmuffs, dust masks, and gloves among others that will be deemed necessary.
d) Maintain an effective reporting procedure and recording for all accidents.
e) The contractor shall have group Insurance Cover for the workers.
f) In case of an accident, the injured person should be given first aid and immediately taken to the nearby hospital, an investigation should be initiated immediately to ascertain the cause of the accident and preliminary findings released within 12 hours.

7.2.4 Impact on local roads and related infrastructure

The excavations for the piping works of the proposed irrigation project will cut across a major feeder road in the area. The excavation works is also likely to affect other infrastructure such as water lines and underground communication lines. The road to be affected by the project is a class E road (Katomei junction-Changara road) under the jurisdiction of county government.

Mitigation measures

a) Obtain necessary permits and approvals from the county government before construction begins.
b) Develop a Traffic Management Plan (TMP) to ensure minimal disruption to road users.

c) Mark all underground cables and water pipes using utility locator equipment before excavation.
d) Work with the roads department to guide on the depth requirement for irrigation pipes along the major roads to minimize destruction of the pipes by future road expansion or upgrade. Where the irrigation pipes crosses major roads, water marks should be put.
e) Use trenchless technology (e.g., horizontal directional drilling) to lay pipes under the road without excavation where possible.
f) If excavation is necessary, provide alternative routes and temporary bypasses for vehicles and pedestrians.
g) Ensure proper signage and safety measures, including warning signs, barricades, and flagmen.
h) Reinstate the road surface to its original condition and Conduct joint inspections with county engineers to ensure road reinstatement meets required standards.

7.2.5 Impact on points of cultural importance

The construction work for the irrigation infrastructure will entail excavation, there are chances that during excavations along the proposed irrigation infrastructure line, points of cultural significance including unknown grave points might be affected.

Mitigation measures

a) Use non-invasive techniques such as Ground Penetrating Radar (GPR) to detect underground features before excavation.
b) Develop and implement a Chance Find Procedure (CFP) as per World Bank standards, ensuring immediate action if cultural artefacts or human remains are discovered during excavations. Include site workers training on how to recognize and handle chance finds. If a grave or cultural artefact is discovered:
    - Stop work immediately in the affected area.
    - Mark the site and secure it from disturbance.
    - Inform the relevant authorities (e.g., National Museums, Cultural Heritage Department).
    - Engage local elders and cultural representatives to determine appropriate next steps.
    - Resume work only after clearance from relevant authorities and cultural leaders.
c) If a significant cultural site is found, explore rerouting the pipeline to avoid the area.

7.2.6 Noise and Vibration

During the planned project's construction, there could be noticeable increases in vibration and noise levels. Construction workers, excavators, loaders, concrete mixers, trucks can produce such noise and vibrations. The noise level from the site will be of minimal consequences as it will be short lived, those working at the site will have noise attenuation gadget.

Mitigation measures

a) In order to meet noise level requirements, those handling noisy equipment will be equipped with standard noise attenuation features.
b) The construction work will be limited to normal working hours (8am-5pm), unless otherwise, no construction work will be done at night.
c) The contractor should establish means for the public to raise their complaints when the noise becomes too much (i.e., provide telephone number, email, etc.) and methods to handle noise complaints.

7.2.7 Effluent from workers sanitary facilities at the construction site

During construction, Workers and visitors will respond to calls of nature, human waste if not well managed cab be a nuisance and is normally associated with diarrhoea diseases.

Mitigation measures

a) The contractor will enter into a formal agreement with the management of the other premises near the project site for the construction workers to use their toilets during the construction period.
b) Open defecation by construction workers should be discouraged at all cost during the construction period.

7.2.8 Solid Waste/Debris

During the construction phase of an irrigation project, solid waste such as excavated soil, packaging materials, metal scraps, plastic pipes, and other construction debris may be generated. Proper management is crucial to prevent environmental pollution and ensure compliance with environmental regulations and best practices.

Mitigation measures

a) Store construction materials in designated areas to prevent damage and reduce wastage. Licensed solid waste handlers will be contracted by the contractor to deposit residual waste in approved dumpsites within Bungoma County.
b) Excavated soil and rocks should be reuse for backfilling or levelling areas instead of disposal.
c) Metal and Plastic Pipes will be collected for re-use and recycling.
d) Open burning of waste should be strictly avoided to prevent air pollution.

7.2.9 Dust and Air Pollution

Even though limited, activities such as excavation, trenching, and material transportation can generate dust and air pollution, affecting workers and nearby communities.

Mitigation measures

a) Regularly spray water on dry and exposed soil, particularly during excavation and earthworks, to reduce dust emissions.
b) Enforce a speed limit (e.g., 20 km/h) on unpaved roads to minimize dust.
c) Provide workers with dust masks, goggles, and respirators in high-risk areas.
d) Set up a system where affected communities can report dust-related concerns.

7.2.10 Risk of increased incidences of HIV/ AIDS and STIs

Considering the possibility that construction workers in most sites are young males with increased income, sexual interactions between local women and construction workers may contribute to spread of communicable diseases in the project area, including sexually transmitted diseases such as HIV and AIDS.

Mitigation measures

a) Proponent and Contractor(s) to sensitize workers and community members on HIV/ AIDS and STIs as part of the contractor's Health and Safety Management Plan.

b) Contractor to ally with nearest Sub County Hospital for provision of VCT services on site to the workers and community at large.

c) Contractor to avail condom dispensers at the construction site.

7.2.11 Child labour and abuse

The project area is neighboured by residential areas. Children within the residential areas are likely to be exposed to risks associated with interaction between them and project workers. These include child labour and sexual abuse which coherently leads to teenage pregnancies and exposure to communicable diseases such as HIV/ AIDS and sexually transmitted diseases STDs.

Mitigation measures

a) The contractor will develop and implement a Children Protection Strategy that will ensure minors are protected against negative impacts associated with the project.

b) All staff must sign, committing themselves towards protecting children, a contract which clearly defines what is and is not acceptable behaviour.

c) Children under the age of 18 years will not be hired at the site. Hiring of workers will entail verification of age using the national identity card.

7.2.12 Risk of Forced Labour

The risk of forced labour may arise if labourers are recruited without transparent contracts or subjected to excessive working hours against their will. This risk not only violates human rights but also contravenes national labour laws, International Labour Organization (ILO) conventions, and the World Bank's Environmental and Social Standard (ESS) 2 on Labour and Working Conditions.

Mitigation measures

a) All workers must be recruited through fair and transparent processes, no recruitment fees should be charged to workers.

b) The contractor must ensure contracts are written in a language understood by workers and explain terms (wages, working hours, grievance process).

c) Train contractors, supervisors, and workers on workers' rights, labour standards, and prohibition of forced labour.

d) Sensitize local communities that no one should be compelled to provide unpaid labour for the project.

e) Establish a confidential and accessible grievance system for workers to report labour violations.

7.2.13 Risk of influx of workers

The construction of irrigation infrastructure will likely attract workers from outside the local area, particularly skilled labour not available within the community. This influx of workers can create a range of environmental and social risks, including: Increased demand for water, food, housing, and health services may strain community resources. Tensions may arise between local communities and incoming workers due to competition for jobs, cultural differences, or perceived inequalities. Presence of non-local workers may increase risks of harassment, transactional sex, or exploitation of vulnerable community members.

Mitigation Measures

a) Prioritize hiring of local labour for unskilled and semi-skilled work, and clearly communicate recruitment processes to avoid perceptions of unfairness.

b) The proponent should oblige the contractor, sub-contractors and workers to sign and adhere to a code of conduct addressing GBV, SEA, child protection, and respect for local customs.

c) The contractor should establish confidential reporting channels for both workers and community members to raise complaints (e.g., about misconduct, SEA/GBV, or conflict), and ensure grievances are addressed promptly.

7.2.14 Gender-based violence/ sexual exploitation, abuse and harassment and (GBV/ SEAH)

This impact is likely to be triggered during project construction phase through the relationships between the construction workers and the local community, particularly young women, boys and girls.

Mitigation measures

a) Develop a human resources policy against sexual harassment that is aligned with national law.

b) Develop a Code of Conduct with specific provisions on protection from sexual exploitation and abuse and ensure employees, sub-contractors, sub-consultants, and any personnel thereof engaged in construction works to individually sign and comply with it.

c) Sensitise workers as well as have display signage around the project site that signal to workers and the community that the project site is an area where SH/SEA/GBV is prohibited.

d) Establish an appropriate GRM to monitor and address SH and GBV in collaboration with the set legal systems and health workers within the locality.

7.2.15 Unresolved Grievances/conflicts

Common grievances expected to arise during the proposed project construction include: grievances from those not considered for the construction work at the site; grievances as a result of negative project impacts which may include physical harm and nuisance from construction activities; health and safety risks; socially unacceptable staff relations with the communities and other stakeholders; conflicts over shared resources such as water and facilities such as public latrines and access roads.

Mitigation measures

a) The contractor should put in place a pre-emptive community liaison structure aimed at identifying potential issues arising from project-related impacts and addressing them before they become grievances or escalate to the relevant government authorities those that cannot be addressed.

b) Implement the NAVCDP grievance mechanism, the project related grievances will be handled by the GRM sub-committee of the Kabkara IWUA who will work with the local administrators as ex-officials of the sub-committee, and expected to resolve the conflicts within 14 days. Unresolved grievances will be escalated to the County Project Coordination Unit (CPCU) and the County Project Steering Committee (CPSC) for review and resolution within 30 days. If still unresolved, cases will be referred to the National Project Coordination Unit (NPCU) through the County Technical Advisory Committee (CTAC), which must provide feedback within 45 days.

7.3 Anticipated positive environmental and social impacts during operation phase

7.3.1 Increased agricultural productivity

Reliable water supply will allow year-round farming, increasing crop yields and food security. Farmers can grow high-value crops that require consistent water supply.

Enhancement measures

a) Train farmers on modern irrigation techniques (e.g., drip irrigation) to optimize water use.
b) Promote soil fertility management practices (e.g., crop rotation, organic fertilizers) to sustain productivity.
c) Establish demonstration farms to showcase best irrigation practices.

7.3.2 Economic growth and improved livelihoods

Increased agricultural output will lead to higher household incomes and poverty reduction. It is as well anticipated to boosts employment opportunities in farming, agro-processing, and trade.

Enhancement measures

a) Provide market access support to help farmers sell their produce at competitive prices.
b) Encourage value addition (e.g., food processing) to maximize income.
c) Establish cooperatives and farmer associations for collective bargaining power.

7.3.3 Improved food security and nutrition

Irrigation project will boost food availability and stable supply all year round, this will reduce malnutrition and hunger in the community, Diversification of crops (e.g., vegetables, fruits, cereals) will leads to better dietary diversity.

Enhancement measures

a) Promote climate-smart agriculture to ensure long-term sustainability.
b) Train farmers on nutritious crop selection for balanced diets.
c) Integrate kitchen gardening programs to supplement household nutrition.

7.3.4 Climate change adaptation and resilience

The proposed irrigation project will provides a buffer against droughts and erratic rainfall commonly experienced in the project area as a result of climate change.

Enhancement measures

a) Encourage agroforestry and conservation agriculture to improve ecosystem resilience.
b) Develop early warning systems for extreme weather events.
c) Support research on climate-resilient crop varieties.

7.3.5 Social stability and community development

The proposed irrigation project has a potential of strengthening community cooperation among the local community members who benefit directly or indirectly from the irrigation project.

Enhancement measures

a) Continuous capacity building of the IWUA members through training programs on irrigation management and conflict resolution.
b) Promote gender-inclusive policies to support women's participation in irrigation farming.

7.4 Anticipated adverse environmental and social impacts during the operation phase

7.4.1 Water use related conflicts

Too much abstraction of water from the Kabkara earth dam could result in conflicts between the upstream and downstream users. This will be a one of the worst case scenarios that could result to the withdrawal of the water abstraction permit for Kabkara dam by Water

Resources Authority (WRA). Competing irrigation water demands among farmers can also result in conflict among farmers.

Mitigation measures

a) Install water meter at the intake and at household levels in order to control water usage and form a basis of rationing.
b) Establish a water monitoring program to track water levels in the dam and stream.
c) Implement controlled water abstraction by regulating pumping schedules.
d) Ensure adherence to water abstraction permits to be issued by WRA.
e) Strengthen the Irrigation Water User Association (IWUA) to monitor water usage and conflict resolution in the project.

7.4.2 Water logging and soil salinity

Excessive irrigation can lead to soil erosion, nutrient depletion, and salinity build-up. Poor drainage may cause waterlogging, making soils less productive. Water logging and soil alkalization is one of the most prolific adverse environmental impacts associated with irrigation.

Mitigation measures

a) Conduct regular soil quality analysis help determine mineral deficiency and guide on remedial measures.
b) Use proper irrigation method that does not lead to water logging.
c) Strictly follow irrigation schedule to prevent an increase in the irrigation hours in one section.

7.4.3 Increase in waterborne diseases

Once the irrigation water is supplied to the farms, most households will use the same as drinking water and for domestic use without any treatment. This would increase the chances of contracting waterborne diseases such as typhoid and cholera. There will be increased chances of stagnating water in the farmers and thus attracting the breeding of mosquitoes, which will be responsible for the spread of malaria leading to ill health problems among the residents.

Mitigation measures

a) Have separate system for domestic and irrigation water.
b) Chose an irrigation system that is very efficient and does not cause water logging in the field.
c) Design an irrigation schedule and follow it to prevent an increase in the irrigation hours in one section.

7.4.4 Intensification in use of agrochemicals and water pollution

Increased use of agricultural biocides (insecticides, herbicides, fungicides etc.) and fertilizers due to expected intensification of agricultural activities in the project area is a key environmental issue during operation phase of the project. Production of horticultural crops (high value crops) will demand increased use of biocides many of which are toxic and can have a long term effect on soils. Agrochemicals might also find their way into the steams thus impact negatively the downstream ecosystems.

Mitigation measures

a) Only use pesticides approved by pesticides control board and KEBS to be used in Kenya.
b) Train farmers on integrated pest management (IPM) to reduce chemical use: use combinations of cultural, mechanical, biological and chemical controls in an integrated manner. Implement useful crop pest control methods like Rotating crops, Adjusting planting times and ensure that major insect pests either starve or get eaten by their natural predators (IPMP attached as annex 19).
c) In case, if chemicals are used, the application of herbicide should be to treat only in designated areas and the chemicals used must be approved for use. Irrigation water users association (IWUA) should control the use of improper products in the project area.

7.4.5 Child labour in irrigated agriculture

The increased demand for agricultural labour in irrigated farming can lead to the exploitation of children, as some families may involve their children in farm work instead of sending them to school. Prolonged exposure to harsh working conditions, chemicals, and physically demanding tasks can have negative health effects on children. Child labour can result in poor educational outcomes, limiting future opportunities for affected children.

Mitigation measures

a) Conduct awareness campaigns to educate farmers and communities about the dangers of child labour and the importance of education.
b) Strengthen the enforcement of child labour laws and policies through regular inspections and penalties for violators. For those to be engaged as labourers in the farms, their verification should be through the identity card.

7.4.6 Theft of farm yield and vandalism of irrigation infrastructure

The proposed irrigation project will most likely result in increased farm yields, cases of theft of the farm produces cannot be ignored especially given the fact that not every households in Lwandanyi ward will benefit directly from the project.

Mitigation measures

a) Farmers can implement fencing, surveillance cameras, and security patrols to protect their farms from theft.
b) Establish local security groups involving the office of the area chief and community members to monitor and report theft and vandalism incidents.

7.4.7 Breakdown of irrigation infrastructure

Frequent breakdowns of irrigation pumps, pipes, and water storage systems will disrupt agricultural activities, reducing crop yields. Unreliable irrigation services may lead to water shortages, negatively impacting crop health and productivity.

Mitigation measures

a) Use durable, high-quality materials when installing irrigation systems to minimize frequent breakdowns.

b) Create a fund specifically for urgent repairs to avoid prolonged disruptions in irrigation services.
c) Establish a preventive maintenance program to regularly inspect and repair irrigation infrastructure.
d) Irrigation infrastructure passing along major roads that experience frequent maintenance should be clearly marked to prevent damages during road maintenance or upgrade.

7.4.8 Management challenges of the Irrigation Water Users Association (IWUA)

Weak leadership and mismanagement of the IWUA can result in conflicts over water distribution, unfair allocation, and inefficiencies in irrigation services. Corruption within the association may lead to misappropriation of funds meant for maintenance and development. Poor record-keeping and lack of transparency can cause disputes among members and undermine trust in the IWUA. Inadequate representation of smallholder farmers may lead to inequalities in decision-making processes.

Mitigation measures

a) Train IWUA leaders and members on governance, financial management, and conflict resolution.
b) Implement clear financial accountability measures, such as regular audits and public disclosure of financial records.
c) Ensure fair representation of all farmers, including smallholder farmers and marginalized groups, in decision-making processes.
d) Develop and enforce fair and transparent water distribution policies to avoid conflicts and inefficiencies.
e) Strengthen government oversight to provide technical assistance and policy guidance for IWUA management.

7.4.9 Low/lack of return on project investment

The proposed project was initiated to increase agricultural yield through growing of high value crops by irrigation. The project is designed to operate for a longer period of time for the maximum benefit to be realized. In the event that a beneficiary sells land considered for the project implementation, irrigation investments may not yield long-term benefits. The new owners may not have the skills, interest, or commitment to farming, leading to underutilization or mismanagement of the irrigation system.

Mitigation measures

a) Establish legally binding agreements with beneficiaries restricting land sales within a specified period (e.g., 5–10 years) unless approved by project authorities.
b) Register landowners benefiting from the project in a database to track ownership changes and prevent unauthorized sales.
c) Work with land administration offices and local governments to track land transactions and enforce project-related restrictions.

d) Improve market access and offer financial support (e.g., low-interest loans) to farmers, reducing their incentive to sell land for quick financial gain.
e) Empower the Irrigation Water Users Association to oversee land use compliance and discourage speculative sales.
f) Link farmers to agriculture based SACCOs to support them get farm inputs at subsidized rates as well as loans to support agriculture based production in the proposed Kabkara irrigation scheme.

7.4.10 Risk of Drowning

Although Kabkara Dam is already secured with chain-link fencing and monitored by a 24-hour security guard, residual risks remain due to potential unauthorized entry.

Mitigation Measures

a) Install visible warning signage in local languages at strategic locations around the dam, indicating "No Swimming," "Deep Water," and "Danger."
b) Maintain and regularly inspect the dam fencing to ensure it remains intact and tamper-proof.
c) Ensure 24-hour security is sustained, with guards trained on emergency response and rescue procedures.

7.4.11 Siltation of the Dam

Excessive sediment inflow reduces the dam's storage capacity, affects water quality, increases turbidity, and shortens the operational lifespan of the dam. This may compromise water availability for irrigation, domestic use, and downstream ecosystem functions.

Mitigation Measures

a) The dam has silt traps and sedimentation basins at water inlets to reduce sediment load entering the dam.
b) Maintain vegetation buffer zones along waterways feeding into the dam to minimize soil erosion.
c) Encourage soil and water conservation practices (e.g., terracing, contour farming, grass strips, and cover cropping) in upstream farmlands.

7.4.12 Risk of Dam Collapse

This may result from poor maintenance, overtopping during heavy rainfall, seepage, structural weakness, or extreme events such as earthquakes and flooding. A dam collapse could cause catastrophic downstream flooding, destruction of property and livelihoods, loss of lives, environmental degradation, and disruption of water supply for irrigation and domestic use. Even though the dam is currently secured and operational, without continuous monitoring and maintenance the risk cannot be ignored.

Mitigation Measures

a) Conduct regular structural inspections and safety audits by qualified dam engineers in compliance with Water Resources Authority (WRA) regulations.
b) Ensure proper maintenance of spillways and drainage systems to prevent overtopping during heavy rains.

c) Maintain an updated Dam Safety Management Plan, including operation and maintenance procedures.

7.5 Anticipated impacts and mitigation measures during the Decommissioning phase

7.5.1 Possible causes of decommissioning

Several factors may necessitate the decommissioning of an irrigation project. One potential cause is the depletion or contamination of the water source. Over time, the earth dam supplying irrigation water may experience sedimentation, reducing its capacity and efficiency. Additionally, water pollution from agricultural runoff or external sources could make the water unsuitable for irrigation. Another significant factor is the deterioration of infrastructure due to aging, wear and tear, or inadequate maintenance, making it financially unsustainable to continue operations.

Changes in environmental regulations, government policies, or land tenure systems may also mandate the closure of the project, especially if it no longer aligns with conservation efforts or legal requirements. Economic constraints, such as the rising cost of system maintenance, breakdown of solar pumps, or reduced profitability due to changing agricultural trends, can further drive decommissioning. Additionally, community disputes over water access, conflicts over land use, or shifts in social dynamics may lead to project closure. Finally, extreme climate conditions, such as prolonged droughts, could make the irrigation system unviable due to inconsistent water availability.

7.5.2 Forms of decommissioning

Decommissioning of an irrigation project can take several forms including:

a) **Full decommissioning**, where all infrastructure, including solar panels, pumps, elevated tanks, and pipeline networks, is dismantled and removed. This method ensures the land can be restored to its natural state or repurposed for non-irrigation activities.
b) **Partial decommissioning**, where some components of the system are retained and repurposed. For example, the solar-powered pumps and elevated tanks could be adapted for domestic water supply, livestock watering, or small-scale irrigation. The pipeline network might also be reconfigured to support alternative agricultural practices, such as reduced irrigation or rainwater harvesting. This method reduces waste and allows continued use of valuable infrastructure without fully abandoning the system.
c) **In-place decommissioning**, where the irrigation system is left intact but is no longer actively maintained or used. This may involve sealing or disabling key components, such as disconnecting the pump from the solar panels or shutting off water flow from the dam. However, periodic monitoring would be necessary to prevent environmental hazards, such as stagnant water in pipes leading to contamination or structural failures of storage tanks. Over time, nature may reclaim the site, or the system may gradually degrade without significant human intervention.

d) **Transfer of ownership** is another viable option, where the irrigation system is handed over to another entity, such as a local community, cooperative, or government agency. This allows for continued use under new management, potentially extending the lifespan of the infrastructure while benefiting farmers or other stakeholders. Alternatively, a private investor or non-governmental organization could take over operations, ensuring sustainability through improved management or modified usage.

The choice of decommissioning method depends on factors such as cost, environmental concerns, and the potential for repurposing the infrastructure to serve other needs.

7.5.3 Impacts of decommissioning

(a) **Loss of Livelihoods and Food Security:** Farmers who rely on irrigation for crop production may suffer reduced agricultural output, leading to food shortages and income loss.

Develop a decommissioning plan and submit to lead agencies to determine whether a study will be needed before decommissioning the project.

8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This chapter lays out the steps that will be done to manage the environment while the proposed project is under construction, during operation phase, and eventually decommissioning. The most effective way to manage the environment is to create and carry out an Environmental and Social Management Plan (ESMP), which guarantees that the project's environmental impacts are recognised and minimised at every stage as stated in Table 19.

As the project develops and new scheduling plans are made, elements of the ESMP could need to be adjusted. This makes it a living document that could be updated as new information becomes available or the actual situation on the ground alters.

The ESMP is based on data gathered through site visits, stakeholder consultations, baseline environmental and social assessments, and technical project design reviews as well as Key environmental and social (E&S) risks and impacts identified. This ESMP outlines mitigation measures, monitoring plans, and institutional responsibilities to ensure that the project is implemented in a sustainable and socially inclusive manner.

Table 18: Environmental and Social Management Plan for the proposed Kabkara dam irrigation project in Lwandanyi ward Sirisia sub-county, Bungoma County

PHASE						
A	**CONSTRUCTION PHASE**					
Potential Environmental and social impacts	**Recommended Actions**	**Monitoring Indicator**	**Responsibility**	**Monitoring frequency**	**Who to monitor**	**Estimated cost in (Ksh)**
Removal of vegetation	a) Properly demarcate the project area to be affected by the construction activities to avoid spillover effects to neighbouring areas. b) During the mapping exercise for the proposed project, the piping lines were designed to avoid sensitive biodiversity habitats. c) Support agroforestry tree planting initiatives among local farmers	• Spatial scale of the excavation works • Number of trees cut down to prevent shade at the solar structure site • Number of trees planted through CSR by the project contractor	-Contractor -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	Throughout construction period	KFS, NEMA, CESCO	100,000 for tree seedlings
Soil erosion	a) Proper planning of site excavation works such that a section is completed and rehabilitated before another section begins. b) Encourage re-use of excavated materials for back-filling which should entail compaction to enhance soil stability.	•Scale of excavations • Excavations debris management practice	-Contractor -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	During Excavation works	CESCO, NEMA	200,000 for soil erosion control measures

Incidents and construction work related accidents	a) Warning tapes should be put along the trench line to alert pedestrians on the dangers. b) A fully equipped First Aid Kit shall be provided at the construction site always and manned by trained/qualified persons. c) Depending on OHS hazards anticipated while performing assigned jobs/task(s), workers will require proper fitting PPE to avoid injuries and illnesses. The PPEs will include: working boots, overalls, helmets, goggles, earmuffs, dust masks, and gloves among others that will be deemed necessary. d) Maintain an effective reporting procedure and recording for all accidents. e) The contractor shall have group Insurance Cover for the workers. f) In case of an accident, the injured person should be given first aid and immediately taken to the nearby hospital, an investigation should be initiated immediately to ascertain the cause of the accident and preliminary findings released within 12 hours.	•Safety protocols at the site •Presence and use of PPEs •Number of accidents reported	-Contractor -Directorate of Occupational safety and health Bungoma County office --NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	Throughout the construction period	DOSH, CESCO CSSGMO	50,000 for PPEs

Damage of local roads and related infrastructure during excavations for irrigation infrastructure	a) Obtain necessary permits and approvals from the county government before construction begins. b) Develop a Traffic Management Plan (TMP) to ensure minimal disruption to road users. c) Mark all underground cables and water pipes using utility locator equipment before excavation. d) Work with the roads department to guide on the depth requirement for irrigation pipes along the major roads to minimize destruction of the pipes by future road expansion or upgrade. Where the irrigation pipes crosses major roads, water marks should be put. e) Use trenchless technology (e.g., horizontal directional drilling) to lay pipes under the road without excavation where possible. f) If excavation is necessary, provide alternative routes and temporary bypasses for vehicles and pedestrians. g) Ensure proper signage and safety measures, including	• Sections of the roads excavated for irrigation piping system • Rehabilitation techniques after the excavations • Traffic management strategies during road excavations • Signage in place to warn other road users of road blockage at specific excavated points.	Contractor Department of roads and public works -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	During excavation works on or along public roads	KERRA County Government of Bungoma Public works department	100,000 for the rehabilitation works

	warning signs, barricades, and flagmen. h) Reinstate the road surface to its original condition and Conduct joint inspections with county engineers to ensure road reinstatement meets required standards.					
Impact on points of cultural importance	a) Develop and implement a Chance Find Procedure (CFP) as per World Bank standards, ensuring immediate action if cultural artefacts or human remains are discovered during excavations. Include site workers training on how to recognize and handle chance finds. If a grave or cultural artefact is discovered: b) Stop work immediately in the affected area. c) Mark the site and secure it from disturbance. d) Inform the relevant authorities (e.g., National Museums, Cultural Heritage Department). e) Engage local elders and cultural representatives to determine appropriate next steps. f) Resume work only after clearance from relevant authorities and cultural leaders.	Development and understanding of the chance find procedure by the contractor and construction workers	-Contractor -National Museums of Kenya -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	During excavation works	National Museums of Kenya Department of cultural services at the County Government of Bungoma CESCO	No added cost

	g) If a significant cultural site is found, explore rerouting the pipeline to avoid the area.					
Noise and vibration	a) In order to meet noise level requirements, those handling noisy equipment will be equipped with standard noise attenuation features. b) The construction work will be limited to normal working hours (8am-5pm), unless otherwise, no construction work will be done at night. c) The contractor should establish means for the public to raise their complaints when the noise becomes too much (i.e., provide telephone number, email, etc.) and methods to handle noise complaints.	• Complain from households near construction points • Availability and use of noise attenuation gadgets by those handling noisy equipment	-Contractor -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	Throughout the construction period	NEMA Department of Environment at the County Government of Bungoma	50,000 for the noise attenuation PPEs
Effluent waste from the sanitary facilities at the construction site	a) The contractor will enter into a formal agreement with the management of the other premises near the project site for the construction workers to use their toilets during the construction period. b) Open defecation by construction workers should be discouraged at all cost during the construction period.	The existing sanitation facility along the project points	-Contractor and proponent -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	Throughout the construction period	Public Health Department CESCO	10,000
Solid waste/Debris	a) Store construction materials in designated areas to prevent damage and reduce wastage.	Solid waste management practices employed	-Contractor -NAVCDP Bungoma County	Throughout the construction period	NEMA CESCO	20,000 for solid waste storage facility

	b) Excavated soil and rocks should be reuse for backfilling or levelling areas instead of disposal. c) Metal and Plastic Pipes will be collected for re-use and recycling. d) Open burning of waste should be strictly avoided to prevent air pollution.		Project Coordinating Unit -Kabkara IWUA			
Dust pollution	a) Regularly spray water on dry and exposed soil, particularly during excavation and earthworks, to reduce dust emissions. b) Enforce a speed limit (e.g., 20 km/h) on unpaved roads to minimize dust. c) Provide workers with dust masks, goggles, and respirators in high-risk areas. d) Set up a system where affected communities can report dust-related concerns.	• Dust suppression techniques used during dry weather • Complains from community members	-Contractor -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	During dry periods of the construction phase	NEMA CESCO	30,000 for dust suppression during dry weather
Risk of increased incidences of HIV/ AIDS and STIs	a) Proponent and Contractor(s) to sensitize workers and community members on HIV/ AIDS and STIs as part of the contractor's Health and Safety Management Plan. b) Contractor to ally with nearest Sub County Hospital for provision of VCT services on site to the workers and community at large. c) Contractor to avail condom dispensers at the construction site.	• Number of new Infections reported in the project area • Rate at which dispensed condoms are used/ picked • Number of sensitization meetings held	-Contractor -Community health promoters -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	Regularly during the construction period	Department of Health	150,000 for sensitization, voluntary counselling and testing as well as condom dispensers

Child labour and abuse	a) The contractor will develop and implement a Children Protection Strategy that will ensure minors are protected against negative impacts associated with the project. b) All staff must sign code of conduct, committing themselves towards protecting children, a contract which clearly defines what is and is not acceptable behaviour. c) Children under the age of 18 years will not be hired at the site.	Number of reported cases of child labour and abuse	-Contractor -Office of the chief/National Government Administration Office (NGAO) -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	Throughout the construction period	Department of Child protection CSSGMO NGAO	50,000 for sensitization training of workers on child abuse
Risk of forced labour	a) All workers must be recruited through fair and transparent processes, no recruitment fees should be charged to workers. b) The contractor must ensure contracts are written in a language understood by workers and explain terms (wages, working hours, grievance process). c) Train contractors, supervisors, and workers on workers' rights, labour standards, and prohibition of forced labour. d) Sensitize local communities that no one should be compelled to provide unpaid labour for the project.	Terms of service for workers	Contractor, Kabkara IWUA, CPCU	Throughout the construction period	Department of labour	……..

	e) Establish a confidential and accessible grievance system for workers to report labour violations.					
Influx of workers	a) Prioritize hiring of local labour for unskilled and semi-skilled work, and clearly communicate recruitment processes to avoid perceptions of unfairness. b) The proponent should oblige the contractor, sub-contractors and workers to sign and adhere to a code of conduct addressing GBV, SEA, child protection, and respect for local customs. c) The contractor should establish confidential reporting channels for both workers and community members to raise complaints (e.g., about misconduct, SEA/GBV, or conflict), and ensure grievances are addressed promptly.	Number of locals employed for non-skilled labour force	Contractor	During recruitment	Kabkara IWUA	……..
Gender-based violence/ sexual exploitation, harassment and Abuse (GBV/ SH)	a) Develop a human resources policy against sexual harassment that is aligned with national law. b) Develop a Code of Conduct with specific provisions on protection from sexual exploitation and abuse and ensure employees, sub-contractors, sub-consultants, and any personnel thereof engaged in	Number of complaints reported; Number of cases handled, number of cases escalated to the police and finally to court of law.	-Contractor -Office of the chief/National Government Administration Office (NGAO) -The Kenya national police service	Throughout the construction period	Office of the chief/National Government Administration Office (NGAO) CSSGMO	50,000 for training and sensitization of the construction workers and the community members.

	construction works to individually sign and comply with it. c) Sensitise workers as well as have display signage around the project site that signal to workers and the community that the project site is an area where SH/SEA/GBV is prohibited. d) Establish an appropriate GRM to monitor and address SH and GBV in collaboration with the set legal systems and health workers within the locality.		-NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA			
Unresolved Grievances/conflicts	a) The contractor should put in place a pre-emptive community liaison structure aimed at identifying potential issues arising from project-related impacts and addressing them before they become grievances or escalate to the relevant government authorities those that cannot be addressed. b) The members of Kabkara IWUA and Lwandanyi CDDC/SAIC will be trained in GRM and equipped with Grievance register and Tusuluhishe book for grievance management	Number of grievances reported, Number of grievances resolved Number of grievances escalated. Number of grievances escalated to CPCU and CGRM committee.	-Contractor -NAVCDP Bungoma County Project Coordinating Unit -Kabkara IWUA	Throughout the construction period	CSSGMO CESCO	200,000 for community liaison work as well as facilitation and training on the GRM
					COST = 860,000	

B	OPERATION PHASE					
Potential Environmental and social impacts	**Recommended Actions**	**Monitoring Indicator**	**Responsibility**	**Monitoring frequency**	**Who to monitor**	**Estimated cost in (Ksh)**
Water use related conflicts	a) Install water meter at the intake and at household levels in order to control water usage and form a basis of rationing. b) Establish a water monitoring program to track water levels in the dam and stream. c) Implement controlled water abstraction by regulating pumping schedules. d) Ensure adherence to water abstraction permits to be issued by WRA. e) Strengthen the Irrigation Water User Association (IWUA) to monitor water usage and conflict resolution in the project.	• Water flow levels downstream • Complaints from farmers about inadequate water supply • Encroachment on water sources or catchment areas for the Kabkara dam • The number of mediated water resource use conflicts by the IWUA Availability/unavailability of water meters	-Kabkara IWUA -WRA -NEMA -National Irrigation Authority - Bungoma County Irrigation Development Unit (CIDU) -NAVCDP National Project Coordinating Unit (NPCU) -Bungoma county Project Coordinating Unit	Throughout the irrigation project operation phase	WRA Bungoma County Irrigation Development Unit (CIDU) CESCO	1,000,000 for the administrative work of the IWUA in collaboration with lead agencies in the water and irrigation sector
Water logging and soil salinity	a) Conduct regular soil quality analysis help determine mineral deficiency and guide on remedial measures. b) Use proper irrigation method that does not lead to water logging. c) Strictly follow irrigation schedule to prevent an increase in the irrigation hours in one section.	• Irrigation methods employed • presence of stagnant water in fields for prolonged periods types of crops grown	-Kabkara IWUA -Individual farmers -Department of Agriculture Bungoma County Government -Bungoma County Project Coordinating Unit	Throughout the irrigation project operation phase	Department of Agriculture Bungoma County Government	1,000,000 for soil quality analysis for beneficiary farmers

			-County Irrigation Development Units (CIDUs)			
Increase in waterborne diseases	a) Have separate system for domestic and irrigation water. b) Chose an irrigation system that is very efficient and does not cause water logging in the field. c) Design an irrigation schedule and follow it to prevent an increase in the irrigation hours in one section.	• Reports of waterborne diseases in local dispensaries and hospitals	• Kabkara IWUA • Individual farmers • Department of health	Throughout the irrigation project operation phase	Department of health	500,000 for frequent maintenance of water leakages
Intensification in use of agrochemicals	a) Only use pesticides approved by Pest Control Products Board (PCPB) and KEBS to be used in Kenya. b) Train farmers on integrated pest management (IPM) to reduce chemical use: use combinations of cultural, mechanical, biological and chemical controls in an integrated manner. Implement useful crop pest control methods like Rotating crops, Adjusting planting times and ensure that major insect pests either starve or get eaten by their natural predators. c) In case, if chemicals are used, the application of herbicide should be to treat only in designated areas and the chemicals used must be approved for use. Irrigation water users association (IWUA) should control the use of improper products in the project area. (IPMP	• Pest control and management techniques employed across farms Types of pesticides used in farms	-Kabkara IWUA -Individual farmers -KALRO -Department of Agriculture Bungoma County -PCPB -NAVCDP Bungoma county project coordinating unit	Throughout the irrigation project operation phase	KALRO -Department of Agriculture Bungoma County -PCPB CESCO	200,000 on trainings and sensitization as well as monitoring by the IWUA and other stakeholders

	attached as annex 19 to guide further)					
Child labour	a) Conduct awareness campaigns to educate farmers and communities about the dangers of child labour and the importance of education. b) Strengthen the enforcement of child labour laws and policies through regular inspections and penalties for violators.	Cases of child labour in the irrigation project	-IWUA -Children welfare department, -Office of the chief/National Government Administration Office (NGAO) --NAVCDP Bungoma county project coordinating unit	Throughout the irrigation project operation phase	Children welfare department, CSSGMO	100,00 for monitoring and sensitization by the IWUA
Theft of farm yield and vandalism of irrigation infrastructure	a) Farmers can implement fencing, surveillance cameras, and security patrols to protect their farms from theft. b) Establish local security groups involving the office of the area chief and community members to monitor and report theft incidents.	Reported and unreported incidents of theft of farm produces.	-The local police stations and patrol bases -IWUA -Individual farmers	Throughout the irrigation project operation phase	Local Security Committees	150,000 for the administrative functions of the security committee of the IWUA
Breakdown of irrigation infrastructure	a) Use durable, high-quality materials when installing irrigation systems to minimize frequent breakdowns. b) Create a fund specifically for urgent repairs to avoid prolonged disruptions in irrigation services. c) Establish a preventive maintenance program to regularly inspect and repair irrigation infrastructure.	• Siting of irrigation infrastructure line Existence/nonexistence of emergency fund in the IWUA to manage infrastructure and equipment breakdown	-IWUA -Individual farmers -NAVCDP National and County Project Coordinating Unit	Throughout the irrigation project operation phase	IWUA management committee	500,000 emergency fund to manage breakdowns of irrigation infrastructure and equipment

	d) Irrigation infrastructure passing along major roads that experience frequent maintenance should be clearly marked to prevent damages during road maintenance or upgrade.					
Management challenges of the Irrigation Water Users Association (IWUA)	a) Train IWUA leaders and members on governance, financial management, and conflict resolution. b) Implement clear financial accountability measures, such as regular audits and public disclosure of financial records. c) Ensure fair representation of all farmers, including smallholder farmers and marginalized groups, in decision-making processes. d) Develop and enforce fair and transparent water distribution policies to avoid conflicts and inefficiencies. e) Strengthen government oversight to provide technical assistance and policy guidance for IWUA management.	• Training schedules of the IWUA members on governance, management and conflict resolution • Structure and membership of the IWUA • Government/ NAVCDP support initiatives to IWUA • Local farmers perceptions on the performance of the IWUA • Rate of success/ returns on investment of the irrigation scheme	-IWUA -NAVCDP National and County Project Coordinating Unit	Throughout the irrigation project operation phase	CESCO CSSGMO	1,000,000 for capacity building trainings
Low/lack of return on project investment	a) Establish legally binding agreements with beneficiaries restricting land sales within a specified period (e.g., 5–10 years) unless approved by project authorities.	• Adherence to binding agreement signed by farmers	-NAVCDP National and County Project Coordinating Unit -IWUA	Regularly during the project operation phase	CSSGMO CESCO Local Farmers Cooperative Societies	200,000 for monitoring and administrative functions by the IWUA

	b) Register landowners benefiting from the project in a database to track ownership changes and prevent unauthorized sales. c) Work with land administration offices and local governments to track land transactions and enforce project-related restrictions. d) Improve market access and offer financial support (e.g., low-interest loans) to farmers, reducing their incentive to sell land for quick financial gain. e) Empower the Irrigation Water Users Association to oversee land use compliance and discourage speculative sales.		-Individual farmers -Land administration office/survey department			
Risk of drowning	a) Install visible warning signage in local languages at strategic locations around the dam, indicating "No Swimming," "Deep Water," and "Danger." b) Maintain and regularly inspect the dam fencing to ensure it remains intact and tamper-proof. c) Ensure 24-hour security is sustained, with guards trained on emergency response and rescue procedures.	Security and safety protocol in place at the Kabkara dam	Kabkara IWUA	Throughout the dam life	County Government of Bungoma	…….

Siltation of the dam	a) The dam has silt traps and sedimentation basins at water inlets to reduce sediment load entering the dam. b) Maintain vegetation buffer zones along waterways feeding into the dam to minimize soil erosion. c) Encourage soil and water conservation practices (e.g., terracing, contour farming, grass strips, and cover cropping) in upstream farmlands.	Soil erosion management practices at the catchment, design of the dam inlet/nature of the silt traps	Kabkara IWUA	Throughout the dam life	County Government of Bungoma, NEMA WRA	----------
Risk of Dam collapse	a) Conduct regular structural inspections and safety audits by qualified dam engineers in compliance with Water Resources Authority (WRA) regulations. b) Ensure proper maintenance of spillways and drainage systems to prevent overtopping during heavy rains. c) Maintain an updated Dam Safety Management Plan, including operation and maintenance procedures.	Structural Audit report of the dam, Signs of seepage along the walls	Kabkara IWUA	Throughout the dam lifeline	County government of Bungoma, NEMA, WRA	----------
					COST= 4,750,000	

8.1 INTEGRATED PEST MANAGEMENT PLAN TO BE ADOPTED FOR THE PROPOSED KABKARA IRRIGATION SCHEME IN LWANDANYI WARD, SIRISIA SUB-COUNTY, BUNGOMA COUNTY, KENYA

Introduction

The proposed Kabkara irrigation scheme will entail transition to irrigated high-value crops which is anticipated to increase the risk of pest infestations due to intensified and continuous cropping. Consequently, there is a risk of increased reliance on chemical pesticides, which can lead to environmental degradation, pest resistance, harm to beneficial organisms, contamination of water bodies (including Kabkara Dam), and adverse effects on human health if not properly managed.

As part of the broader environmental and social sustainability framework guiding the proposed sub-project, this Integrated Pest Management Plan (IPMP) has been developed to guide the IWUA members during the sub-project operation. This (IPMP) has been developed in compliance with the World Bank's Environmental and Social Framework (ESF), specifically Environmental and Social Standard 3 (ESS3): *Resource Efficiency and Pollution Prevention and Management*, and ESS6: *Biodiversity Conservation and Sustainable Management of Living Natural Resources*.

Crops to be grown and their major pests and diseases

Main crops to be grown under irrigation, their pests and related diseases as well as management options are presented in Table below. The main crops to be grown are informed by the feasibility study for the sub-project investment.

Table 19: Priority crops in Kabkara

Crop	Major Insect/Pest	Major Diseases	Management Options
Onion	Thrips, Onion fly	Downy mildew, Purple blotch	Use of certified seeds, crop rotation, proper spacing, insecticides (e.g. lambda-cyhalothrin), fungicides
Tomato	Tuta absoluta (Tomato leaf miner), Whiteflies, American bollworm	Early/late blight, late blight, Bacterial wilt	Timely spraying with recommended pesticides, use of recommended fungicides, staking, crop rotation, use of resistant varieties, field hygiene and sanitation
Watermelon	Aphids, Whiteflies, Melon fly	Fusarium wilt, Powdery mildew	Use of resistant varieties, proper field sanitation, insecticide sprays, avoid waterlogging
Kales (Sukuma wiki)	Diamondback moth, Aphids	Black rot, Downy mildew	Regular scouting, biopesticides, neem-based sprays, rotation with non-crucifer crops
Tissue Culture Bananas	Banana weevil, Nematodes	Panama disease (Fusarium wilt), Sigatoka leaf spot	Use of clean tissue culture planting materials, mulching, proper drainage, pruning, fungicides
Cucumber	Thrips, Whiteflies	Angular leaf spot, Powdery mildew	Netting, mulching, use of resistant varieties, sulphur-based fungicides, insecticide application
Cabbages	Diamondback moth, Cabbage looper	Black rot, Clubroot	Crop rotation, trap cropping (e.g. mustard), biocontrol (e.g. Bacillus thuringiensis), copper fungicides
Black Nightshade	Aphids, Leaf miners	Leaf spot, Damping-off	Handpicking pests, proper spacing, seedbed sterilization, minimal chemical use

Common Pesticides used for the Targeted Crops and their Environmental and Social Risk

Common pesticides anticipated to be used, their class and health as well as environmental risks are presented in table below.

Table 20: Common Pesticides used at Kabkara

Crop	Common Pesticide Used	Active Ingredient	WHO Hazard Class	Health/Environmental Risk
Onion	Dudu Acelamectin 46EC	Abamectin	Class II – Moderately Hazardous	Toxic to aquatic life, can cause skin and eye irritation in humans
Tomatoes	Belt 480 SC	Flubendiamide	Class U – Unlikely to Present Acute Hazard	Low toxicity but long persistence in the environment
Watermelon	Thunder 145 O-TEQ	Imidacloprid + Beta-cyfluthrin	Class II – Moderately Hazardous	Harmful to bees and aquatic organisms; skin irritant
Kales (Sukuma wiki)	Karate 5EC	Lambda-cyhalothrin	Class II – Moderately Hazardous	Highly toxic to aquatic life, may cause skin numbness in humans
Tissue Culture Bananas	Mocap 15G	Ethoprophos	Class Ia – Extremely Hazardous	Highly toxic to humans; restricted use, requires full PPE and strict handling procedures
Cucumber	Milraz WP	Cymoxanil + Mancozeb	Mancozeb: Class U; Cymoxanil: Class III – Slightly Hazardous	Potential reproductive toxicity; Mancozeb under scrutiny for environmental persistence
Cabbages	Duduthrin	Lambda-cyhalothrin	Class II – Moderately Hazardous	Can lead to resistance; highly toxic to bees and fish
Black Nightshade	Actara 25 WG	Thiamethoxam	Class II – Moderately Hazardous	Toxic to pollinators, moderately toxic to humans through ingestion or inhalation

WHO Hazard Class Summary

- **Class Ia**: Extremely hazardous
- **Class Ib**: Highly hazardous
- **Class II**: Moderately hazardous
- **Class III**: Slightly hazardous
- **Class U**: Unlikely to present acute hazard in normal use

The Integrated Pest Management Plan Matrix

To ensure effective, sustainable, and environmentally responsible pest control in the proposed Kabkara irrigation scheme, a detailed Integrated Pest Management Plan is presented in Table below. The plan outline specific measures to be implemented including preventive and control measures, responsible parties, timing, and monitoring indicators. These actions are designed to reduce reliance on chemical pesticides, promote ecological balance, and align with both EMCA (1999, Amended 2015) regulations and the World Bank's ESF standards, particularly ESS3 and ESS6.

Table 21: Integrated Pest Management Plan

Impact Issue / Pest & Pesticide Threat	Mitigation Measures	Implementation Tool	Expected Results	Monitoring Indicators	Responsibility	Cost Estimate (KES)
Excessive use of chemical pesticides	Promote use of bio-pesticides and IPM practices (crop rotation, intercropping, trap cropping)	Farmer training, demo plots, extension services	Reduced chemical dependency, improved soil and crop health	% of farmers adopting IPM techniques	IWUA, County, sub-county and ward Agriculture Office	150,000 for training materials, transport, facilitation
Pest resistance due to repeated pesticide use	Rotate pesticide classes and encourage integrated pest management	Pest management plans, record-keeping template	Reduced pest resistance, improved pesticide effectiveness	Number of farms with updated pest rotation plans	IWUA, Agro-dealers, County, sub-county and ward Agriculture Office, Pest Control Products Board (PCPB)	50,000 for Pest record booklets, scout training for lead farmers
Improper storage and disposal of pesticides	Establish pesticide storage protocols and disposal pits for containers	Storage Standard Operation Procedures (SOPs), awareness campaigns, waste pits	Reduced contamination risks	Number of farms with compliant storage and disposal	Farmers, NEMA, IWUA, County, sub-county and ward Agriculture Office	100,000 for construction of disposal pits and awareness materials
Health risks to farmers during pesticide handling	Train farmers on safe pesticide use and provide PPE (gloves, masks, boots)	Capacity building sessions, PPE kits	Safer handling, reduced exposure to chemicals	Number of farmers using PPE	County Health, County, sub-county and ward Agriculture Office, IWUA, DOSH	200,000 for purchase of PPE kits and awareness sessions
Water contamination from pesticide runoff	Promote buffer zones, and drip irrigation to reduce leaching	Layout maps, water quality testing	Protected water sources, healthier aquatic systems	Pesticide residues in water samples/ water quality test results	NEMA, WRMA, IWUA, County, sub-county and ward Agriculture Office	120,000 for field visits and water quality analysis

Impact Issue / Pest & Pesticide Threat	Mitigation Measures	Implementation Tool	Expected Results	Monitoring Indicators	Responsibility	Cost Estimate (KES)
Invasive pests (e.g. Fall Armyworm, Tuta absoluta)	Early detection and rapid response measures	Pest surveillance, reporting app	Controlled spread of invasive pests	Frequency of pest reports and response times	KEPHIS, MOALD, IWUA, County, sub-county and ward Agriculture Office	80,000 for surveillance tools, phone-based alert system training
Limited farmer knowledge on IPM	Regular capacity building and farmer field schools	Field schools, posters, radio sensitization	Increased awareness and adoption of IPM	Number of sensitization events, attendance records	IWUA, farmers, County, sub-county and ward Agriculture Office	90,000 for farmer field schools, radio airtime and training materials
Pesticide residues on produce	Promote pre-harvest intervals and good agricultural practices (GAPs)	IPM manual, harvest scheduling	Safer produce meeting market standards	Residue test results on sampled crops	KEBS, Public health department, Farmers, IWUA, County, sub-county and ward Agriculture Office	110,000 for residue testing and training on harvest timing
					Cost of the IPMP Implementation=900,000	

C	DECOMISSIONING PHASE					
Potential Environmental and social impacts	**Recommended Actions**	**Monitoring Indicator**	**Responsibility**	**Monitoring frequency**	**Who to monitor**	**Estimated cost in (Ksh)**
Loss/interruption of livelihoods and food security	a) Support diversification of economic activities such as ecotourism, agro-processing industries, and alternative income-generating projects to stabilize the economy.	Safeguard measures put in place before decommissioning	-IWUA -County government of Bungoma -Ministry of Agriculture and Livestock Development (state department for Agriculture)	Before and during decommissioning	CSSGMO CESCO Ministry of Agriculture and Livestock Development (state department for Agriculture)	Decommissioning budget will be developed before decommissioning based on socio-economic Study.

TOTAL COST OF THE ESMP & IPMP IMPLEMETATION= 6,410,000

Implementation of the Construction Phase of the ESMP will cost KSh. 760,000 and should be included as part of construction cost and loaded into the contract. However, the cost can be amended based on the market dynamics and other technical variations. During the first year of operations a cost estimate of KSh. 4,650,000 should be set aside for monitoring, maintenance as well as capacity building of the IWUA.

9 Conclusions and Recommendations

9.1 Conclusions

In line with the Environmental Management and Coordination Act of 1999 (Revised2015) and the Environmental (Impact and Audit) Regulations, 2019; the results of the environmental impact assessment conducted for the proposed irrigation project suggest that the mitigation measures outlined in the ESMP will effectively address any potential environmental impacts that may arise during the construction and operation phases.

9.2 Recommendations

Based on the experts' judgment after a thorough assessment, the proposed project should be approved as long as the specified mitigation measures are followed. Nonetheless, the main focus should be on reducing the likelihood of effects that would deteriorate the environment as a whole. However, this will be resolved by closely monitoring the situation and putting the suggested Environmental and Social and Management Plans (ESMP) into action.

Based on the project design, the proposed project pipeline infrastructure will cut across a stream as it supplies water to block A of the irrigation command area, the proponent and the contractor are advised therefore to seek for easement permit from WRA before the construction works begin.

A year after the project is commissioned, a thorough audit be conducted and reported to NEMA to verify that all suggested mitigating measures have been followed.

References

1) Architectural design drawings for the proposed project obtained from the proponent
2) Bungoma County Government (2022). County Integrated Development Plan 2022-2027. Bungoma.
3) GOK (1999). Kenya Gazette Supplement Acts 2000, Environmental Management and Coordination Act, 1999 (Cap. 387) (Amendment 2015), NCLR, Nairobi.
4) GOK (1999). Kenya Gazette Supplement Acts, Sessional Paper No. 6 of 1999 on Environment and Development, NCLR, Nairobi.
5) GOK (2003). Kenya Gazette Supplement Acts, Environmental (Impact Assessment and Audit) Regulations 2003 (Revised 2019), NCLR, Nairobi.
6) GOK (2007). Kenya Gazette Supplement Acts, Occupational Health and Safety Act, 2007, NCLR, Nairobi.
7) GOK (2007). Kenya Gazette Supplement Acts, Work Injury Compensation Benefit Act (WIBA), 2007, NCLR, Nairobi.
8) GOK (2009). Kenya Gazette Supplement Acts, Environmental Management and Coordination (Noise and Excessive Vibration, and Pollution Control) Regulations, 2009, NCLR, Nairobi.
9) Ministry Of Agriculture, Livestock, Fisheries and Irrigation. State Department for Crops Development National Agricultural and Value Chain Development Project (NAVCDP) Environment and Social Management Framework.
10) GOK (2010). The Constitution of Kenya, 2010, NCLR, Nairobi.
11) GOK (2011). Kenya Gazette Supplement Acts, National Construction Authority Act, 2011, NCLR, Nairobi.
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14) GOK (2013). Kenya Gazette Supplement Acts, National Environmental Policy, 2013, NCLR, Nairobi.
15) Nairobi County CIDP II (2022– 2027).
16) GOK (2019). Kenya Gazette Supplement Acts, Physical and Land Use Planning Act, 2019, NCLR, Nairobi.
17) GOK (2019). Kenya Population Census 2019, Government Printer, Nairobi.
18) GOK (2020).
19) GOK (2022). Kenya Gazette Supplement Acts, Sustainable Waste Management Act, 2022, NCLR, Nairobi.
20) Kabkara irrigation sub-project feasibility study report 2025.
21) Kenya National Bureau of Statistics (KNBS) (2019A). 2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County. Nairobi, Government Printer.
22) Republic of Kenya (2019). Environmental Management and Coordination (Amendment) Act, 2019. Amendment of the second schedule. NEMA legal Notice No. 31. Kenya gazette supplement no. 62. Nairobi, Government Printer.

23) Republic of Kenya (2019). Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019. NEMA legal Notice No. 32. Kenya gazette supplement no. 62. Nairobi, Government Printer.
24) World Bank (2018) Environment and Social Management Framework.

Annexes

1) Evidence of ongoing registration of the Kabkara IWUA
2) ESS Screening Checklist
3) Evidence of land sale agreement of site where the elevated irrigation water tank will be constructed
4) Topographical map of the irrigation command area
5) Layout of the irrigation infrastructure
6) Elevation across the irrigation command area
7) Design of the pump house and pipeline infrastructure
8) Design of the solar modules and support structures
9) Bills of quantities
10) Minutes of the 1st public forum held
11) Minutes of the 2nd public forum held
12) Attendance list to the 1st public forum
13) Attendance list to the 2nd public forum held
14) The Questionnaires administered
15) List of targeted beneficiaries
16) EIA Practicing License for the lead expert
17) Structure of the Kabkara IWUA
18) Hydrological Study Report
19) Integrated Pest Management Plan (IPMP)

Annex 1: Evidence of Ongoing Registration of the Kabkara (IWUA)

APPLICATION NO:
SOCA-PKSAD6A

BILL REFERENCE NO:
NAO7DV3

DATE:
11 December 2024

SHERIA HOUSE, HARAMBEE AVENUE

Registrar Of Societies

P.O. BOX 40112 – 00100
Nairobi ,Kenya
Tel: +254 732 529 995, +254 711 944 555
Website: http://www.ag.go.ke

CUSTOMER COPY

RECEIPT PAID

ID No: 3355310
Name: MAURICE ASURU ONYARA

Email: mauriceaonyara@gmail.com
Tel: +254725367442

Service Code	Service Description	KES
1	Access fee	50
2	Name Search Service Fee	250
3	Society Registration Service Fee	5000
	Total KES	**5300**

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Annex 2: ESS Screening Checklist

ANNEX 3: ENVIRONMENTAL AND SOCIAL SCREENING CHECKLIST BY BENEFICIARY COMMUNITIES FOR COMMUNITY INVESTMENTS (DEMONSTRATIONS, FLID, EDP ETC)

Section A: Background Information

Name of County..... Bungoma.

Name of CPCU - Environmental /Social Safeguard Compliance Officer

(i) ..... Elijah Obasha.

INVESTMENT LOCATION (Include GPRS Co-ordinates) .....

Name of CIG/VMG/Group ..... KABKARA IRRIGATION WATER USERS ASSOCIATION

Postal Address: .....

Contact Persons

(i) ..... MAURICE ONYARA ..... Cell phone: 0725367442

(ii) ..... Cell phone .....

Sub -project name..... PROPOSED KABKARA IRRIGATION SCHEME.

Estimated cost (Kshs.)..... 55,897,547/=

Approximate size of land area available for the sub -project..... 4.6 HA 4.6 HA

Objectives of the Sub - project

..... TO ESTABLISH IRRIGATION SCHEME.

Activities/enterprises to be undertaken (List)...

(i) .... LAYING OF PIPES

(ii) .... CONSTRUCTION OF OVER HEAD TANK. / TANK

(iii) ....

Be on monoculture cropping?	☐	☑	
Affect any watershed?	☐	☑	
Focus on Biomass/Bio-fuel energy generation?	☐	☑	
Cause accumulation of solid wastes	☐	☑	
Cause accumulation of liquid wastes	☐	☑	

If the answers to any of the above is 'yes', please include an ESMP with Subproject application.

Section C: Socio-economic Issues

Will the subproject/Investment:	**Yes**	**No**	**Remarks** (*If yes, elaborate how*)
Have challenges for women farmers to benefit	☐	☑	
Target vulnerable community members such as physically challenged, Child headed household etc..?	☐	☑	
Interfere with the normal health and safety of the worker/employee?	☐	☑	
Reduce the employment opportunities for the surrounding communities?	☐	☑	
Reduce settlement (*..no further area allocated to settlements)?*	☐	☑	
Reduce income for the local communities?	☐	☑	
Increase insecurity due to introduction of the project?	☐	☑	
Increase exposure of the community to HIV/AIDS?	☐	☑	

Induce conflict?	☐	☑	
Have machinery and/or equipment installed for value addition?	☑	☐	
Introduce new practices and habits?	☐	☑	
Lead to child delinquency (school drop-outs, child abuse, child labour, etc.?	☐	☑	
Lead to gender disparity?	☐	☑	
Lead to poor diets?	☐	☑	
Lead to social evils (drug abuse, excessive alcohol consumption, crime, etc.)?	☐	☑	
Will engage community labour	☑	☐	If yes, Community labor engagement agreement required
Lead to exclusion of disadvantaged and vulnerable groups from participating and benefiting from the investments	☐	☑	
Exacerbate social exclusion of other members of the society	☐	☑	
Lead to increase GBV/SEAH issues	☐	☑	

Section D: Natural Habitats

Will the Subproject:	**Yes**	**No**	**Remarks (If yes, elaborate)**
Be located within or near environmentally sensitive areas (e.g. intact natural forests, mangroves, wetlands) or threatened species?	☐	☑	
Adversely affect environmentally sensitive areas or critical habitats – wetlands, woodlots, natural forests, rivers, etc.)?	☐	☑	
Affect the indigenous biodiversity (Flora and fauna)?	☐	☑	
Cause any loss or degradation of any natural habitats, either directly (through project works) or indirectly?	☐	☑	
Affect the aesthetic quality of the landscape?	☐	☑	
Reduce people's access to the pasture, water, public services or other resources that they depend on?	☐	☑	

Section E: Pesticides and Agricultural Chemicals

Will the subproject.....:	Yes	No	Remarks (If yes, elaborate)
Involve the use of pesticides or other agricultural chemicals, or increase existing use?	☑	☐	
Cause contamination of watercourses by chemicals and pesticides?	☐	☑	
Cause contamination of soil by agrochemicals and pesticides?	☐	☑	
Experience effluent and/or emissions discharge?	☐	☑	
Involve annual inspections of the producers and unannounced inspections for Export produce?	☐	☑	
Require scheduled chemical applications?	☐	☑	
Require chemical application even to areas distant away from the focus?	☐	☑	
Require chemical application to be done by vulnerable group (pregnant mothers, chemically allergic persons, elderly, etc.)?	☐	☑	

*If the answer to the above is 'yes', please consult the **IPMF** that has been prepared for the project to help prepare **IPMP.***

Section F: Indigenous Peoples/VMGs as per ESS7

Are there:	Y	N	Remarks
IP/VMGs living within the boundaries of, or near the project?	☐	☑	Name of the VMG community
Members of VMGs in the area who could benefit from the project?	☐	☑	
IP/VMGs livelihoods to be affected by the subproject?	☐	☑	If yes, How
Unique/specific challenges for VMGs to benefit from the project	☐	☑	Explain
VMGs minority in the community	☐	☑	If yes, Explain/name of minority VMG
Does VMG require to donate land to benefit from the project		✓	If yes, follow Free, prior and informed consent procedure

If the answer to any of the above is 'yes', please consult the VMGF that has been prepared for the project.

Section G: Land Acquisition and Access to Resources

Will the subproject/Investment:	Yes	No	Remarks
Require that land (public or private) be acquired (temporarily or permanently) for its development?	☑	☐	If yes, elaborate the tenure type
Require that community land be acquired (temporarily or permanently) for its development?	☑	☐	If yes, elaborate the registration status and community claims. Community land agreement required following principles of FPIC.
Require more than 10 percent of the affected private land parcel	☐	☑	If yes, exclude from the project proposal
Use land that is currently occupied or regularly used for productive purposes (e.g. gardening, farming, pasture, fishing locations, forests)	☐	☑	If yes, Elaborate the current use/Prepare IRP
Complete land documents are not available for the sub- project investment?	☐	☑	If yes, what process is needed?
Is the land proposed have encumbrances?	☐	☑	If yes, elaborate the encumbrance
Physically displace individuals, families or businesses?	☐	☑	If yes, exclude from the project proposal
Cause loss of income for more than 30 days	☐	☑	If yes, how many. Exclude from the project proposal
Result in temporary or permanent loss of crops, fruit trees/fencing and pasture land/ loss of income from business activity?	☐	☑	If yes, elaborate and prepare IRP
Adversely affect small communal cultural property such as funeral and burial sites, or sacred groves?	☐	☑	If yes, avoid or exclude from project proposal
Result in involuntary restriction of access by people to legally designated parks and protected areas?	☐	☑	If yes, exclude
Be on monoculture cropping?	☐	☑	

If the answer to any of the above is 'yes', please consult the mitigation measures in the ESMF.

Section H: Proposed action

(i) Summarize the above:	(ii) Guidance
☐ All the above answers are 'No' ☑ There is at least one 'Yes'	• If all the above answers are 'No', there is no need for further action; • If there is at least one 'Yes', please describe your recommended course of action (see below).

(iii) Recommended Course of Action

If there is at least one 'Yes', which course of action do you recommend?

☐ CPCU, Social services officer, labour Officer, Children Officer and NEMA - CDE will provide detailed guidance on mitigation measures as outlined in the ESMF; and

☐ Specific advice is required from CDE[1], Lead Scientist and CPCUs regarding Sub -project specific Assessment (s) and also in the following area(s)

☑ All Subproject applications/proposals MUST include a completed ESMF checklist. The NAVCDP-CPCU will review the subproject applications/proposals and the CDEs will sign off; The input from the NLC, Social Services office, Children's office, labour office and the CSSCO will be sought before the documents are presented to the CPSC.

☐ The proposals will then be submitted to CPSC for clearance for implementation by communities in the proposed Subprojects. The projects that require CPRs will be forwarded to NPCU for further analysis also may be forwarded to the World bank for approval and finally to NEMA for clearance certificate (License).

Expert Advice

☐ The Government of Kenya through the Department of Monuments and Sites of the National Museums of Kenya can assist in identifying and, mapping of monuments and archaeological sites;

☐ Expert guidance will also be provided by the land registrar on all issues related to land tenure, The children department on all issues on children, especially child labour, plus department of social services on IPs/vulnerable groups in the community, and

☐ Subproject specific Environmental and Social impact assessments, if recommended, must be carried out by experts registered with NEMA and be followed by monitoring and review. During the process of conducting an ESIAs the proponent shall seek views of persons who may be affected by the Subproject. The ESS10 requires consultation of Subproject affected groups and disclosure of ESIA's conclusions. In seeking views of the public after the approval of the Subproject, the proponent shall avail the draft ESIA report at a public place accessible to project-affected groups and local NGOs/CSO/SAIC/CDDCs.

Completed by: ....

Name: ...IRINE WAFULA.......................

Position / Community: ...B.E (ESS)...........................

[1]County Director of Environment and the County Technical Team

Date: ...9/1/2025...........................

Field Appraisal Officer (NEMA-CDE): ...[illegible]...........

Signature: ....[signature]..............

Date....20/1/2025..............

COUNTY DIRECTOR OF ENVIRONMENT
NEMA - BUNGOMA
20 JAN 2025
P. O. Box 506-50200,
Email: bungoma@nema.go.ke

Note:

Project category	Characteristics
High impact	Full and extensive ESIA needed- irreversible environmental impacts; impacts not easy to pick or isolate and mitigation cost expensive; EMP design not easily done; Must have the ESIA done and future annual EAs instituted
Medium impact ✓	Site specific environmental impacts envisaged; mitigation measures are easy to pick, not costly and ESMP needed, design readily done; need an ESIA and future EAs
Low impact	Have minimal or occasionally NO adverse environmental & social impacts; exempted from further environmental processes save environmental audits. ESMP required
Land	Land tenure documentation needed and land resolution and consent Form needed with project affected person/community
Loss of income and assets	Income restoration plan needed
Presence of VMG/IP	Additional actions needed
Risk of Child labor/SEAH	Additional actions needed

Annex 3: Memorandum of land sale agreement of site where the elevated irrigation water tank will be constructed

REPUBLIC OF KENYA

MEMORANDUM OF LAND SALE AGREEMENT

THIS SALE AGREEMENT is made on this 07TH Day of FEBRUARY 2025 Between MR. RICHARD VINCENT BWARI Of Post Office Box 101-50200 ID No. 4384778 (Herein called *"the vendor"*). Which expression shall where the context so admit include his executers and assigns of the first part and KHWASA BAND IRRIGATED WATER USERS ASSOCIATION Of Post Office Box 56-50201 ID No. ..... (Herein called *"the purchaser"*).

Whereas the vendor is the proprietor of the plot L.T. No. 1047 located in KATONELA 'B' AREA CHEBUKUYI SUB LOCATION LWANDANYI LOCATION LWANDANYI DIVISION BUNGOMA WEST SUB COUNTY BUNGOMA COUNTY Measuring approximately 50X100 FEET of an acre with a commercial building or thereabout and whereas the vendor has agreed to sell and the purchaser has agreed to buy his said interest now this agreement witnessed as follows:-

1. The vendor shall sell and the purchaser shall buy the portion in the said plot at a said price of Kshs. 250,000/= (in words TWO HUNDRED AND FIFTY THOUSAND).
2. The purchaser has paid the vendor the sum of Kshs. 250000/= (TWO HUNDRED AND FIFTY THOUSAND in words) cash and the remaining balance shall be paid by PAID IN FULL the ..... day of 02/05/2025 on signing the agreement. The vendor hereby acknowledges the receipt.
3. Vacant possession of the said plot shall be given by the vendor to purchase on transfer.
4. The vendor shall assist the purchaser in obtaining all the necessary consents to facilitate the sub-division and transfer of the plot.
5. The cost of sub division and transfer of the plot.
6. The cost of sub-division shall be done by the vendor.
7. The vendor shall be responsible for obtaining the rates clearance certificate.
8. Each party shall pay its own Advocates, Chief's / Chief costs.

Signed by:

The vendor: MR. RONALD VINCENT BWABI [signature]
ID No. 4384978

In the presence of MR: STEPHEN SIMIYU BWABI [signature]
ID No. 24683621

Signed by:

Purchaser : MR: MAURICE ASURU ONYARA - CHAIRMAN [signature]
ID No. 3355310
FOR AND ON BEHALF OF KABKARA DAM IRRIGATION WATER USERS ASSOCIATION

In the presence of MR: PHILIP CHEMIAT MNANDI - SECRETARY. [signature]
ID No. 22220705
FOR AND ON BEHALF OF KABKARA DAM IRRIGATION WATER USERS ASSOCIATION.

BUYER'S WITNESS:

1. MAURICE ASURU ONYARA ID No. 3355310 Sign: [signature]
2. PHILIP CHEMIAT MNANDI ID No. 22220705 Sign: [signature]
3. JOHNMARK CHESEBE ID No. 22208505 Sign: [signature]
4. ID No. Sign:

SELLER'S WITNESS:

1. MARY SITAWA BWABI ID No. 4385259 Sign: [signature]
2. AGNETAH LUKELA WAKUNDUKHA ID No. 26943370 Sign: [signature]
3. ID No. Sign:
4. ID No. Sign:

GOVERNMENT REPRESENTATIVE

Name: PHILLAS MUTIEMBU ID No. 21690792 Sign [signature]

COMMISSIONER OF OATHS / MAGISTRATE

Name: ID No. Sign [signature]

KEVIN LUSWETI ADVOCATE COMMISSIONER FOR OATHS P.O. Box 849-50200, BUNGOMA

CHEBUKUYI SUB-LOCATION P.O. Box 100-50208, SIRISIA

7. Annex 7: Standard land take agreement form

County	Sub-County	Ward	Settlement/village
BUNGOMA	(SIRISIA) BUNGOMA-WEST	LWANDANYI	KATOMEI

Name of land/Asset owner	ID Number:	Beneficiary of the project: Y/N
MR RONALD VINCENT BWABI	4384978	Y

Gender (M/F)	Age	Occupation
M	77yrs-	FARMER

Address	P.O. Box 101 – 50209 MALAKISI

Description of land that will be taken for the subproject	Area affected	Total landholding area	Ratio of land affected to total land held:	Map/Title Deed, if available
50 X 100 M	50 X 100 M	5 YEARS		

Description of annual crops/ trees growing on the land now and project impact: BEANS	Description of assets affected and project impact: NO NIL

By signing or providing thumb-print on this form, the land/asset user or owner agrees to contribute assets to the project for the construction and development of the IRRIGATION WATER TANK ...for the benefit of the community. The contribution is voluntary, and the Owner/user will not claim any compensation against the grant of this asset nor obstruct the construction process on the land in case of which he/she would be subject to sanctions according to law and regulations. The owner certifies that they hold the transferable rights of land/asset in question. The owner also commits that the parcel of land does not have encroachment and is free of any litigation or encumbrances

By signing or providing thumb-print on this form, the subproject proponent agrees to accept this grant of asset for the purposes mentioned.

Name of affected person : RONALD VINCENT BWABI
Signature :
Id Number 4384978 :
Date 24/5/2025 :

Name of CIG/VMG Representative MAURICE ASURU ONYARA
Signature
ID. 3355310 No
Date 24/5/2025

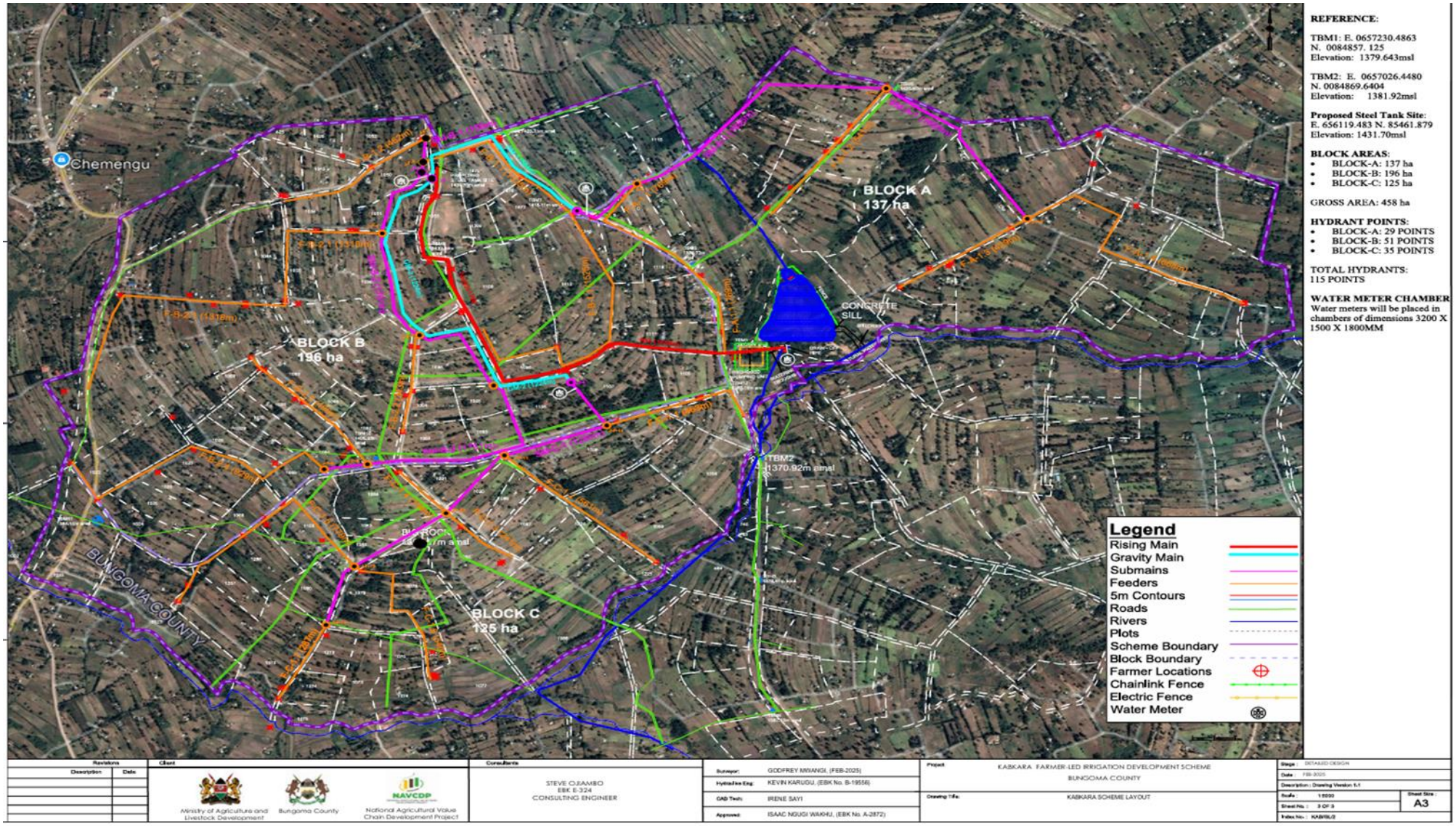
Name of Local Chief : PHYLLIS NTIEMBU
Signature :
ID. No : 21690792
Date : 24/5/2025

Commissioner for Oaths
Signature
Date

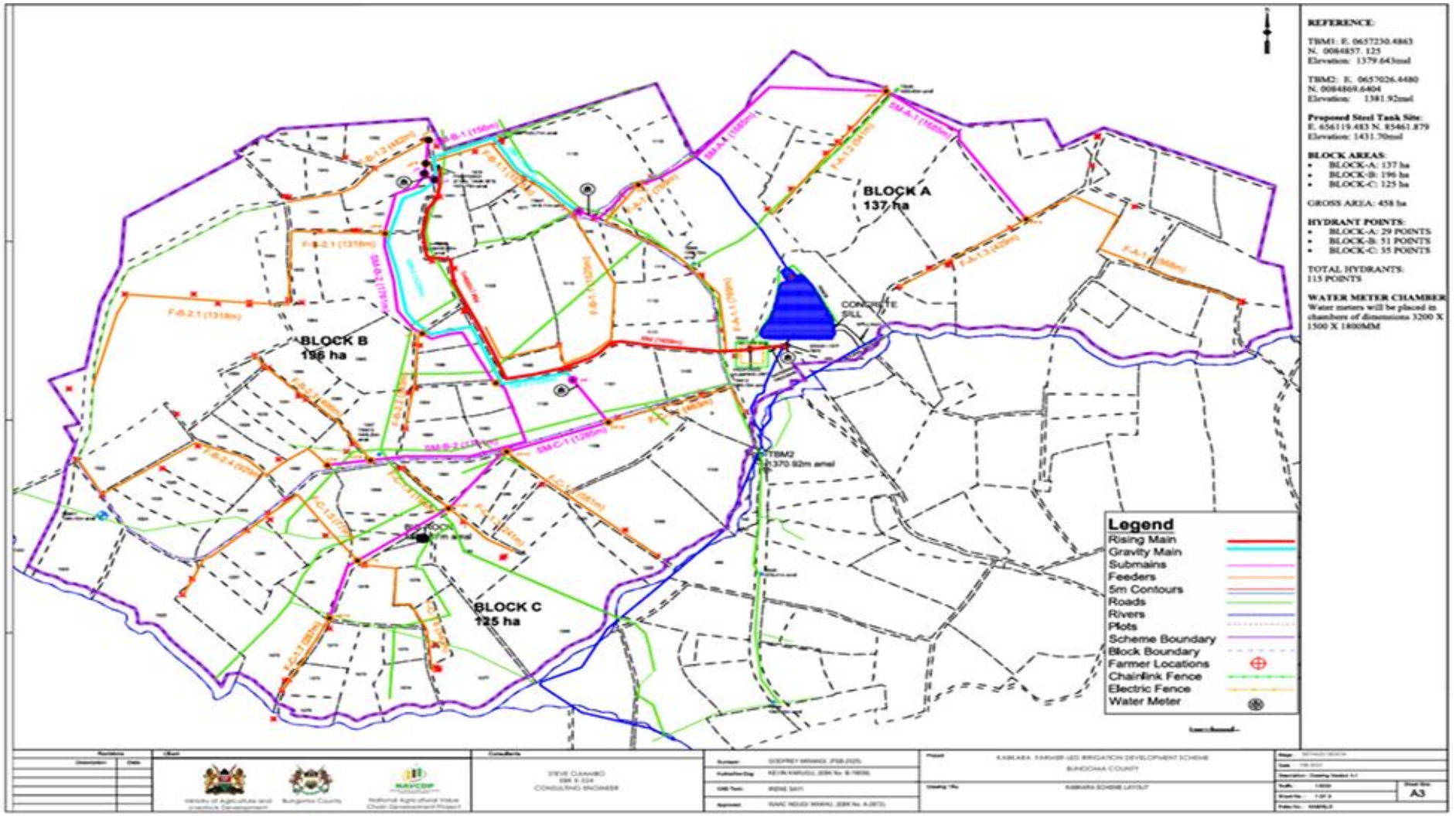
KEVIN LUSIVETI
ADVOCATE
COMMISSIONER FOR OATHS
P. O. Box 349-50200, BUNGOMA

CHEBUKATI SUB-LOCATION
P. O. Box 100-50208, SIRISIA

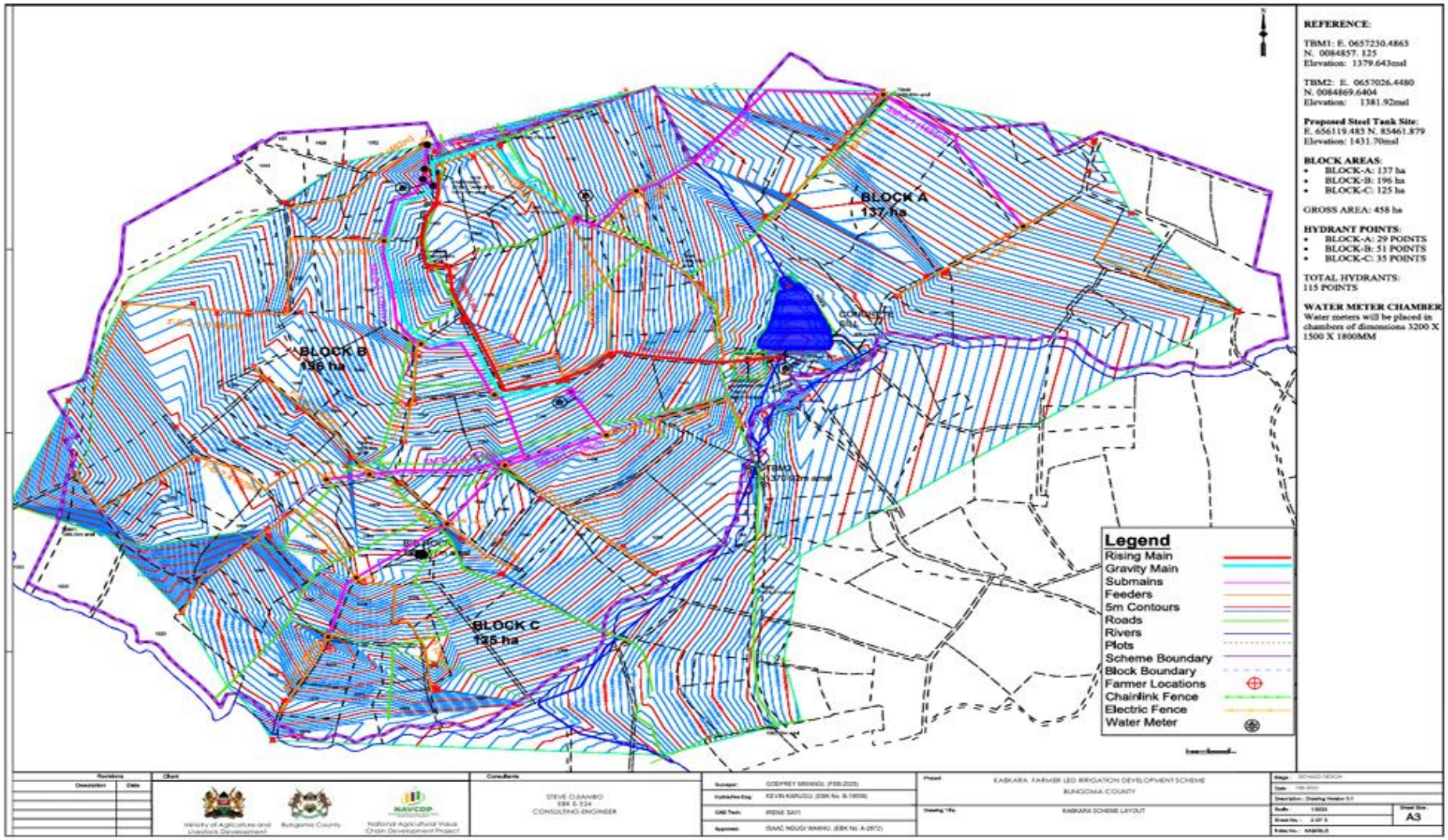
Annex 4: Topographical Maps of the irrigation Command Area



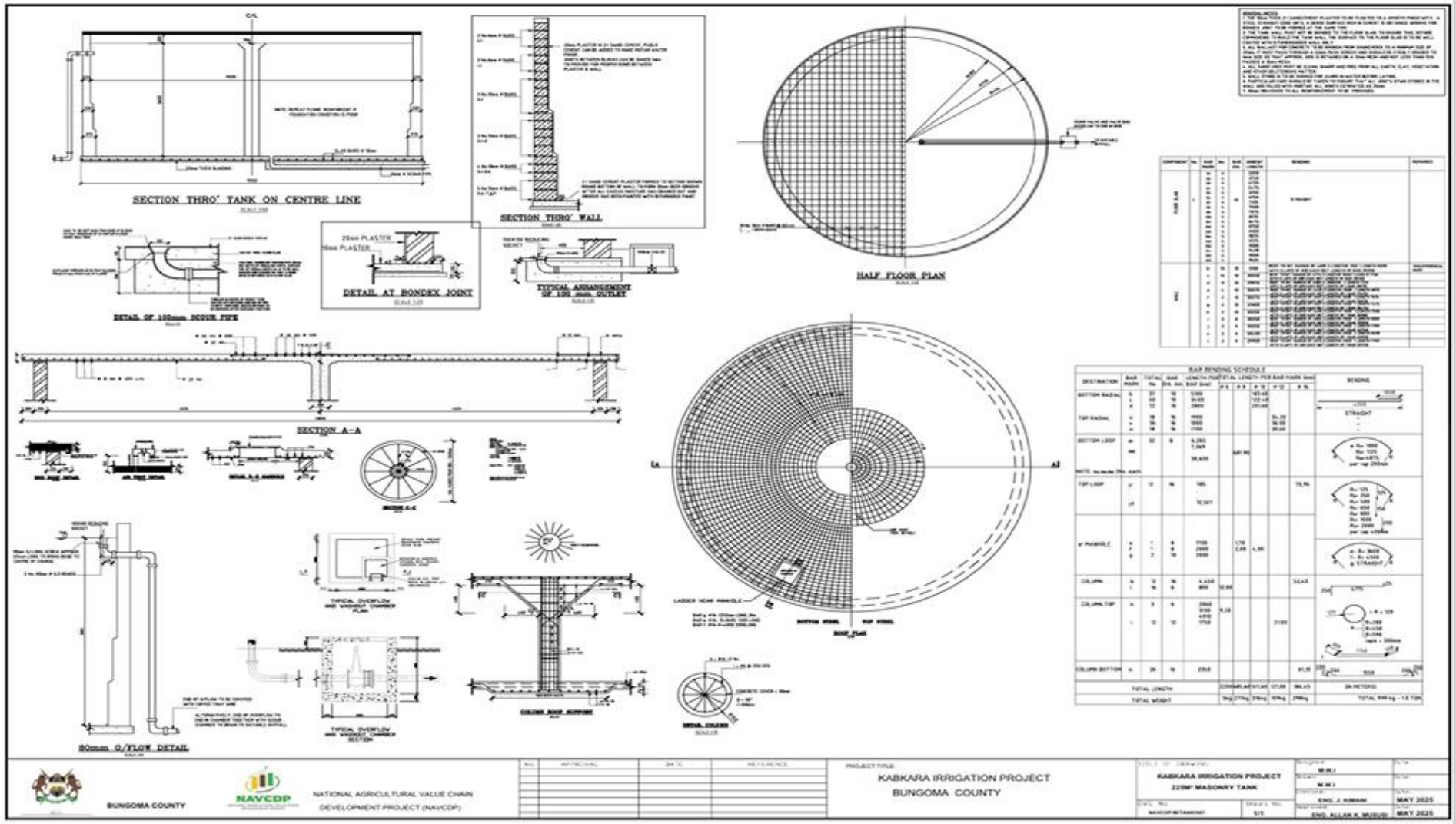
Annex 5: The layout of the irrigation infrastructure in the command area

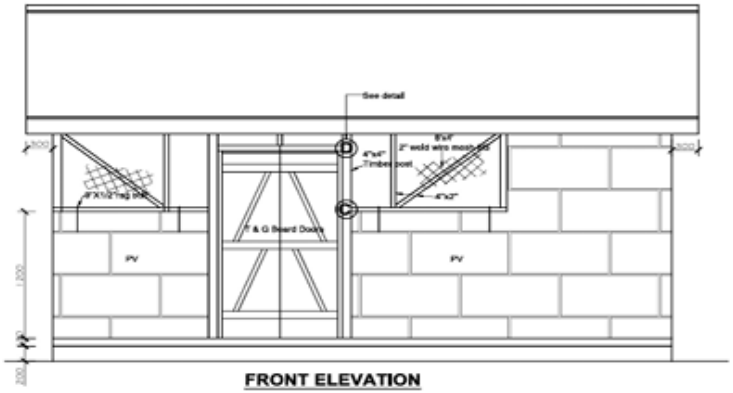


Annex 6: Map of the Irrigation Command Area Showing Elevation across the Area

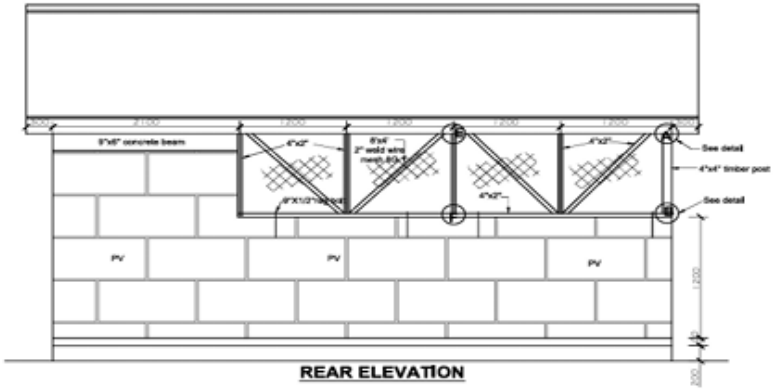


Annex 7: Designs of the Pump House and the Pipeline Infrastructure

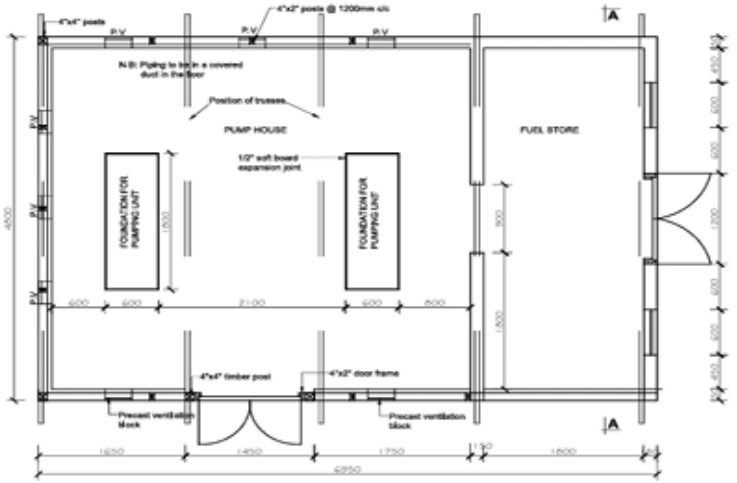




FRONT ELEVATION

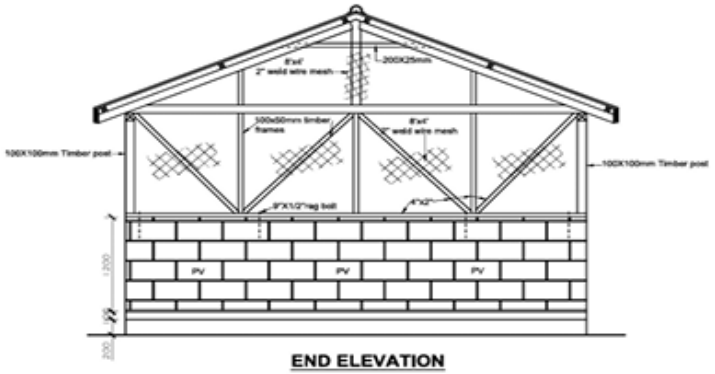


REAR ELEVATION

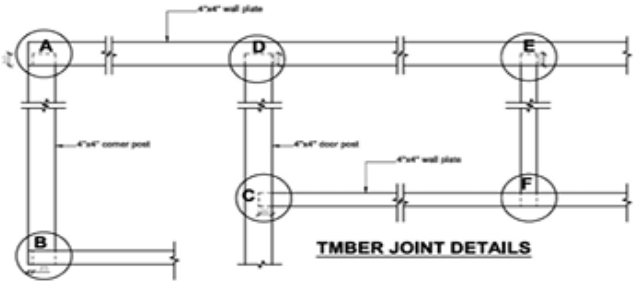


PLAN

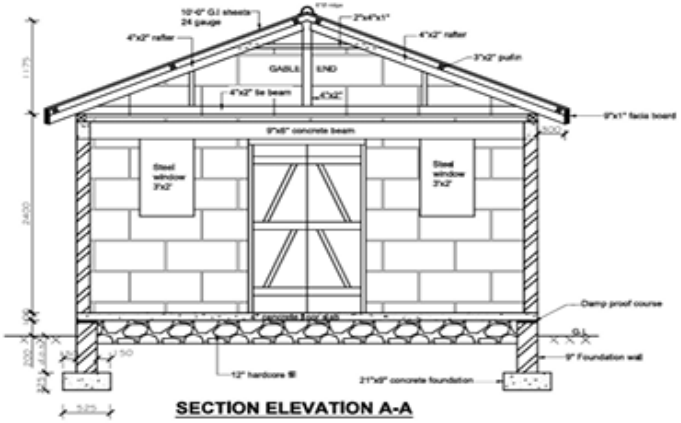
Revisions		Client:			Consultant:			
Description	Date	Ministry of Agriculture, Livestock and Fisheries	Bungoma County	National Agricultural Value Chain Development Project	STEVE OJIAMBO EBK R-324 CONSULTING ENGINEER	Surveyor: GODFREY MWANGI (FEB-2025) Hydraulics Eng: KEVIN KARUGU (EBK No. R-11556) CAD Tech: IRENE SAYI Approved: ISAAC NGUGI WAKAI (EBK No. A-2672)	Project: KABKARA FARMER LED IRRIGATION DEVELOPMENT SCHEME BUNGOMA COUNTY Drawing Title: PUMP HOUSE WITH FUEL STORE PLAN AND ELEVATIONS	Stage: DETAILED DESIGN Date: Description : Drawing Version 1.1 Scale: NTS Sheet No. : 1 OF 3 Index No. : KKD-MD-11A Sheet Size: A3



END ELEVATION



TMBER JOINT DETAILS



SECTION ELEVATION A-A

MATERIALS - PUMPHOUSE

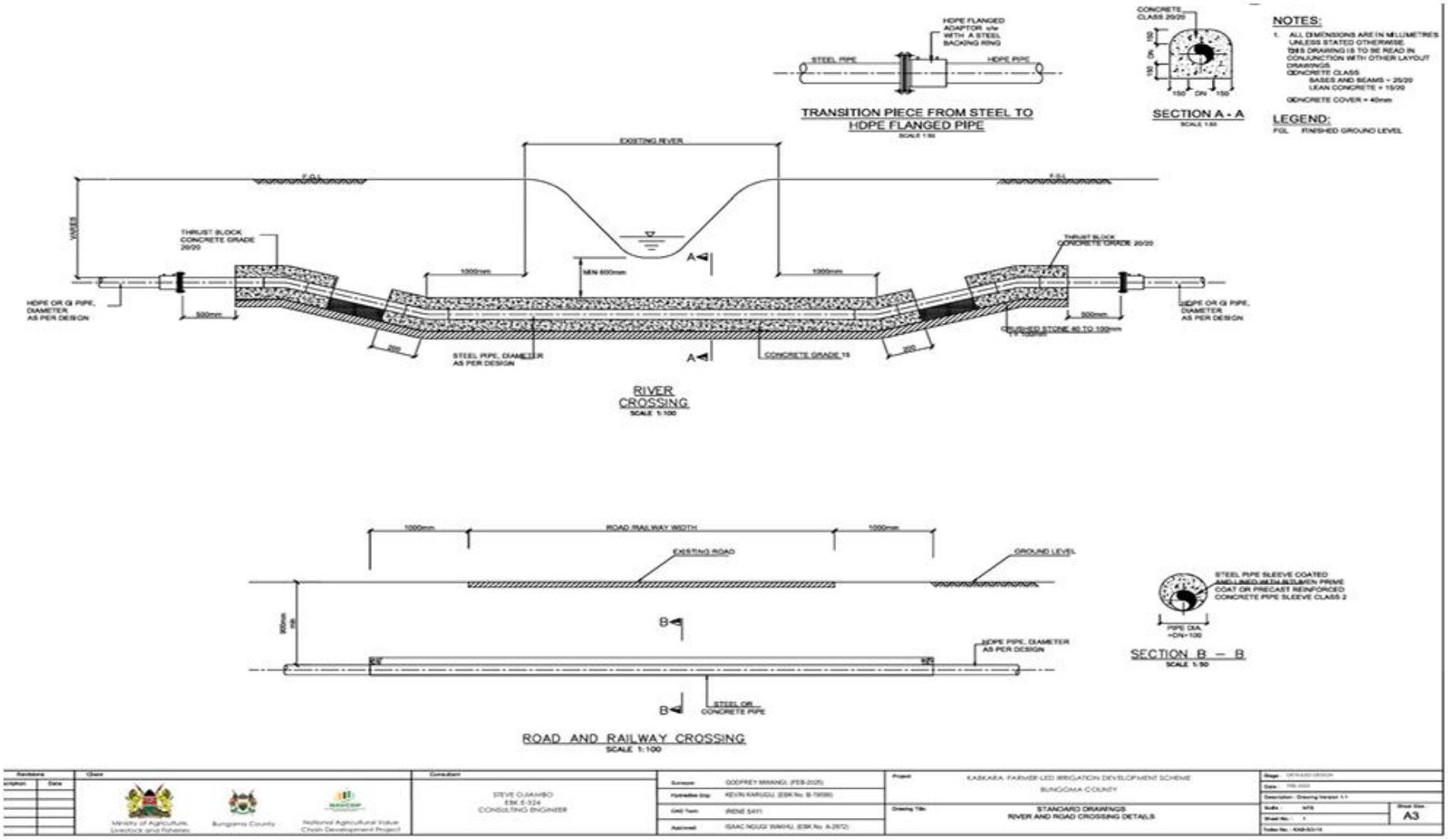
Description	Unit	Quantity
18"x9"x6" concrete blocks	No	1,000
Aggregate 3/4"- 1/4" graded	Tons	20
Cement	Bags	140
1/2"Ø M.S. bars	Ft	100
X(12x9" long bolts and nuts with washers	No	18
X(12x9" long bolts and nuts with washers	No	6
3"x2" cellcure podo timber G.S	Ft	200
4"X1"X8ft. Long	No	12
4"X2"X12ft. Long	No	12
4"X2"X8ft. Long	No	25
4"X2"X14ft. Long	No	10
4"X2"X8ft. Long	No	13
4"X4"X10ft. Long	No	4
4"X4"X7ft. Long	No	2
4"X4"X8ft. Long	No	2
8'x4' weldmesh (2"x2") sheets	No	8
9"x1" fascia board	Ft	120
2"x1" timber	Ft	350
(Steel windows N.C.I 1'-6"X3'-5/8" R&L Manufacture of ideal casement) or approved equal	No	2
C.I roofing sheets 24G, 10ft. long	No	28
Ridge 24G, 6ft. Long	No	5
Roofing Nails	Kg	16
Wire Nails 2"	Kg	4
Wire Nails 21/2"	Kg	10
Wire Nails 3"	Kg	10

MATERIALS - PUMPHOUSE

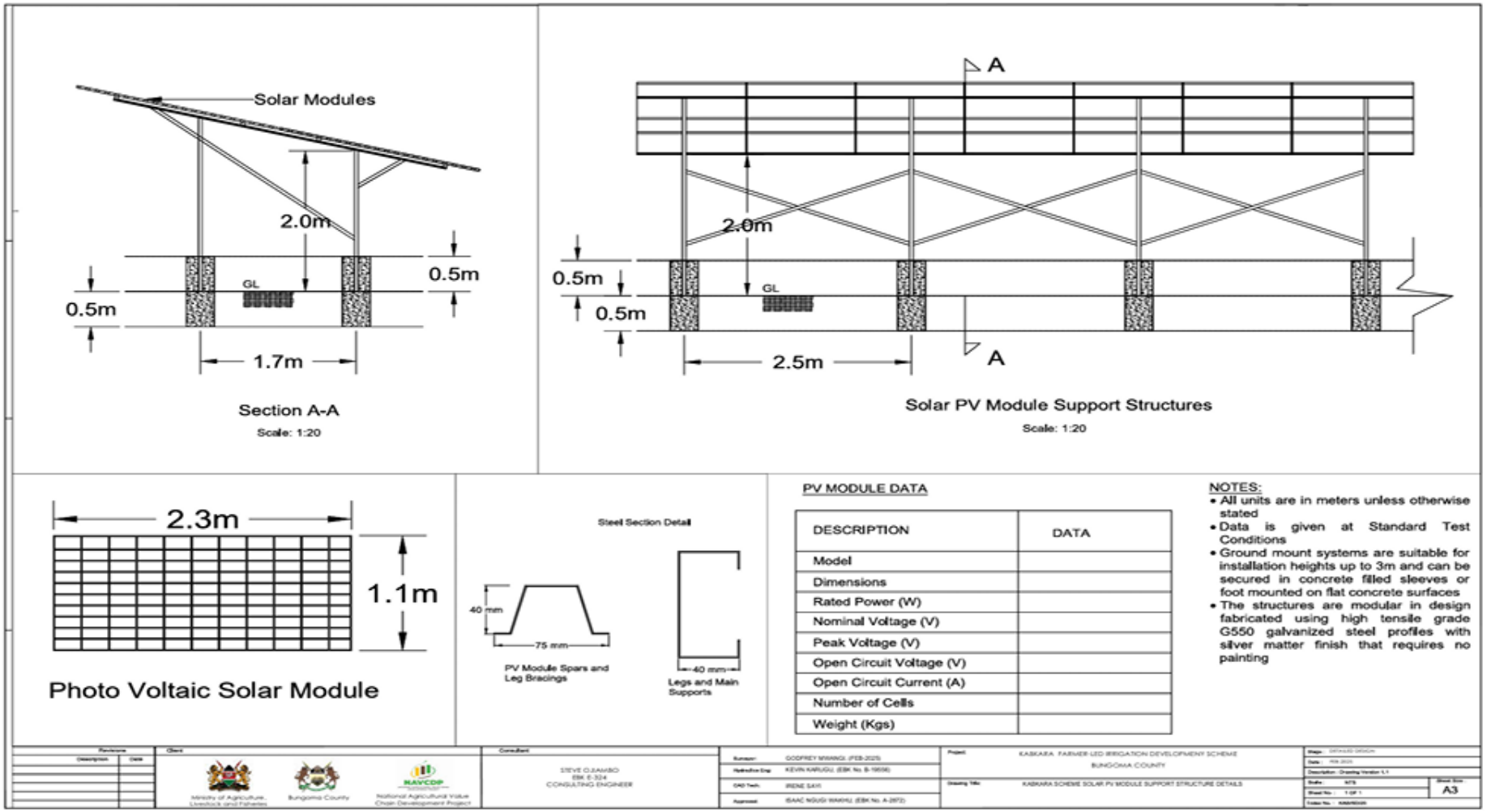
Description	Unit	Quantity
Wire Nails 4"	Kg	15
Wire Nails 5"	Kg	10
1 1/2" "U" fencing staples		
3Ply damp proof course roofing felt	Roll	1
Hoop iron plate, 1" thick	Rolls	2
Cedar timber double doors T & G battern	No	2
"T" Hinges, 6" long, heavy	pairs	6
Screws 11/4"x9" long	Packets	2
Pad bolt, 9" long	No	1
Pad lock, 2" long	No	1
Tower bolts, 6" long	No	4
TIMBER FOR SHUTTERING (CYPRESS)	Ft	200
4"X2"	Ft	200
3"X2"	Ft	250
6"X1"		

Note:
All joints and ends of weldmesh to be covered with 2"x1" timber.

Revisions		Client	Consultant				
Description	Date	Ministry of Agriculture, Livestock and Fisheries; Bungoma County; National Agricultural Value Chain Development Project	STEVE OJIAMBO EBK E-324 CONSULTING ENGINEER	Surveyor: GODFREY MWANGI. (FEB-2025)	Project: KABKARA FARMER-LED IRRIGATION DEVELOPMENT SCHEME BUNGOMA COUNTY	Stage: DETAILED DESIGN	
				Hydraulics Eng.: KEVIN KARUGU. (EBK No. B-19556)		Date: FEB-2025	
				CAD Tech.: IRENE SAYI	Drawing Title: PUMP HOUSE WITH FUEL STORE SECTIONS	Description: Drawing Version 1.1	
				Approved: ISAAC NGUGI WAKHU. (EBK No. A-2672)		Scale: NTS	Sheet Size: A3
						Sheet No.: 2 OF 3	
						Index No.: KAB-SCI-11B	



Annex 8: Design of the Solar Modules and Support Structures



Annex 9: Bills of Quantities

Bill of Quantities – Engineer's Estimate

Grand_Summary

	Grand Summary	
	Net Area (ha)	46
Ref	**Description**	**Amount (KES)**
2	Pipe works	32,850,192
3	Solar Array, Water pumps and Pontoon	9,431,213
4	Fencing and Lightning Protection	1,157,000
5	Balancing 225m3 Masonry Tank	3,330,780
	Sub total (A)	**46,769,185**
P&G	Preliminaries and general items	6,466,575
	Sub total (B)	**53,235,760**
CS	Contingecy Sum (5% of subtotal B)	2,661,788
	GRAND TOTAL	**55,897,548**
	Cost Per HA	**1,215,164**

Annex 10: Minutes of the first public forum held (The minutes are the typed as well as handwritten and signed copy for the forum held)

Minutes for Consultative Public Participation on the Environmental and Social Impact Assessment Report of the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County

CONSULTATIVE PUBLIC PARTICIPATION FOR IRRIGATION AND WATER USERS' ASSOCIATION (IWUA) COMMITTEE

Minutes of the consultative public participation meeting for irrigation and water users' association (IWUA) committee held at Kabkara dam in Kabkara village, Lwandanyi ward, Bungoma County on the 28th January 2025.

Members present: (*attached participants lists*)

AGENDA

1. Opening remarks
2. Introduction of the proposed project-background and technical aspects
3. The importance and legal requirements of the environmental and social impact assessment (ESIA)
4. IWUA Committee contribution-questions, comments, views
5. Response to the IWUA questions and comments
6. Adjournment

Minute 1/28/01/2025/ESIA: Opening Remarks

The meeting commenced at 12:00 noon, with the chairman of the Kabkara dam Irrigation and Water Users' Association (IWUA) leading the session. He welcomed the attendees and expressed gratitude for their participation. The IWUA treasurer then opened the meeting with a prayer. The chairman introduced the IWUA committee members, followed by the introduction of the project team and the ESIA experts by the CESCO of Bungoma County. The CESCO outlined the primary objective of the meeting, which was to provide an opportunity for the IWUA committee to share their views—both positive and negative—on the proposed Kabkara Irrigation Project and to propose possible mitigation measures.

Minute 2/28/01/2025/ESIA: Introduction of the proposed project

The vice chairman of the IWUA outlined the history of the Kabkara dam proposed irrigation project. Originally the dam was built between 1952 and 1962 for livestock, domestic use, and fishing, the dam fell into disrepair by the 1980s. Heavy rainfall in 2019 and siltation further reduced its water storage capacity. In 2022, the water user's association secured funding from the NARIGP project to desilt the dam, increasing its capacity to 133,200 cubic meters. Building on this, the association proposed an irrigation project under the NAVCDP initiative, which will use solar energy to pump water for gravity-fed irrigation, ensuring sustainable agriculture in the area.

Minute 3/28/01/2025/ESIA: The importance and Legal Requirements of the ESIA

Silas Rakama, an ESIA expert, addressed the IWUA committee to highlight the importance of their input both positive and negative on the environmental and social impacts of the Kabkara irrigation

project, as required by the EMCA 1999 (amended 2015). He outlined the key phases of the Environmental and Social Impact Assessment (ESIA)—construction, operation, and decommissioning—and stressed the committee's role in ensuring a comprehensive evaluation. After discussing potential environmental impacts, Silas invited sociologist Carolyne Mungu to present the social impacts and possible mitigation strategies.

Positive Social and Environmental Impacts

- Creation of employment opportunities during construction and operational phase
- Creation of market for construction materials that can be sourced locally
- Transfer of skills (contractor and other experts)
- Creation of business opportunities to local traders
- Women empowerment
- Economic development of the area
- Increased income and improved livelihoods
- Year-round farming through irrigation hence increased food security
- Poverty elievation among the targeted beneficiaries
- Improved nutrition due to diversification of diet
- Improved water availability and supply in the area

Negative Social and Environmental Impacts

- Conflict over water when the level of the dam goes down
- Conflict over land during the piping process
- Conflict with road users during construction of the way leave
- Disputes on who is responsible to ensure sustainability of the project when its operationalized
- Pollution of air and soil when using farming chemicals and sprays
- Risk of accidents and injuries for workers
- Solid and liquid waste generation from the construction site
- Soil erosion due to excavation during laying of pipes
- Sexual harassment and exploitation
- Gender based violence
- Conflict on water usage due to poor knowledge of the proposed project

Minute 4/28/01/2025/ESIA: Stakeholders /IWUA Contributions (Questions, Comments and Views)

Agriculture Department Bungoma County

- There is need for the IWUA to embrace the proposed project

- It is essential for the owners of the farms with marked elevated points to provide a plot for the construction of the collection tank.
- The IWUA committee should identify a willing member who is ready to offer the plot, and in return, be compensated through contributions from the IWUA committee
- There is need for the members who will receive the water to distribute it to the other family members to avoid conflicts

Irrigation and water users Association (IWUA) Committee

- Clarity is needed by the IWUA committee on how they will select the plot to build the collection tank
- Guidance is needed on how the IWUA will ensure that the water for irrigation is used appropriately and not diverted for other water-intensive activities like brick making by the community
- During the operational phase of the project, how will overproduction of farm produce be controlled?
- Clarity is needed on how a 100ft land needed to build the collection tank will acquire the title deed
- Guidance on whether consent letter can replace title deeds in plots that have no title deeds for the construction of the collection tank
- What is the deadline for the IWUA to get the plot needed to construct the tank?
- If the collection tank ends up being built at Katomei primary school, will a title deed be required for the plot allocated for the water tank or the IWUA will use the school title deed?
- How will the IWUA committee benefit from the fish which is stocked in Kabkara dam?
- Will the NAVCDP project assist the IWUA in purchasing the required plot of land for building the water tank?
- How will conflicts resulting from water shortage be addressed by the IWUA?
- Why was the number of beneficiaries for the proposed irrigation project reduced from 116 to 42?
- Why is the proposed irrigation project excluding farms near the Bungoma-Busia border, claiming they are in Busia County? Is the project being politicized?

ESIA Experts

- Does the IWUA has a registration certificate and KRA certificate?
- Does the IWUA has a grievance management committee?
- How many wards are benefiting from Kabkara dam water?
- Are there any conflicts between the wards benefiting from Kabkara dam?
- Can any land issues affect the production of crops under the proposed irrigation project?

- Does the IWUA understand how the irrigation process will be done?
- Does the IWUA committee understand the activities that will be carried out before the project is implemented?
- Is the IWUA committee contributing maintenance fee of the project through operations and maintenance committee?

Minute 5/28/01/2025/ESIA: Response from ESIA Experts

- On how to select the plot for the collection tank it will be based on the elevated points marked by engineers at the three farms near Katomei primary School. The IWUA committee will work with the farm owners to find one willing to donate the land, and the chosen owner will be fairly compensated upon agreement.
- On how to regulate water usage and prevent wastage, community sensitization is essential. Educating the public on water conservation and its importance can encourage responsible behavior. Implementing a metering system, with penalty fees for exceeding consumption limits, can also help reduce waste and promote efficient use.
- In the operation phase, overproduction will be managed through training farmers on value addition, diversifying markets to new towns, and forming cooperatives for collective marketing, improving organization and bargaining power.
- On how the 100ft land will get a title deed, the project increased the size of the plot to construct the collection tank to ¼ an acre to accommodate the water tank, IWUA office and a SACCO building
- Using a consent letter instead of a title deed is not feasible for World Bank-funded projects, as only a title deed or official minutes from the land control board are accepted for compliance.
- The deadline for acquiring the plot to build the water tank is not yet issued but the IWUA committee should move with haste to get the plot through meeting the owners of the identified farms. When the process of finalizing the proposed irrigation project is complete and the proposed project is ready to start information will be relayed to the IWUA immediately
- If the collection tank ends up being constructed at Katomei primary school there will be no need to get a title deed for the plot which the tank will be constructed however the school can give consent letter and attach it with its title deed or parcel land number since many schools don't have title deeds. However, construction of the collection tank in the school is highly discouraged to avoid conflicts between the community and the school
- On whether NAVCDP project will assist the IWUA committee on purchasing the ¼ acre plot of land it will be discussed by the county project coordinating unit and the IWUA committee once a willing seller among the three marked farms comes forward and agreement is reached
- On matters of conflict resulting from water shortage, communities will be sensitized on water rationing to ensure equitable distribution of resources
- The claim that the number of beneficiaries for the proposed irrigation project has been reduced from 116 to 42 is inaccurate. The number of beneficiaries remains at 116. However, it is the area of land that will be served by the proposed project that has increased to 42 hectares.

- On the issues of irrigation project extending to Busia County will not be possible because the proposed irrigation project is for Bungoma county but Busia County can benefit buy watering their livestock

Response from the IWUA Committee Chairman

- The IWUA has no KRA certificate nor the registration certificate but it's in the process of acquiring them
- The IWUA has grievance management committee in place
- The Kabkara dam water benefits two wards, Lwandanyi in Bungoma county and Angurai East in Busia County. The Angurai East ward in Busia County will not benefit from the irrigation project since it's located in another county but they will water livestock using the dam water
- There is no conflict between Lwandanyi and East Angurai wards over the proposed irrigation project. The Irrigation Water Users Association (IWUA) supports the decision to focus the project in Bungoma County, acknowledging its benefits will also positively affect neighboring areas.
- On whether the land issues can affect production under the proposed project the answer is no the community is supporting the project
- On whether the IWUA is aware of how the irrigation process will be done, yes, the IWUA is aware that the irrigation project will cover a 3km radius of land where 116 farmers will benefit by irrigating a1/4 of their land from the irrigation project. Using solar energy water will be pumped to the collection tank and then it will flow to the beneficiaries' farms using gravity flow
- The IWUA is aware of preliminary activities before the project starts like excavation activities, piping and tank construction
- The IWUA is still contributing monthly fee for the maintenance of the dam through the operations and maintenance committee

Way forward from the ESIA Experts

- The team thanked everybody for their contribution and assured the IWUA committee that during the assessment, every concern will be considered and merited
- The ESIA experts assured the IWUA committee that they will generate a comprehensive environmental management plan (EMP)that will incorporate all their concerns and their proposed mitigation measures in their final report before submitting to the National Environment Management Authority (NEMA) for evaluation
- The EMP will be a guiding tool to the contractor on the issues of sustainability managing the social and environmental aspects during construction operation and decommissioning phase of the proposed project
- The IWUA committee was encouraged to cooperate with the contractor to ensure easy implementation and success of the proposed project

Minute 6/28/01/2025/ESIA: Adjournment

There being no other business the IWUA chairman thanked the committee and the ESIA experts as well as the project officers for attending the meeting and the contributions raised and addressed.

Afterwards, he invited a volunteer from the meeting to close the meeting with award of prayer and the meeting ended at 2:30 pm.

Minutes For Consultative Public Participation on the Environmental and Social Impact Assessment Report of the proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County

CONSULTATIVE PUBLIC PARTICIPATION FOR IRRIGATION AND WATER USERS' ASSOCIATION (IWUA) COMMITTEE

Minutes of the consultative public participation meeting for irrigation and water users association (IWUA) Committee held at Kabkara dam in Kabkara village, Lwandanyi ward, Bungoma County on the 28th January 2025.

Members present: (attached participants list)

AGENDA

1. Opening remarks
2. Introduction of the proposed project - background and technical reports
3. The importance and legal requirements of the environmental and social impact assessment (ESIA)
4. IWUA committee contribution - questions, comments, views
5. Response to the IWUA questions and comments
6. Adjournment

Minute 1/28/01/2025/ESIA: Opening Remarks

The meeting commenced at 12:00 noon, with the chairman of the Kabkara dam Irrigation and water users Association (IWUA) leading the session. He welcomed the attendees and expressed gratitude for their participation. The IWUA treasurer then opened the meeting with a prayer. The chairman introduced the IWUA committee members followed by the introduction of the project team and the ESIA experts by the CEEO of Bungoma County. The CEEO outlined the primary objective of the meeting, which was to provide ~~any~~ an opportunity for the IWUA committee to share their views - both positive and negative - on the proposed Kabkara Irrigation project and to propose possible mitigation measures.

Minute 2/28/01/2025/ESIA: Introduction of the proposed project

The vice chairman of the IWUA outlined the history of the Kabkara dam proposed Irrigation project. Originally the dam was build between 1952 and 1962 for livestock, domestic use and fishing, the dam fell into disrepair by the 1980s. Heavy rainfall in 2018 and siltation further reduced its water storage capacity. In 2022 the water users association secured funding from the NARIGP project to desilt the dam, increasing its capacity to 132,200 (m^3) cubic metres. Building on this, the association proposed an Irrigation project under the NAVCDP project, which will use solar energy to pump water

for gravity-fed irrigation ensuring sustainable agriculture in the area.

Minute 3/28/01/2025 | ESIA: The Importance and Legal requirement of the ESIA

Silas Rakama, an ESIA expert addressed the IWUA committee to highlight the importance of their input both positive and negative on the environmental and social impacts of the Kabkara irrigation project, as required by the EMCA 1999 (amended 2015). He outlined the key phases of the Environmental and Social Impact Assessment (ESIA) – Construction, operation and decommissioning – and stressed the committee's role in ensuring a comprehensive evaluation. After discussing potential environmental impacts, Silas invited sociologist Carolyne Mungu to present the social impacts and possible mitigation strategies.

Positive Social and Environmental Impacts

- Creation of employment opportunities during construction and operational phase
- Creation of market for construction materials that can be sourced locally
- Transfer of skills (Contractor and other experts)
- Creation of business opportunities to local traders
- Women empowerment
- Economic development of the area
- Increased income and improved livelihoods
- Year-round farming through irrigation hence increased food security
- poverty alleviation among the targeted beneficiaries
- Improved nutrition due to diversification of diet
- Improved water availability and supply in the area.

Negative Social and Environmental Impacts:

- Conflict over water when the level of the dam goes down
- Conflict over land during the piping process
- Conflict with road users during construction of the way leave
- Disputes on who is responsible to ensure sustainability of the project when its operationalized
- pollution of air and soil when using farming chemicals and sprays
- Risk of accidents and injuries for workers
- Solid and liquid waste ~~management~~ generation from the construction site
- Soil erosion due to excavation during laying of pipes
- Sexual exploitation and harassment and exploitation
- Gender based violence
- Conflict on water usage due to poor knowledge of the proposed project.

Minute 4/28/01/2025 | ESIA: Stakeholder | IWUA Contribution (Question, Comments and Views)

Agriculture Department Bungoma County

- There is need for the IWUA to embrace the proposed project
- It is essential for the owners of the farms marked elevated points to provide a plot for the construction of the collection tank
- The IWUA committee should identify a willing member who is ready to offer the ~~plot~~ plot and in return, be compensated through contributions from the IWUA committee.
- There is need for the members who will receive the water to distribute it to the other family members to avoid conflicts.

Irrigation and Water Users' Association (IWUA) Committee

- Clarity is needed by the IWUA committee on how they will select the plot for construction of the collection tank
- Guidance is needed on how the IWUA will ensure that the water for irrigation is used appropriately and not diverted for other water-intensive activities like brick making by the community.
- During the ~~proposed~~ operational phase of the project, how will overproduction of farm produce be controlled?
- Clarity is need on how a 10ft land needed to build the collection tank will acquire the title deed.
- Guidance on whether consent letter can replace title deed in plots that have no title deed for the construction of the collection tank.
- What is the deadline for the IWUA to get the plot needed to construct the tank?
- If the collection tank ends up being built at Katomei primary school, will a title deed be required for the plot allocated for the water tank or the IWUA will use the school title?
- How will the IWUA committee benefit from the fish which is stocked in the dam?
- Will ~~the~~ the NAVCDP project assist the IWUA in purchasing the required plot of land for building the water tank?
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ESIA Experts

- Does the IWUA has a registration certificate and KRA certificate?
- Does the IWUA has a grievance management committee?
- How many wards are benefiting from Kabkara dam?
- Can any land issues affect the production of crops under the proposed irrigation project?
- Does the IWUA understand how the irrigation process will be done?
- Does the IWUA committee understand the activities that will be carried out before the project is implemented?
- Is the IWUA committee contributing the maintainance fee of the project through the operations and and maintainance committee?

Minute 5/28/01/2025/ESIA: Response from ESIA Experts

- On how the IWUA will select the plot for the collection tank it will be based on the elevated points marked by engineers at the three farms near Katomei primary school. The IWUA committee will work with the farm owners to find one willing to donate the land, and the chosen owner will be fairly compensated upon agreement
- On how to regulate water usage and prevent wastage, community sensitization is essential. Educating the public on water conservation and its importance can encourage responsible behavior. Implementing a metering system, with penalty fees for exceeding consumption limits, can also help reduce waste and promote efficient use.
- In the operation phase, overproduction will managed through training farmers on value addition, diversifying markets to new towns, and forming cooperatives for collective marketing, improving organization and bargaining power
- On how the IWUA land will get a title deed the project increased the size of the plot to construct the collection tank to ¼ an acre to accommodate the water tank, IWUA office and a SACCO building.
- Using a consent letter instead of a title deed is not feasible for World Bank funded projects, as only title deeds or official minutes from the land control board are accepted for compliance.
- The deadline for acquiring the plot to build the water tank is not yet issued but the IWUA committee should move with haste to get the plot through meeting the owners of the identified farms. When the process of finalizing the proposed irrigation project is complete and the proposal project is ready to start information will be relayed to the IWUA immediately
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- The IWUA committee faces challenges in benefiting from the fish in the dam due to non-compliance with the fish rearing and harvesting protocols. A potential solution is to partner with the fisheries department ensuring adherence to the required procedures for responsible fish management
- On whether NAVCDP project will assist the IWUA committee on purchasing the ¼ acre plot of land it will be discussed by the county project coordinating unit and the IWUA committee once a willing seller among the three marked farms comes forward and agreement is reached.
- On matters of conflict resulting from water shortage, communities will be sensitized on water rationing to ensure equitable distribution of resources.
- The claim that the number of beneficiaries for the proposed project has been reduced from 116 to 42 is inaccurate. The number of beneficiaries remains at 116. However, it is the area of land that will be served by the proposed project that has increased to 42 ~~acres~~ hectares.
- On the issues of irrigation project extending to Busia county will not be possible because the project is for Bungoma County but Busia county can benefit by watering their livestock in the Kabkara dam.

Response from the IWUA Committee chairman

- The IWUA has no KRA certificate nor the registration certificate but its in the process of acquiring them
- The IWUA has grievance management Committee in place to manage grievances.
- The Kabkara dam water benefits two wards, Lwandanyi in Bungoma county and Angurai East in Busia county. The Angurai East ward in Busia county will not benefit from the irrigation project since its located in another county but they will water livestock using the dam water.
- There is no conflict between Lwandanyi and East Angurai wards over the proposed project. The IWUA supports the decision to pow the project in Bungoma county, acknowledging its benefits will also positively affect neighbouring areas.
- On whether land issues can affect production under the proposed project the answer is no the community is supporting the project.
- On whether the IWUA is aware of how the irrigation proces will be done, yes, the IWUA is aware that the irrigation project will cover a 3km radius of land where 116 farmers will benefit by irrigating ¼ of their land from the irrigation project. Using solar energy water will be pumped to the collection tank and then it will flow to the beneficiaries' farms using gravity flow.
- The IWUA is aware of preliminary activities before the project starts like excavation activities, piping and tank construction
- The IWUA is still contributing monthly fee for the ~~maintenance~~ maintenance of the dam through the operations and maintainance committee

Way forward from the ESIA Experts

- The team thanked everybody for their contributions and assured the IWUA (IWUA Committee) that during the assessment, every concern will be considered and merited
- The ESIA experts assured the IWUA Committee that they will generate a comprehensive environmental management plan (EMP) that will incorporate all of their concerns and their proposed mitigation measures in their final report before submitting to the National Environmental Management Authority (NEMA) for evaluation
- The EMP will be a guiding tool to the contractor on the issue of sustainably managing the social and environmental aspects during construction, operation and decommissioning phase of the proposed project
- The IWUA Committee was encouraged to cooperate with the contractor to ensure easy implementation and success of the proposed project

Minute 6/28/01/2025/ESIA/ Adjournment

There being no other business the IWUA chairman thanked the committee and the ESIA experts as well as the project officers for attending the meeting and the contributions raised and addressed. Afterwards he invited a volunteer from the meeting to close the meeting with a word of prayer. and the meeting ended at 2:30 pm.

MINUTES PREPARED BY: CAROLYNE MUHGU

28/01/2025

MINUTES ENDORSED BY: GEDION OMUNYIN AJA

28/01/2025

...OF BUNGOMA
VILLAGE ADMINISTRATOR
KABKARA ... UNIT
LWANDANYI WARD

Annex 11: Minutes of the second public meeting held (typed copy for clarity and handwritten notes approved and signed)

Minutes for Consultative Public Participation on the Environmental and Social Impact Assessment Report of the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County

CONSULTATIVE PUBLIC PARTICIPATION MEETING

Minutes of the consultative public participation meeting held at Kabkara Dam, Kabkara village, Lwandanyi Ward, Bungoma West Sub- County, Bungoma County, on 30th January 2025.

Members present: (*attached participants list*)

AGENDA

7. Opening remarks
8. Introduction of the proposed project to the participants
9. The importance and legal requirements of the environmental and social impact assessment (ESIA)
10. Community contribution-questions, comments, views and response to the questions and comments
11. Adjournment

Minute 1/30/1/2025/ESIA: Opening Remarks

The meeting was called to order at 11:30 AM by the Irrigation and Water Users Association chairman, Maurice Onyara. He began by requesting a volunteer to lead the meeting with a word of prayer, which was followed by a round of introductions by the community members (see attached list of participants). After the introductions, the chairman invited the county project team to introduce themselves. Following this, the team proceeded to introduce the ESIA experts from the national project office**.**

Minute 2/30/1/2025/ESIA: Introduction of the proposed project to the participants

Elijah Obatha (CESCO) introduced the proposed project to the attendees, providing a detailed explanation of its operations. He elaborated on the necessity of conducting an environmental and social impact assessment (ESIA) for the project, emphasizing its significance in ensuring sustainability and compliance with environmental regulations. Additionally, he highlighted the importance of public participation, explaining that involving the community from the outset would help address concerns, gather valuable input, and promote transparency before the project commenced.

Minute 3/30/1/2025/ESIA: Importance and Legal Requirements of the ESIA

The IWUA chairman invited the CESCO, who then invited ESIA experts to provide guidance on the proposed Kabkara Irrigation Project. ESIA expert Silas Rakama outlined the meeting objective which was to allow the participants to share their views, as required by law under EMCA (1999, amended in 2015). He explained the ESIA process, its phases (construction, operation, and decommissioning), and the importance of community participation. He then highlighted the project's environmental impacts before inviting his sociologist colleague, Carolyne Mungu, to discuss the proposed project social impacts and propose mitigation measures.

Positive Social and Environmental Impacts

- Creation of employment opportunities during construction and operational phase
- Creation of market for construction materials that can be sourced locally
- Transfer of skills (contractor and other experts)
- Creation of business opportunities to local traders
- Women empowerment
- Economic development of the area
- Increased income and improved livelihoods
- Year-round farming through irrigation hence increased food security
- Poverty elievation among the targeted beneficiaries
- Improved nutrition due to diversification of diet
- Improve water availability and supply in the area

Negative Social and Environmental Impacts

- Conflict of water when the level of the dam goes down
- Conflict over land during the piping process
- Conflict with road users during construction of the way leaves
- Disputes on who is responsible to ensure sustainability of the project when its operationalized
- Pollution of air and soil when using farming chemicals and sprays
- Risk of accidents and injuries for workers
- Solid and liquid waste generation from the construction site
- Soil erosion due to excavation during laying of pipes
- Sexual harassment and exploitation
- Gender based violence
- Conflict on water usage due to poor knowledge of the proposed project

Minute 4/30/1/2025/ESIA: Stakeholders /Community Contributions (Questions, Comments and Views) and response to the questions and comments

The members in attendance were given the opportunity to ask questions, seek clarification, and provide input on the proposed project. After thorough discussion, they accepted the proposed project, acknowledging its potential impacts and the corresponding mitigation measures.

Key issues /opinions raised and responses

S/No	KEY ISSUES/OPINIONS RAISED	RESPONSES/OPINIONS

1.	The vice chairman of the Kabkara IWUA sought clarification on how family members of mapped farms will benefit from the irrigation project, particularly if their own farms were not included?	The farm owner will share water with the other family members through resource-sharing, based on a consensus for fair distribution of resources. This will ensure efficient water use and supports sustainable farming for both parties.
2.	Will all the people living in the marked parcels of land even if they are buyers not the original owners of the land benefit from the proposed project?	Yes, they will benefit from the proposed project
3.	How will the community address conflict on water use?	Conflicts will be managed by the IWUA sub-committee of grievance management, which will create by laws to control disputes. A water metering system will be implemented, with penalty fees for exceeding usage limits, promoting accountability and responsible consumption.
4.	How will the community control pollution which may result from excess use of farm chemicals during operationalization of the project	Through capacity building of the community to use the regulated pesticides. Promoting organic farming and eco-friendly alternatives will further reduce chemical reliance.
5.	What are some of the factors that can cause the close of the irrigation project?	If the dam's water levels drop and the Kabkara stream's supply is insufficient, along with complete silting. The community should focus on regular dam maintenance and explore alternative livelihoods. This will help reduce reliance on a single water source and ensure long-term economic resilience.
6.	Can the NAVCDP project support those famers excluded from the irrigation project by establishing fishponds?	The community should join SACCOs to save money and access loans, which will enable them to finance fish pond projects independently. By pooling resources, they can build a sustainable financial base and empower themselves to implement these projects without relying on grants.
7.	How will the payment to the workers happen during the excavation to lay the water pipes, before work or after a week?	A mutual agreement will be established between the workers and the contractor, with the IWUA committee ensuring that the workers receive payment from the contractor
8.	How will SEAH issues be handled during the construction phase of the proposed project?	The contractor must comply with SEAH conditions outlined in the contract, ensure the use of a dedicated hotline for reporting issues, and cooperate with authorities, including the police gender desk, to address incidents promptly and effectively.
9.	During the operational phase of the project, how will overproduction of farm produce be controlled?	overproduction will be managed through training farmers in value addition, diversifying markets to new towns, and forming cooperatives for collective marketing and bargaining power
10.	Clarity was needed on how a 100ft land needed to build the collection tank will acquire the title deed	The project increased the size of the plot to construct the water tank for collection to ¼ an acre to accommodate the water tank, IWUA office and a SACCO
11.	Give guidance on whether consent letter can replace title deeds in plots that have no title deeds for the construction of the collection tank	Using a consent letter instead of a title deed is not feasible for World Bank-funded projects, as only a title deed or official minutes from the land control board are accepted for compliance
12.	Will the NAVCDP project assist the IWUA in purchasing the required plot of land for building the water tank?	It will be discussed by the county project coordinating unit and the IWUA committee once a willing seller among the three marked farms comes forward and an agreement is reached
13.	If the collection tank ends up being built at Katomei primary school, will a title deed be required for the plot allocated for the water tank or the IWUA will use the school title deed?	There will be no need to get a title deed for the plot which the tank will be constructed however the school can give consent letter and attach it with its title deed or parcel land number since many schools don't have title deeds. However, construction of the collection tank in the school is highly discouraged to avoid conflicts

14.	Why was the number of beneficiaries for the proposed irrigation project reduced from 116 to 42?	The number of beneficiaries remains at 116. However, it is the area of land that will be served by the proposed project that increased to 42 hectares.
15.	Why is the proposed irrigation project excluding farms near the Bungoma-Busia border, claiming they are in Busia County? Is the project being politicized?	On the issues of irrigation project extending to Busia County will not be possible because the proposed irrigation project is for Bungoma county but Busia County can benefit by watering their livestock
16.	Are there any conflicts between the wards benefiting from Kabkara dam?	There is no conflict between Lwandanyi and East Angurai wards over the proposed irrigation project. The Irrigation Water Users Association (IWUA) supports the decision to focus the project in Bungoma County, acknowledging its benefits will also positively affect neighboring areas.
17.	Can any land issues affect the production of crops under the proposed irrigation project	No, the community is supporting the project
18.	How will the IWUA committee benefit from the fish which is stocked in Kabkara dam?	The IWUA committee struggles with benefiting from the dam's fish due to non-compliance with fish rearing and harvesting protocols. A possible solution is partnering with the fisheries department to ensure proper adherence to responsible fish management practices.
19.	How will conflicts resulting from water shortage be addressed by the IWUA?	communities will be sensitized on water rationing to ensure equitable distribution of resources

Way forward from the ESIA Experts

- The team thanked everybody for their contribution and assured the community that during the assessment, every concern will be considered and merited
- The ESIA experts assured the community that their final report, submitted to the National Environment Management Authority (NEMA) for evaluation, will include a comprehensive Environmental Management Plan (EMP) that addresses all community concerns and proposed mitigation measures.
- The EMP will serve as a guiding tool for the contractor, ensuring the management of social and environmental aspects while promoting sustainability throughout the construction, operation, and decommissioning phases of the proposed project
- The community was encouraged to cooperate with the contractor to ensure easy implementation and success of the proposed project

Minute 5/30/1/2025/ESIA: Adjournment

The attendees in unison by show of hands accepted the proposed irrigation project. Then the IWUA chairman thanked attendees for their participation and contributions, acknowledged the issues discussed, and invited a volunteer to close the meeting with a prayer. The meeting adjourned at 3:00 PM.

Annex 12: Attendance list to the first public engagement forum (28th January 2025)

REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: KABKARA IWUA PUBLIC PARTICIPATION

VENUE: KABKARA DAM DATE: 28/01/2025

ATTENDANCE LIST

	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1	CAROLINE MUNGU	28230319	F	NAVCDP-NPOE	HQ	0724792462	✓		[illegible]
2	SILAS RAKAMA	28039721	M	NAVCDP-NPOE	HQ	0711445914	✓		[illegible]
3	NAOMI KOMOL	26062665	F	NEMA	HQ	0726577065		✓	[illegible]
4	WILIAM ONURA	29307281	M	NAVCDP-NPOE	HQ	0720123110	✓		Onura
5	ELIJAH OBAGA	14721202	M	NAVCDP	HQ	0720611742		✓	[illegible]
6	JONAS OKOTO	9320291	M	MOALC	HQ	0724869435		✓	[illegible]
7	Irene Ikubano	23650647	F	NAVCDP	HQ	0720856533		✓	[illegible]
8	LEWIS MARAHI	27740639	F	NAVCDP	HQ.	0727303542		✓	[illegible]
9	Rebbecca Luswili	1199531	F	NAVCDP	HQ	0722629693		✓	[illegible]

REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: INCEPTION COMMUNITY ENTRY MEETING

VENUE: KABKARA DAM DATE: 27/01/2025

ATTENDANCE LIST

NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
SILAS RAKAMA	28039721	M	NAVCDP-NPOE		0711445914	✓		[illegible]
CAROLINE MUNGU	28230319	F	NAVCDP-NPOE		0724792462	✓		[illegible]
Caroline Chitembe	21324670	F	NAVCDP		0729916771		✓	[illegible]
Abwao Biketi	22664586	M	NAVCDP		0728086210		✓	[illegible]
Silvanus Wanjala	21777691	M	NAVCDP		0725891283		✓	[illegible]
Mary Lulu	9570987	F	NAVCDP		0721547250		✓	[illegible]
Emmanuel Kibebe	21653683	M	NAVCDP		0726927581		✓	[illegible]
Dan Omia	11048135	M	NAVCDP		0722635272		✓	[illegible]
Daniel Luagu	21915990	M	NAVCDP	HQ	0720971396		✓	[illegible]
Shadrack Wafula	12704483	M	NAVCDP	HQ	0727574615		✓	[illegible]
Antony Luvai	8836692	M	NAVCDP	HQ	0721117131		✓	[illegible]

National Agricultural Value Chain Development Project (NAVCDP) – Bungoma County

REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: INCEPTION MEETING

VENUE: KABKARA DAM DATE: 27/1/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
	Irene Ikiluno	23651097	F	NAVCDP	HQ	0720856537		✓	[illegible]
	Stephen Menahi	20328671	m	MOALFC	HQ	0712964835	✓		[illegible]
	NAOMI KOMOL	26062665	F	NEMA	HQ	0728577066		✓	[illegible]
	ELECTINA NABWIRE	28562572	F	MOALFC	HQ	0715490231	✓		[illegible]

REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: KABKARA QUESTIONNAIRE ADMINISTRATION

VENUE: KABKARA VILLAGE DATE: 29/01/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1	CAROLINE MUNGU	28730319	F	NAVCDP-NPOE	HQ	0724792462	✓		[illegible]
2	SILAS RAKAMA	28039721	M	NAVCDP-NPOE	HQ	0711445914	✓		[illegible]
3	William Onura	29307281	M	NAVCDP-NPOE	HQ	0720123110	✓		[illegible]
4	Elijah Obadha	1472000	m	NAVCDP	HQ	0720611743		✓	[illegible]
5	JOAB OKOTO	9376291	M	MOALFC	HQ	0724869455		✓	[illegible]
6	LEWIS MARATI	27740639	F	NAVCDP	HQ	0727303542		✓	[illegible]
7	Rebbecca Lusweti	1119958	F	NAVCDP	HQ	0702629673		✓	[illegible]
8	IRINE WAFULA	30925329	F	MOALFC	HQ	0799329924	✓		[illegible]

National Agricultural Value Chain Development Project (NAVCDP) – Bungoma County

Annex 13: Attendance list to the second public engagement forum (30th January 2025)

REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

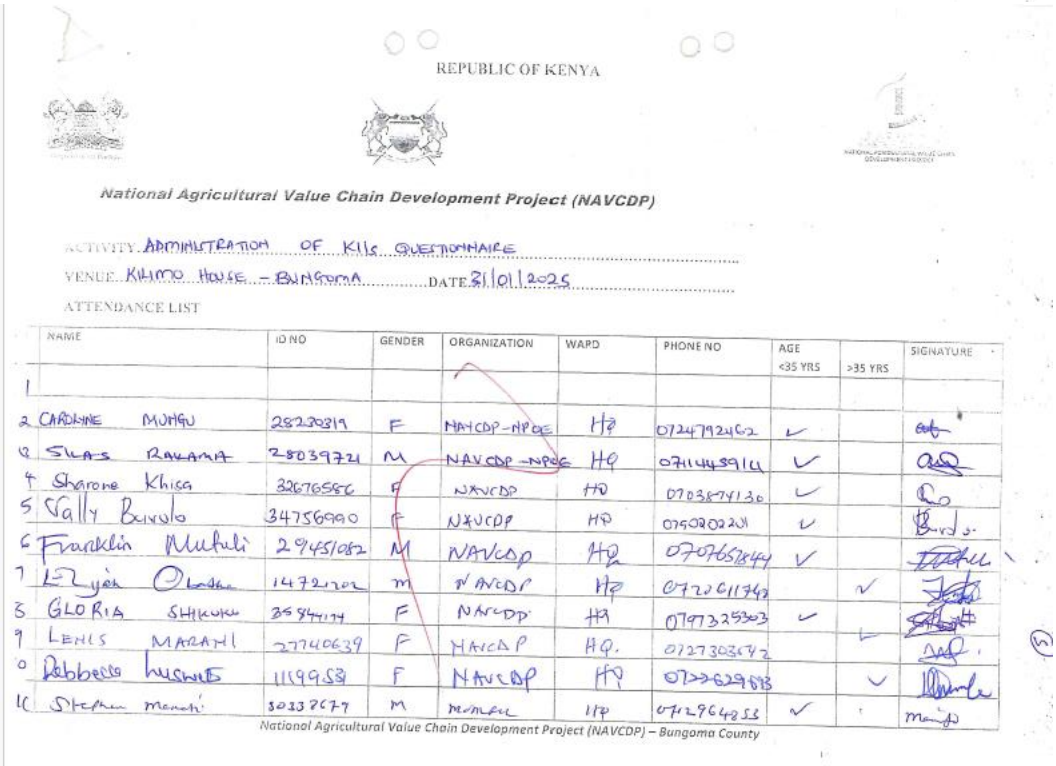
ACTIVITY: COMMUNITY PUBLIC PARTICIPATION

VENUE: KABKARA DAM DATE: 30/01/2025

ATTENDANCE LIST

	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1	CAROLYNE MUNGU	28280319	F	NAVCDP-NPDE		0724792462	✓		
2	SILAS RAKAMA	28039721	M	NAVCDP-NPDE	HQ	0711445914	✓		
3	William Owuor	29307281	M	NAVCDP-NPDE	HQ	0720123110	✓		
4	ELIJAH ORMDIA	14721702	M	NAVCDP	HQ	0720611742		✓	
5	LENIS MARAMI	27740639	F	NAVCDP	HQ.	0727303542		✓	
6	Rebbecca Lusweti	11199583	F	NAVCDP	HQ	0722629688		✓	

National Agricultural Value Chain Development Project (NAVCDP) – Bungoma County



REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: ADMINISTRATION OF KIIs QUESTIONNAIRE

VENUE: KILIMO HOUSE – BUNGOMA DATE: 31/01/2025

ATTENDANCE LIST

	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1									
2	CAROLYNE MUNGU	28280319	F	NAVCDP-NPDE	HQ	0724792462	✓		
3	SILAS RAKAMA	28039721	M	NAVCDP-NPDE	HQ	0711445914	✓		
4	Sharone Khisa	32676556	F	NAVCDP	HQ	0703874130	✓		
5	Sally Barula	34756990	F	NAVCDP	HQ	0750202201	✓		
6	Franklin Mukuli	29451082	M	NAVCDP	HQ	0707652844	✓		
7	ELijah Ondieki	14721702	M	NAVCDP	HQ	0720611742		✓	
8	GLORIA SHIKUKU	35844174	F	NAVCDP	HQ	0797325363	✓		
9	LENIS MARAMI	27740639	F	NAVCDP	HQ.	0727303542		✓	
10	Rebbecca Lusweti	11199583	F	NAVCDP	HQ	0722629688		✓	
11	Stephen Mwanzi	30337677	M	NAVCDP	HQ	0712964855	✓		

National Agricultural Value Chain Development Project (NAVCDP) – Bungoma County

REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY..2ND PUBLIC BARAZA

VENUE.....KABKARA DAM.....DATE.....30/01/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1.	GRACE N. KUTO	10040837	F	V/ELDER	LWANDANYI	0741877103		✓	
2.	LYDIA ALUNGATA	632866	F	FARMER	LWANDANYI	0724951273		✓	
3.	ABIGAEL OKOBA	11020222	F	1WUA FM	LWANDANYI	0711266735		✓	
4.	MOURINE CHEPTABUT	34511031	F	1WUA	LWANDANYI	0757535880	✓		
5.	BRAMWEL KOMES	2098271	M	Farmer	Lwandanyi	0720665290		✓	
6.	LAURENCE PAPA	7600358	M	Farmer	Lwandanyi	0721791044		✓	
7.	SIMON N. MKUU	4385410	M	FARMER	LWANDANYI	0700824917		✓	
8.	~~PETER BARASA~~	~~32449191~~	~~M~~						
9.	PETER BARASA	32449191	M	FARMER	Lwandanyi	0743640027		✓	
10.	Fredrick Kamundu	27055787	M	1 WUA	Lwandanyi	0796448825		✓	
11.	ABUD BIKETI	22664584	M	NAVCDP	HQ	0728466210		✓	

REPUBLIC OF KENYA

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY...PUBLIC PARTICIPATION FOR LIST OF BENEFICIARIES

VENUE.....KABKARA DA.....DATE..30/1/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1.	BRAMWEL OPESI	7958964	M.	FARMER	Lwandanyi	0724872228		✓	
2.	EMILY PAPAI	29450490	F	1WUA. M	LWANDANYI	0712856616		✓	
3.	EVERLYNE AMOJONG	23669846	F	1WUA MEMBER	LWANDANYI	0700715965		✓	
4.	FRANCIS M. KIPROKIET	7958564	M	V/ELDER FARMER	LWANDANI	0713970886		✓	
5.	BRAMWEL KARAKWAI	9682516	M	V "	LWANDANYI	0729916871		✓	
6.	JUSTUS F. GMUNGASI	22027643	M	V/ELDER	LWANDANYI	0741155261		✓	
7.	CHETERA JAMES	23841162	M	1WUA	LWANDANYI	0718306600		✓	
8.	JOSEPHINE N. WEKESA	20174758	F	1WUA TREASURER	LWANDANYI	0790885579		✓	
9.	RICHARD EMURIA	6325261	M	V. ELDER	LWANDANYI	0704161803		✓	
10.	HELEN CHEPKWEMOI	13435044	F	V-ELDER	LWANDANYI	0706941559		✓	
11.	BEATRICE NDIWA	13145760	F	V/ELDER	LWANDANYI	0711501767		✓	

REPUBLIC OF KENYA

Republic of Kenya

NAVCDP

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: Public participation for ESIA Development.

VENUE: KABAKARA DATE: 30/1/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
12	James Wasilonwa	20576762	M	Security	Lwandanyi	0799462038		✓	[signature]
13	George . E. EB	8783997	M	F	Lwandanyi	0758211514		✓	[signature]
14	Lani Sangalo	13649786	M.	Farmer	Lwandanyi	0745218000		✓	[signature]
15	WILFRED Juma	2063695	M	Farmer	Lwandanyi	0720872966		✓	[signature]
16	Ilias Murunga	10719913	M.	Farmer	Lwandanyi	0792595986		✓	[signature]
17	LUCY CHENGEK	34807726	F	Security	Lwandanyi	0790134462	✓		[signature]
18	ELIAKIM OMASET	62317	M	Farmer	Lwandanyi	—		✓	[signature]
19	Dominic Ojuma	26173114	M	Farmer	Lwandanyi	07686878		✓	[signature]
20	EREMINA HASAMBU	–	F	Farmer	Lwandanyi	–		✓	[signature]
21	RAEL KHAYANGA	8972802	F	Farmer	Lwandanyi	0727686464		✓	[signature]
22	MORICE MUTULI	9238961	M	Farmer	LWANDANYI	0715815631		✓	[signature]

REPUBLIC OF KENYA

Republic of Kenya

NAVCDP

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: PUBLIC PARTICIPATION FOR ESIA DEVL

VENUE: KABAKARA DATE: 30/1/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
23	JUKREA CHEMIAT	13650105	M	FARMER	LWANDANYI	0798612715		✓	[signature]
24	Roda MOSE	4383596	C			0706884462			[signature]
25	JUSTUS WAMATO	4367068	M	FARMER	LWANDANYI	0716912062		✓	[signature]
26	GODFREY WCMAKHA	11787969	M	FARMER	Lwandanyi	071598047		✓	[signature]
27	EDWARD SEME	23932414	M	FARMER	Lwandanyi	0742826478		✓	[signature]
28	MOSES ETYANG	13649964	M	FARMER	"	0716305852		✓	[signature]
29	Mafura Edwin	27313069	M	FARMER	"	0725790369		✓	[signature]
30	OMAKABA-K DOUGLAS	31978142	M	IWUA-YOUTH REP	" "	0740731753	✓		[signature]
31	David Isilo	25890533	M	FARMER	"	0711974204	✓		[signature]
32	ISAAC EMOJONG	1289415	M	IWUA	LWANDANYI	0726319609		✓	[signature]
33	Jannis Malaha	11021265	M	Farmer	"	0711944483	✓		[signature]

REPUBLIC OF KENYA

Republic of Kenya

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY......PUBLIC PARTICIPATION FOR LESIA DEVL.

VENUE......KATAKALA......DATE......30/1/2025......

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
34	BENSON JAMHURI	22568290	M	MOALFIC	LWANDANYI	0721306017		✓	
35	BAKIARABAH W. WEKESA	1511269	M	OCPD		0722-135800			
36	A.F MOHAMUD	9566915	M	DCC	BGM WEST	0722134642		✓	
37	DENNIS OLWIPIP	23736442	M	DCI	BGM WEST	0729696584		✓	
38	EMMANUEL MABONGA	22714726	M	NGAO	BGM WEST	0725725315			
39	JUDITH CHEROTICH	20637415	F	NGAO	LWANDANYI	0711425762		✓	
40	PHYLLIS MUTIEMBU	21690792	F	NGAO	LWANDANYI	0724496040		✓	
41	MAURICE A. ONYARA	3355310	M	IWUA CHAIR	"	0725367412		✓	
42	PHILIP C. MANANDI	22220705	M	IWUA SECRETARY	LWANDANYI	0720558978		✓	
43	DISMAS OSIKUKU	2098470	M	COFFEE CHAIR.	LWANDANYI	0113864830		✓	
44	TIMOTHY CHEPKOI	20692355	M.	VILLAGE ELDER	LWANDANYI	0768851424		✓	

National Agricultural Value Chain Development Project (NAVCDP) – Bungoma County

REPUBLIC OF KENYA

Republic of Kenya

NAVCDP
NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

National Value Chain Development Project (NAVCDP)

ACTIVITY......LESIA DEVL......

VENUE......KATAKALA......DATE: 30/1/2025......

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	POSITION	WARD	MOBILE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1.	ANDREW OTORI OBUSURU		M	MEMBER	LWANDANYI	0722-302097	[illegible]	✓	
2	BEN OTORI	13158266	M	MEMBER	LWANDANYI	0740026457		✓	
3	IRINE WAFULA	30925329	F	PoE	HQ	0799329924	✓		
4.	GEDION OMUNYIN	13439736	M	V. ADM	LWANDANYI	0740296585	[illegible]	✓	
5.	CAROLINE MUHGU	28230819	F	NPOE-EU	NAVCDP	0724792462	✓		
6.	SILAS RAKAMA	28039721	M	NPOE-ESS	NAVCDP	0711445914	✓		
7.	REUBEN BUCHACHA	5615295	M	WAO-	LWANDANYI	0728297214		✓	
8	SAMMY R. CHEMININGWA	20981146	M	SCAO-SIRISIA	SIRISIA HQS	0725517462		✓	
9	DIANA NAMBUCHI	31940791	F	SSG	NAVCDP	0729573155	✓		
10	JARED MAKORI	28517023	M	EO	NEMA	0715628863		✓	

National Value Chain Development Project (NAVCDP)

REPUBLIC OF KENYA

Republic of Kenya

NAVCDP

NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

National Value Chain Development Project (NAVCDP)

ACTIVITY: KESIA FOR KATAKARA

VENUE: KATAKARA DATE: 30/1/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	POSITION	WARD	MOBILE NO	AGE <35 YRS	>35 YRS	SIGNATURE
	SILAS RAKAMA	28039721	M	NPOE-ESS	—	0711445914	✓		[signature]
	CAROLINE MUHIA	28280319	F	NPOE-EU	–	0724712462	✓		[signature]
	ABRAHAM WAFULA	20306087	M	DRIVER	–	0708590814		✓	[signature]
	HENRY KERE	[illegible]	M	DRIVER	HQ	0722851119		✓	[signature]
	SHEILA GEBE	28382079	F	F.O	HQ	0716444998	✓		[signature]
	NAOMI KOMOL	26062665	F	EO	HQ	0728574065		✓	[signature]
	[illegible] Chepkembe	21884530	F	CPAA	HQ	0729909811		–	[signature]
	ABWAO BURETI	22664036	M	CCIDO	HQ	072846216		✓	[signature]
	SILVANUS WANJALA	21777691	M	COM	HQ	0725891783		✓	[signature]
	Mary Lulu	9909711	F	CO CPIM	HQ	[illegible]		✓	[signature]

National Value Chain Development Project (NAVCDP)

REPUBLIC OF KENYA

Republic of Kenya

NAVCDP

NATIONAL AGRICULTURAL VALUE CHAIN DEVELOPMENT PROJECT

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY: KESIA FOR KATAKARA DAM

VENUE: KATAKARA DATE: 30/1/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
	Emmanuel Kibobo	21653683	M	NAVCDP	HQ	0726927581		✓	[signature]
	Dan Omre	11048135	M	NAVCDP	HQ	0722635272		✓	[signature]
	Daniel Lwagn	21915590	M	NAVCDP	H/Q	0720971396		✓	[signature]
	Shadrack Wasike	12704483	M	NAVCDP	HQ	072757461		✓	[signature]
	Antony Luvai	8836690	M	NAVCDP	HQ	07			
	William Onura	29307281	M	NAVCDP-NPOE	HQ	0720123110	✓		Onura
	Elijah Obadha	14721201	M	NAVCDP	HQ	0710611748		✓	[signature]
	Irene Kibandu	23651047	F	NAVCDP	HQ	0729256523		✓	[signature]
	LEWIS MARAH I	27740639	F	NAVCDP	HQ.	0727303742		✓	[signature]
	Rebbecca Lusweti	11199531	F	NAVCDP	HQ	0722629658		✓	[signature]

REPUBLIC OF KENYA

Republic of Kenya

NAVCDP

National Agricultural Value Chain Development Project (NAVCDP)

ACTIVITY KEY INFORMANT INTERVIEWS

VENUE.................... DATE 31/01/2025

ATTENDANCE LIST

NO	NAME	ID NO	GENDER	ORGANIZATION	WARD	PHONE NO	AGE <35 YRS	>35 YRS	SIGNATURE
1	DOMINIC MANGULA	1203213	M	MOALFC	Bgm HQ	0721553783		✓	[signature]
2	HERBERT MULIRO	11564020	M	MOALFIC	HQs	0729058130		✓	[signature]
3	Dismas Wanyonyi	28187520	M	DOPW	HQ	0721439472	✓		[signature]
4	ELECTINA NABWIRE	28562570	F	MOALFC	HQ	0715490231	✓		[signature]

National Agricultural Value Chain Development Project (NAVCDP) – Bungoma County

Annex 14: The Questionnaires administered

(1)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

---

1. General Information

1.1 Name (Optional): NANCY WANDABWO

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Katome

1.5 Occupation: ☐ Farmer ☐ Businessperson ☑ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☑ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☐ More than 10 years

1.7 Phone Number: 0704466195 Date: 29/01/2024

---

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☐ Yes ☑ No

2.2 How did you learn about the project? — N/A

☐ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

N/A

2.3 What is your perception of the project?

☐ Very beneficial ☐ Beneficial ☑ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: _____

---

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☐ No ☑ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

—

3.3 How do you think these impacts can be minimized? —

1

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): Long distance to water point.

4.4 Do you think the project will affect your current water sources?

☑ Yes ☐ No ☐ Not sure

4.5 If yes, how? will bring water closer to our homes

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☐ Increased farm productivity ☑ Employment opportunities ☐ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): NIA

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☑ Yes ☐ No

5.6 If yes, what are your concerns?

☑ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting The project is good.

6.3 What specific recommendations do you have for the proposed project?

NIA

Thank you for your participation.

I.D Number: 30457269 Sign: [signature]

(2)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Canon Namikaya Mafwa

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kaptomei A

1.5 Occupation: ☑ Farmer ☑ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0725259148 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: The proja will provide water for irrigation farming

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☑ River ☐ Borehole ☐ Dam ☐ Rainwater harvesting ☑ Other (Specify): well

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☐ High costs ☑ Other (Specify): long distance to get clean water

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

---

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☑ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify):

_____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

---

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting It will improve living conditions through irrigation farming during the dry season of the year

6.3 What specific recommendations do you have for the proposed project?

The irrigation project will help farmers through farming throughout the year hence its implementation should be done as soon as possible.

Thank you for your participation.

I.D Number: 27077341 Sign: _____

(3)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): SYLVIA ATIAN

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: KATOMEI

1.5 Occupation: ☐ Farmer ☑ Businessperson ☐ Employed ☑ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☑ 6-10 years ☐ More than 10 years

1.7 Phone Number: 0719879285 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☑ No

2.2 How did you learn about the project?

☐ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify): _____

2.3 What is your perception of the project?

☐ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: _____

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify): _____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☑ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☑ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify):

_____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting water for domestic use and irrigating farm produce.

6.3 What specific recommendations do you have for the proposed project?

Thank you for your participation.

I.D Number: 35018308 Sign: _____

(A)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

---

1. General Information

1.1 Name (Optional): LUCY CHENGEK

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kaptorwei

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0790134462 Date: _____

---

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☑ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: Provide water for both domestic use and farm irrigation leading to increased farm yield.

---

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☑ River ☐ Borehole ☐ Dam ☐ Rainwater harvesting ☑ Other (Specify): well

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☑ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☐ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☑ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify):

_____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting The project will improve livelihood through irrigation farming

6.3What specific recommendations do you have for the proposed project?

The project implementers should continue with the irrigation projects to benefit the locals

Thank you for your participation.

I.D Number: 20163774 Sign: JAM

(5)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Jennifer Nekesa

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☐ 31-45 ☑ 46-60 ☐ Above 60

1.4 Village/Location: Kamoi A

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☑ 1-5 years ☐ 6-10 years ☐ More than 10 years

1.7 Phone Number: 0726939086 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify): _____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: It will improve economic

activities of the community through farming

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify): _____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): long distance

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting The project will help to access water easily, reduce walking for long distance, irrigation of farm

6.3 What specific recommendations do you have for the proposed project?

: Wishes the project implementation could have started long time ago

Thank you for your participation.

I.D Number: 34807726 Sign: _____

(6)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Rose Nafula Wafula

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kaburei A

1.5 Occupation: ☑ Farmer ☑ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☑ 6-10 years ☐ More than 10 years

1.7 Phone Number: 0716830683 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify): _____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: through irrigation of crops and watering livestock

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify): _____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): long distance

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting The project will help to access water easily, reduce walking for long distance, irrigation of farms

6.3 What specific recommendations do you have for the proposed project?

· Wishes the project implementation could have started long time ago

Thank you for your participation.

I.D Number: 34807726 Sign: _____

(7)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

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1. General Information

1.1 Name (Optional): Nancy Cherop

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kabkara B

1.5 Occupation: ☑ Farmer ☑ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☑ 6-10 years ☐ More than 10 years

1.7 Phone Number: 0704932906 Date: 29/Jul 2025

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2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: Provide water for irrigating nursery bed/domestic use

---

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☑ River ☑ Borehole ☐ Dam ☑ Rainwater harvesting ☐ Other (Specify): ~~Stream~~

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☑ High costs ☐ Other (Specify): Water treatment before use

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

---

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☐ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify):

_____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

---

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting will provide

6.3 What specific recommendations do you have for the proposed project? The Project has been delayed, wish it could have already started. Ready for the implementation of the project.

Thank you for your participation.

I.D Number: 26731315 Sign: [signature]

(8)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

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1. General Information

1.1 Name (Optional): Esther Nafula Mulupi

1.2 Gender: ☐ Male ☑ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kabkara B

1.5 Occupation: ☑ Farmer ☑ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0793954063 Date: 23/01/2025

---

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: Water for irrigation, domestic use

---

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☐ Yes ☑ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☐ Pollution ☐ High costs ☑ Other (Specify): Walking for long distance to access water

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting Provide water for domestic and farm use

6.3What specific recommendations do you have for the proposed project?

Thank you for your participation.

I.D Number: 29078138 Sign: _____

(9)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Justus Waplings Wamatti

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☐ 31-45 ☐ 46-60 ☑ Above 60

1.4 Village/Location: Katome B

1.5 Occupation: ☐ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0716912062 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: in our area we dont have even tap water, this project is beneficial indeed.

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

N/A

3.3 How do you think these impacts can be minimized? N/A

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☑ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): Long distance to water point

4.4 Do you think the project will affect your current water sources?

☑ Yes ☐ No ☐ Not sure

4.5 If yes, how? Water will be closer to our homes

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they? N/A

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): N/A

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): N/A

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting N/A

6.3What specific recommendations do you have for the proposed project?

N/A

Thank you for your participation.

I.D Number: 41367063 Sign: _____

(10)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Anthony BERA

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kamorel

1.5 Occupation: ☐ Farmer ☑ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0716810569 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: Water for domestic use

Reduced distance to fetch water for home use.

Water for irrigation during dry seasons.

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☑ River ☐ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☑ High costs ☐ Other (Specify): water treatment cost

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☑ Yes ☐ No

5.4 If yes, what are they?

☑ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting it will be of great use in farms and domestic use

6.3 What specific recommendations do you have for the proposed project?

The project should have even started long ago. Apart from no even a delay in its implementation.

Thank you for your participation.

I.D Number: 26706962 Sign: _____

(11)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): GIDEON SIMIYU

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: KABKARA A

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0743556953 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: Water for domestic & farm use.

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☐ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): long distance

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☐ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify):

_____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☐ Yes ☐ No:

6.2 Give reason for supporting or not supporting _____

6.3What specific recommendations do you have for the proposed project?

Thank you for your participation.

I.D Number: 31930019 Sign: _____

(12)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): George Barasa Nalume

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☐ 31-45 ☐ 46-60 ☑ Above 60

1.4 Village/Location: Kabkara

1.5 Occupation: ☐ Farmer ☑ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0732681870 Date: 29/01/2023

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☐ Community meeting ☐ Government officials ☐ NAVCDP representatives ☑ Other (Specify): Dam Committee chairperson

2.3 What is your perception of the project?

☐ Very beneficial ☑ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: _____

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☑ Yes ☐ No ☐ Not sure

3.2 If yes, what are your concerns?

☑ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify): _____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): long distance

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☐ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☐ Yes ☐ No:

6.2 Give reason for supporting or not supporting _____

6.3What specific recommendations do you have for the proposed project?

Thank you for your participation.

I.D Number: 31930019 Sign: _____

(B)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): EMMANUEL WAFULA

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: KATOMEI 'A' VILLAGE, LWANDANYI LOCATION

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0711183521 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: WILL ASSIST IN MY FARMING ACTIVITY AND IMPROVE PRODUCTIVITY AND LIVESTOCK PRODUCTION.

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☑ River ☐ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): Well

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges? WE FETCH WATER FROM A DISTANT PLACE DURING DRY SPELL.

☑ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☑ Employment opportunities ☑ Improved food security ☐ Other (Specify): WATER FOR LIVESTOCK

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): NONE

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting IT WILL IMPROVE OUR LIVELIHOOD THROUGH FARMING OF HORTICULTURAL CROPS.

6.3 What specific recommendations do you have for the proposed project?

THE PROJECT TO PROCEED TO ITS COMPLETION.

Thank you for your participation.

I.D Number: 27080932 Sign: WAFULA

(14)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Shadrack Amen

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☑ 18-30 ☐ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kabkara B

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0758437886 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: imgation farming during dry season from march and for watering livestock

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☐ Yes ☑ No

4.3 If yes, what are the main challenges?

☐ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☑ Employment opportunities ☐ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify):

_____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting it create employment through farming and get the youth busy

6.3 What specific recommendations do you have for the proposed project?

The project should be implemented as soon as possible for the community to start benefiting

Thank you for your participation.

I.D Number: 20620990 Sign: _____

(15)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

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1. General Information

1.1 Name (Optional): Edwin Mafura

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kabkara B.

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0725790367 Date: 29/01/2025

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2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: will provide water from May to March for farming during those dry months

---

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☑ Yes ☐ No ☐ Not sure

3.2 If yes, what are your concerns?

☑ Water depletion ☐ Soil erosion ☑ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

Minimize water usage by sensitizing community members to adopt water saving techniques

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☑ Other (Specify): Spring well

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☑ Yes ☐ No

5.4 If yes, what are they?

☑ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☑ Yes ☐ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☑ Other (Specify): theft of farm produce by community members not benefiting from the irrigation project

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting Because [redacted] is a beneficiary

6.3 What specific recommendations do you have for the proposed project?

the community is ready and anticipating for faster implementation of the Irrigation project

Thank you for your participation.

I.D Number: 27313069 Sign: [signature]

2

(16)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): MOSES OLIAUNA

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☑ 18-30 ☐ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: KABKARA B

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0707694902 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☐ Community meeting ☑ Government officials ☑ NAVCDP representatives ☐ Other (Specify): _____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: Water for domestic use, farm produce will increase such as Kales due to Irrigation

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☑ Yes ☐ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☑ Soil erosion ☑ Pollution ☑ Biodiversity loss ☐ Other (Specify): _____

3.3 How do you think these impacts can be minimized?

- Excavation to be done timely.
- Irrigation pipes to be refilled immediately they are installed.

1

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☐ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☑ Yes ☐ No

5.4 If yes, what are they?

☑ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☑ Yes ☐ No

5.6 If yes, what are your concerns?

☑ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting Will Provide water for domestic use/ Irrigating nursery beds

6.3 What specific recommendations do you have for the proposed project?

Eagerly Waiting for project Implementation

Thank you for your participation.

I.D Number: 50258403 Sign:

(17)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Emukule Okwamong Omulepu

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☐ 31-45 ☐ 46-60 ☑ Above 60

1.4 Village/Location: Kibkara B

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0712578157 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: It will improve farming through irrigation

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☐ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☑ Yes ☐ No

5.4 If yes, what are they?

☑ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☑ Yes ☐ No

5.6 If yes, what are your concerns?

☑ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting will Provide water for domestic use/ Irrigating nursery beds

6.3What specific recommendations do you have for the proposed project?

Equally treating for project Implementation

Thank you for your participation.

I.D Number: 50058403 Sign:

(18)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Patrick Lubusimo

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☐ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Kabkara B

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0796444296 Date: 29/01/2025

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☐ NAVCDP representatives ☐ Other (Specify): _____

2.3 What is your perception of the project?

☐ Very beneficial ☑ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: _____

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify): _____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☑ Borehole ☐ Dam ☐ Rainwater harvesting ☐ Other (Specify): _____

4.2 Do you experience any challenges in accessing clean water?

☐ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☐ High costs ☐ Other (Specify): _____

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting It will provide water for farm irrigation - hence high farm yield

6.3 What specific recommendations do you have for the proposed project?

Very ready for the irrigation infrastructure to be installed

Thank you for your participation.

I.D Number: 29441550 Sign: [signature]

(19)

Consultation and Public Participation Questionnaire towards the Proposed Kabkara Irrigation Project in Lwandanyi Ward, Bungoma County, Kenya

Through the support from NAVCDP, Kabkara irrigation Water User Association (IWUA) intent to set-up an irrigation project utilising water from the existing Kabkara dam. The proposed irrigation project is anticipated to enable beneficiaries irrigate 44ha of high value crops.

The Environmental Management and Coordination Act (1999) reviewed 2015 and its subsidiary legislation (Environmental Impact Assessment and Audit) Regulations 2019 requires this type of project to undertake Environmental and Social Impact Assessment before financing or construction. The Kenya Constitution (2010) gives the public and stakeholders the right to participate and demand a clean and healthy environment. We are therefore seeking your views on the likely impacts of this project. Your views will only be used to inform mitigation measures for the proposed project and not any other unintended purpose.

Participation is voluntary, and your responses will be kept confidential.

1. General Information

1.1 Name (Optional): Philip Mungindi

1.2 Gender: ☑ Male ☐ Female ☐ Other

1.3 Age: ☐ 18-30 ☑ 31-45 ☐ 46-60 ☐ Above 60

1.4 Village/Location: Katomi 61

1.5 Occupation: ☑ Farmer ☐ Businessperson ☐ Employed ☐ Other (Specify): _____

1.6 How long have you lived in this area? ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☑ More than 10 years

1.7 Phone Number: 0720555178 Date: _____

2. Awareness and Perception of the Project

2.1 Are you aware of the proposed irrigation project?

☑ Yes ☐ No

2.2 How did you learn about the project?

☑ Community meeting ☐ Government officials ☑ NAVCDP representatives ☐ Other (Specify):

_____

2.3 What is your perception of the project?

☑ Very beneficial ☐ Beneficial ☐ Neutral ☐ Problematic ☐ Very problematic

2.4 Please explain your response: will provide water for livestock and irrigating crops especially during dry season

3. Environmental Concerns

3.1 Do you foresee any negative environmental impacts from the project?

☐ Yes ☑ No ☐ Not sure

3.2 If yes, what are your concerns?

☐ Water depletion ☐ Soil erosion ☐ Pollution ☐ Biodiversity loss ☐ Other (Specify):

_____

3.3 How do you think these impacts can be minimized?

4. Water Resource and Management

4.1 What are your current sources of water?

☐ River ☐ Borehole ☐ Dam ☐ Rainwater harvesting ☑ Other (Specify): Stream/well

4.2 Do you experience any challenges in accessing clean water?

☑ Yes ☐ No

4.3 If yes, what are the main challenges?

☑ Water scarcity ☐ Pollution ☑ High costs ☐ Other (Specify): walking for long distance

4.4 Do you think the project will affect your current water sources?

☐ Yes ☑ No ☐ Not sure

4.5 If yes, how? _____

5. Social and Economic Considerations

5.1 How do you think the project will impact local livelihoods and economic activities?

☑ Positively ☐ Negatively ☐ No impact ☐ Not sure

5.2 What benefits do you expect from the project?

☑ Increased farm productivity ☐ Employment opportunities ☑ Improved food security ☐ Other (Specify): _____

5.3 Do you foresee any social challenges arising from the project?

☐ Yes ☑ No

5.4 If yes, what are they?

☐ Conflicts over water use ☐ Land disputes ☐ Displacement of people ☐ Other (Specify): _____

5.5 Do you foresee any challenges with the installation of irrigation infrastructure?

☐ Yes ☑ No

5.6 If yes, what are your concerns?

☐ Road disruption ☐ Land disputes ☐ High costs ☐ Other (Specify): _____

6. Recommendations and Way Forward

6.1 Do you support the implementation of the proposed irrigation project?

☑ Yes ☐ No:

6.2 Give reason for supporting or not supporting Easy access to water

6.3 What specific recommendations do you have for the proposed project?

Wish the project had started many years ago.

Thank you for your participation.

I.D Number: 22220705 Sign:

(1)

Key Informant Interview (KII) Questionnaire (*Roads Sector/ Kenya Rural Roads Authority)*

Project Title: Environmental and Social Impact Assessment (ESIA) for the Proposed Kabkara Irrigation Project in Lwandanyi Ward Bungoma County

Date of Interview: 31/01/2025

Location: _____

Interviewer's Name: CAROL MUNGU

Respondent's Name: DISMAS WAMIALA

Designation: ENGINEER

Organization: PUBLIC WORKS BUNGOMA

1. Roads under KeRRA's jurisdiction are likely to be affected by the construction of the irrigation project, particularly trenching for irrigation pipes, what specific challenges do you anticipate regarding road use, maintenance, and durability due to the project?

1. Disturbance of the road base during excavation to lay the pipe
2. Potholes where excavation will take place if proper procedure to reinstate the road is not followed
3. During the ~~coming~~ yearly road maintainance by KeRRA if pipes are not laid in a reasonable depth they will get damanged
4. The initial lifespan of the road will reduce especially where excavation will take place.

2. What measures would you recommend to minimize negative impacts on the roads during trenching and pipe installation?

1. Micro-tunnelling application should be done through KeRRA for guidance on how to go about it
2. Consultation with KeRRA for guidance on how to reinstate the road after excavation to avoid disturbance of the road base.

(2)

Key Informant Interview (KII) Questionnaire (*Agriculture stakeholder)*

Project Title: Environmental and Social Impact Assessment (ESIA) for the Proposed Kabkara Irrigation Project in Lwandanyi Ward Bungoma County

Date of Interview: 31/1/2024

Location: Bungoma DPT. office

Interviewer's Name: ___________

Respondent's Name: Dominic Masinde

Designation: [illegible]

Organization: MOALFC

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1. How is the proposed irrigation project likely to affect current agricultural practices?

The proposed irrigation project will affect the agricultural practices positively because farmers may use the water for irrigation of horticultural crop enterprises, the water will also be used for animals - livestock & poultry.

2. What are the expected benefits of the irrigation project for farmers in terms of crop yield and productivity?

It will increase yield, the production & productivity will also go up, and farmers will not depend entirely on rain fed agricultural production. It will also ensure that there is a constant supply of vegetables.

3. What potential challenges do you foresee in implementing the irrigation project for crop production?

Challenges:
- Flow of funds may time a problem
- Unreliable rainfall to fill the dam
- Lack of irrigation equipments.
- Negative perception of the community if any.

4. Are there any risks of waterlogging, soil degradation, or salinity? If so, how can they be mitigated?

There can be Minimal case of such But if they occur, there can be cut off drains to be constructed and issue of reclaiming saline areas.

5. Are there any concerns regarding pesticide and fertilizer use that may arise due to increased irrigation?

No serious concerns

6. What strategies can be put in place to ensure the long-term sustainability of the irrigation project?

- Maintenance of the Water channels.
- Soil conservation structures in the catchment to reduce heavy soil runoff.
- Periodic Maintenance of the irrigation system.

7. What recommendations would you provide to enhance the resilience of the irrigation system to climate change impacts?

- Increase Agroforestry
- CA- technologies in the catchment area
- Protection of the Water channels / Banks
- efficient & effective use of Water for irrigation to avoid Wastage, & Water Harvesting Structures (more)

8. Do you have any additional remarks or suggestions regarding the proposed project?

The project is a noble idea and will boost Crop production in the area leading to increased food security and income. However there is need to take precaution on the possible negative impacts

Official Use Only

(3)

Key Informant Interview (KII) Questionnaire (*Water and Irrigation Stakeholder)*

Project Title: Environmental and Social Impact Assessment (ESIA) for the Proposed Kabkara Irrigation Project in Lwandanyi Ward Bungoma County

Date of Interview: 31/01/2025

Location: Bungoma County (Kilimo office)

Interviewer's Name: [redacted] Carol Nungu

Respondent's Name: Albert Mulilo

Designation: Director Irrigation

Organization: SDA

1. Can you briefly describe your role in the Water and Irrigation Sector?

- To develop policies on irrigation drainage and water storage
- feasibility studies for new irrigation projects
- Designs of irrigation projects
- Supervision during implementation of the irrigation projects

2. Are you familiar with the proposed irrigation project from Kabkara Earth Dam? If yes, how were you engaged in the planning process?

Yes, was part of the team that did peer review of the design and part of feasibility study and preliminary survey

3. What measures do you think should be put in place to ensure sustainable water management for the irrigation project?

- Capacity building of the community
- scheduled maintenance of the irrigation project
- Community participation to own the project

4. What potential environmental and social risks do you foresee with the proposed irrigation project?

- No environmental and social risks

5. What mitigation measures would you recommend to minimize negative environmental and social impacts?

N/A

6. In your opinion, what are the key success factors that should be considered for the sustainability of the proposed Kabkara irrigation project?

1: Community participation
2: Irrigation scheduling to accomodate more farmers
3: Farm activities around the source of water to ~~ensure~~ ensure continuity

7. Any additional comments or concerns you would like to share?

- Irrigation component the proposal had gravity irrigation system which will favour farmers outside the county hence recommend planned piping to cater for farmers upstream.
- Market access should be looked into for the produce that will come from farms after irrigation.

Annex 15: Details of proposed Irrigation Scheme Sub-Project Beneficiaries

Ref	Name of Farmer	ID	LR No.	Contact	E	N	Elevation	Other Members
1	JAMES EMBURUSURU ONAU				656167	85107	1,436.000	
2	ROSE OCHUDI	2061784	1051	724942098	656165	85058	1,438.000	
3	PATRICK ONYAIT	6454901	1109	711266735	656196	84963	1,432.000	
4	PETER OKIMUNG	9513873	1097	717161887	656194	84955	1,434.000	
5	MARGRAT OMAKADA	6328927	1065/1067	758085172/0728590715	656055	84838	1,421.000	4
6	DOMINIC OJUMA	26173114	1096	768618518	656070	84835	1,424.000	
7	JULIUS ILIKAU	6328910	1094	791809318	656057	84683	1,416.000	2
8	BEDAH EDETE		1067		656038	84668	1,415.000	4
9	AGGREY EMOJONG	11452833	1092	724178370	656029	84542	1,407.000	2
10	MOSESEJUMATBM10	727990	1084	728590715	656005	84400	1,404.000	4
11	YUSUF CHEMWIRE		1091		656020	84403	1,406.000	
12	WANGUSI		1090		656192	84212	1,397.000	
13	SAMUEL OCHODI	790853	1086	713079092	656302	84086	1,380.000	
14	OKANYERE TITUS	7908612	1385	710531127	656308	84091	1,385.000	
15	EPOLOT FREDRICK	6328037	1391	710628536	655914	84059	1,391.000	
16	ALFRED KIYUI NGEYWA	20944513		798619981	655815	83836	1,377.000	
17	CELESTINE OLEKETE	9902658		719555153	656113	83780	1,371.000	
18	JASINTA AJUMA ORONI	35490843	1070	791783437	656124	83695	1,363.000	
19	EVALINE NANGILA	26568140		736181905	656119	83690	1,361.000	
20	KABKARA RIVER				655658	83517	1,344.000	
21	ROSE NAIBEI IKAATE	13435002		707938429	656115	83700	1,364.000	
22	HARRISON TITUS ORONI	9513842	1070	718837005	655690	83653	1,357.000	
23	ALEX AAGWA	22361201		702556364	655701	83655	1,357.000	
24	DEBORA KARANI	12849234		726690708	655682	83618	1,356.000	
25	YONAH PAPA	9513840	1386	791932652	655804	84164	1,386.000	
26	DISMUS OSKUKU	7523584		717618431	655694	84292	1,387.000	
27	BERNARD OMUSUGU	27520067		725875452	655445	84480	1,383.000	
28	JANET OPILI	24510957		707589257	655345	84401	1,374.000	
29	FANUEL OKADAPAU	4384112			655173	84307	1,367.000	

30	KURUSIADET ROAD				655102	84434	1,357.000	
31	MARTHIUS EKWENYI OMOJONG	4367734	1034	700802415	655082	84682	1,366.000	
32	TBM11				655385	84593	1,384.100	
33	EVANS OSIRANGI	27123044			655640	84244	1,381.000	
34	OMODING PARAPARA FESTO	29203109		745239252	655648	84220	1,381.000	
35	LUDIA OJUMA ALUNG'ATA	6328066		724951873	655583	84182	1,368.000	2
36	ROSE INYELE NYONGESA	7958255		703413070	655429	84012	1,351.000	
37	LAWI ONYAPIDI			704883221	655429	84012	1,351.000	
38	JEFUTA OLILO			702946793	655402	83955	1,350.000	
39	ELIKANA ATTE	4383565	1029	718415654	655672	84433	1,388.000	
40	DENIS ATTE	6328920		706841121	655864	84461	1,397.000	
41	TBM8				656285	85551	1,421.000	
42	TBM9				656104	85132	1,436.000	
43	JOELMULOSI	828201		705179704	655880	84487	1,401.000	
44	PHILISAKISA				655750	84645	1,400.000	
45	EVANSEMACHARI	33788207		746972958	655728	84656	1,402.000	
46	WICLIFFEEOMUSE	4212111	1032	745349102	655643	84756	1,402.000	
47	BREDACHEPTOO	30379655		727342742	655630	84762	1,400.000	
48	LEONARDOMUNYINI	29903871		743443915	655605	84800	1,402.000	
49	JOHNBARASA	21080829		110282176	655433	85016	1,392.000	
50	MORISWERAKA	4384192	1038	726096662	655239	85016	1,394.000	
51	JENNIFERMULONGO	4385211		790101100	655501	84983	1,395.000	
52	EVANSJUMA	36534762		799058166	655590	84987	1,400.000	
53	GEOFFREYMUTUAEMBU	13719519		717670044	655590	84979	1,402.000	
54	JOSEPHEMBU	827099		713994042	655700	84997	1,411.000	
55	JHNSONEKOBA	11787912		746546529	655737	84986	1,408.000	
56	WILLIAMIMAYOEMBU	6328671	1042	724301725	655701	85359	1,404.000	
57	JOSEPHINEASWAN	12446095	1043	706074818	655690	85362	1,409.000	
58	HARRISONOKADAPAU	209996662	1055	704809264	655787	85239	1,414.000	
59	RONALDBWABIVINCENT				655883	85241	1,418.000	
60	GAMALIELITAPARA	2099908		727157965	655899	85240	1,419.000	
61	WALTERPANYAKOIMALE	6328719	1051	783642451	656114	85357	1,426.000	

62	VINCENTBWABI	4385259	1047	729416895	656125	85360	1,430.000	
63	MANNASSESETYANG	604275	1051	722593292	656115	85462	1,432.000	
64	LILIANOCHUDI	685956	1049	113859170	656117	85538	1,423.000	
65	WASHINGTONERIKODI	4385683	1052	740310056	656083	85558	1,420.000	1
Ref	**Name of Farmer**	**ID**	**LR No.**	**Contact**	**E**	**N**	**Elevation**	**Other Members**
66	JOHNTHANKHAEMBA	4372536	1045	738556506	655942	85460	1,418.000	3
67	FREDRICKOMASETE	37991567	1046	743271999	655860	85499	1,412.000	
68	CHARLESOMELU	3355310	1879	725367442	656225	85519	1,425.000	
69	PHILIPMNANDICHEMIATI	22220705	1116	720558978	656299	85552	1,422.000	
70	ELIUDONAUOTWANE	21081200	1059	743369509	656300	85562	1,422.000	
71	JOSEPHEMOJONG			752778490	656363	85428	1,422.000	
72	JUSTUSWAMATOI	4567068	1878	716912062	656390	85409	1,424.000	1
73	VINCENTWAMALWA	6328839	1242	713914853	656503	85294	1,419.000	
74	WIKFREDBARASA	23250887	1244	791584549	656560	85286	1,415.000	
75	HANDAMOTOKA		1245	729850671	656638	85366	1,408.000	
76	LEONARDOTEBA	26844786	1246	792451741	656689	85402	1,405.000	
77	ROSEIPARA				656704	85411	1,405.000	
78	RONALDEKIRAPA	10718752	1422	729778324	656721	85429	1,402.000	
79	GRADYSNASIMIYU	7958550	1110	705716360	656486	84755	1,413.000	
80	MARGRETMAKOKHA	6625572	1109	710070606	656461	84837	1,419.000	
81	DOUGLASOMAKADA	31978142	1107	740073753	656488	84752	1,413.000	
82	HAMANOCHEBO	7958527	1111	740231469	656614	84840	1,411.000	4
83	GEORGEOKENDI	14725200	1108	727339219	656472	84742	1,412.000	
84	JOHNOKISEGERE	27306180	1106	794563799	656314	84464	1,401.000	2
85	OTTOOMUSE	4618333	1229	713231084	656414	84344	1,388.000	
86	MOSESETYANG	13649964	1099	716305852	656648	84184	1,373.000	
87	BRAMWELKOTUTMASAI	20091599	1029	712586158	656738	84092	1,365.000	2
88	EMMYKIMOLI	11470283		717616907	656626	84582	1,399.000	
89	BENSONNAMIKASAMAFYRA	27077341		725259148	656862	84658	1,388.000	
90	SIMONOKADAPAU	2670578	1105	799335819	656863	84671	1,386.000	
91	MAEGRETAKAWA	7958607		758367165	656986	84599	1,374.000	
92	ALLOYSOPECH	6328986	111	743060363	656957	84798	1,383.000	

93	BENSONBARASA	825312		758437889	656915	84889	1,390.000	
94	EMMANUELWAFULA	27080932		711183521	656904	84932	1,390.000	
95	DAVIDCHENGEONDIEMA	33321439	1112	768657865	656863	85084	1,396.000	
96	JAPHTAHPAPACHEBON		1112		656837	85098	1,396.000	
97	JOHNSTONEORIAMA	2310711	533	721892703	657048	85317	1,392.000	
98	BOAZOELIAKIM	7958597	427	703771824	657115	85388	1,401.000	
99	ESTHERNAFULANASIMIYU				657213	85514	1,403.000	
100	ESTHERNAFULA	1287153		710485506	657246	85555	1,406.000	
101	LIVINGTONOTWANE	2314056	540	727782773	657250	85549	1,407.000	
102	ROSANELEMAWAMALABE	6328239		115421925	657282	85603	1,414.000	
103	JOINANASIMIYU	3669009		112375325	657379	85725	1,423.000	
104	TBN6				657379	85744	1,421.000	
105	PETERTOROKOI	43852555		728665629	657978	85570	1,430.000	
106	JOSECKKIRONGETKONESI	844042		791542698	657976	85575	1,431.000	3
107	LEVIAMBUCH	24085653	473	799066176	657961	85471	1,427.000	2
108	TERESAAMURWONIOSITOO	6328224		740959936	658081	85325	1,423.000	5
109	BENKIMENGICH				658385	84991	1,407.000	
110	JUSTOBARASA				658381	84987	1,409.000	
111	AGNES ORIAMA		472	718822983	657732	85250	1,411.000	
112	STEPHEN MASAI	7587523		710311229	657563	85126	1,402.000	10
113	BENSON OMANYALA	26731615		713090413	657556	85118	1,401.000	
114	ISACK EMOJONG	1289415	1153	726319659	657503	85109	1,395.000	
115	SIMON MFURA		1151		657420	85043	1,389.000	

Annex 16: EIA Practicing License for the lead expert

EAE 23064068

FORM 7 (r.15(2))

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/23172

Application Reference No: NEMA/EIA/EL/29884

M/S **SILAS OMONDI RAKAMA**
(individual or firm) of address
C/O P.O. Box 1767 - 0200 Nairobi

is licensed to practice in the capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert General**

registration number **9976**

in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **3/17/2025** Expiry Date: **12/31/2025**

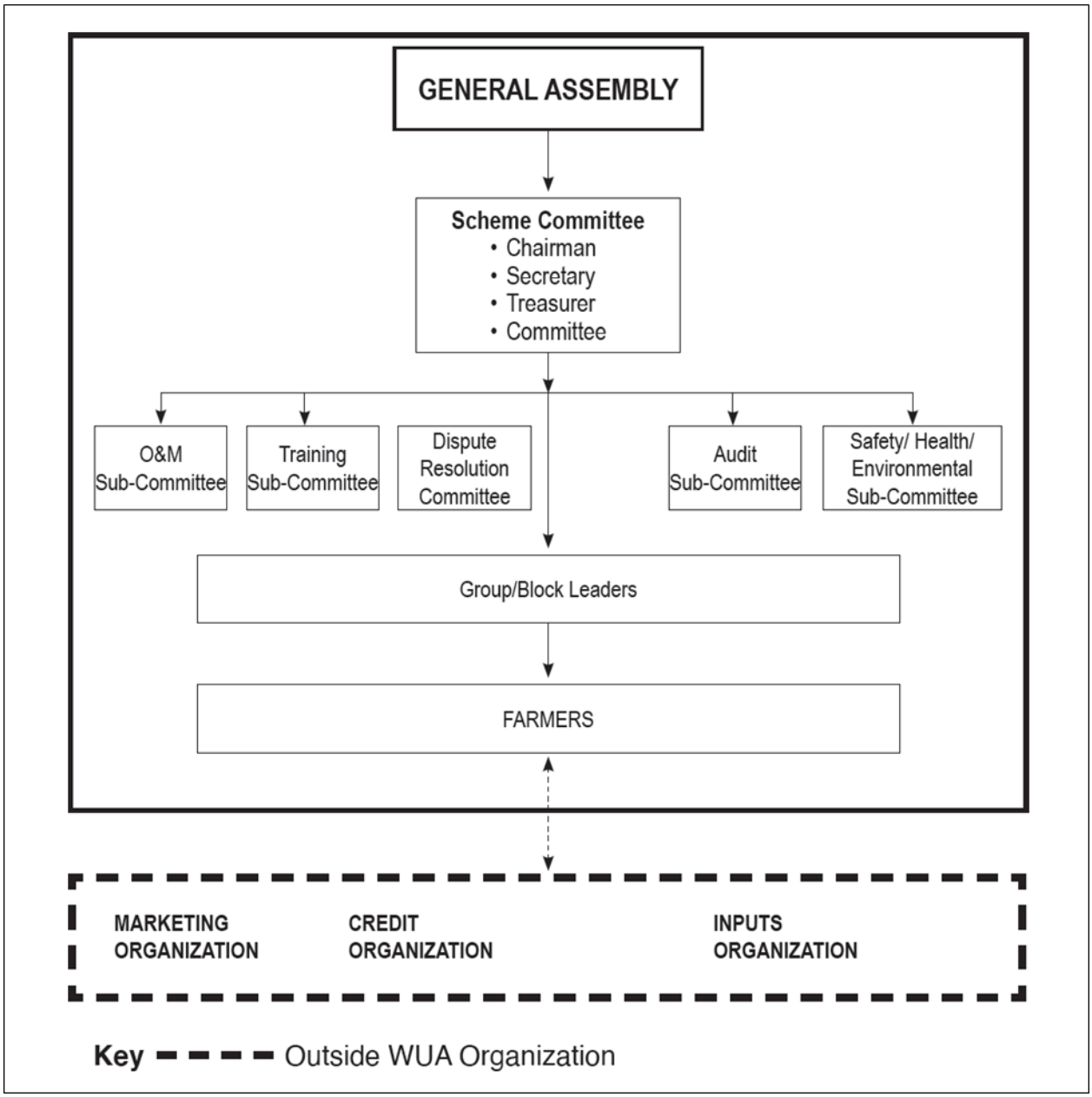
Signature.....

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001 : 2015 Certified

Annex 17: Organization Structure of the Kabkara IWUA



Annex 18: Hydrological Study Report of the Kabkara Dam

Kabkara Dam Rehabilitation Project

PREPARED BY
WATER RESOURCES AUTHORITY,
LAKE VICTORIA NORTH CATCHMENT AREA,
KAKAMEGA

DECEMBER 2020

➢ SUMMARY

This report describes the methods and results of the hydrological assessment that was carried out for the Kabkara Dam water supply. Due to the lack of reliable streamflow data, the assessment was based on hydrological modelling of the basin upstream of the point of interest. Principally global datasets were used for the biophysical input requirements of the hydrological modelling.

The principal output is a flow-duration curve based on multiple model simulations. The flow duration curve includes confidence bounds based on the uncertainties that exist currently in rainfall data, evapotranspiration and runoff mechanisms. These uncertainties were also assessed for the monthly flow regime, based on the daily model simulations. From this hydrological assessment, a number of recommendations are put forward that aim at increasing the level of accuracy in the outcomes and narrow the uncertainty range for the following implementation stage. Recommendations are done for data improvements, model improvements and field validation. The GPS coordinates for the dam N: 00.7663936^0 E: 034.413057^0 Alt: 1433m. The client intends to abstract $143.69m^3$/day from a dam which has the capacity of 133,480 m^3. The dam sub catchment is ungauged therefore the necessitated correlation with the Malaba River to understand both the base flow and recharge of the dam.

➢ INTRODUCTION

General

Water resources development contributes immensely to economic productivity and social well-being of the country. Socio-economic activities rely heavily on the supply of water both in terms of quantity and good quality. Managing water resources requires a coordinated approach by all stakeholders. This is in realization that water is an essential natural resource that we all need to manage and use effectively and sustainably. Deliberate efforts are therefore required to ensure that water is utilized to the fullest extent for the benefit of the present and future generations. It is in the light of this that County Government of Bungoma under NARIGP has embarked on rehabilitation of Kabkara dam into a community water supply project within Kabkara sub catchment. The success of their endeavor heavily relies on the availability of sufficient amount of water from Kabkara dam.

The dam was first constructed during the colonial days between 1949 and 1953 which served two locations namely; Namubia and Lwandanyi. Over the years the dam silted due to soil erosion, poor farming practices upstream and lack of maintenance it the same. The dam was first rehabilitated in 2014 by the County Government of Bungoma but has since silted. County Government of Bungoma one more time is assisting the community to desilt the dam so as to create water storage of 133,480m^3.

In order to achieve this goal, the client commissioned a hydrological assessment study to ascertain the availability and the possibility of abstracting water from Kabkara dam. The client intends to abstract approximately 143.69 m^3/day for public use and general irrigation. The client has identified Kabkara dam where an intake is sited and pipeline used to deliver water to storage.

- **Scope and objectives of the study**

The aim of this study is to assess the availability of water from Kabkara Dam and undertake hydrological analysis of the data from the dam and advice on the viability of the proposed abstraction scheme. The sustainability of the water abstraction will be utterly dependent on the availability of adequate amounts of fresh water from the dam source

- **Methodology and assessment**

The tools employed for this assessment included:

- Desktop review pertaining to project activities and salient environmental, socio-economic and other features of the project area;
- Analysis of topographical and other relevant demographic documentation;
- On site reconnaissance surveys to interrogate the various impacts on the ground;
- Unstructured interviews with key project stakeholders.

Assessment of the site

In the assessment of the water supply potential at a site, the first step is to select potential intake position, pipeline routes and suitable reservoir sites. This assessment is guided by several factors, may include;

- ❖ Hydrological and Watershed characteristics
- ❖ Environmental and Water quality status of the resource
- ❖ Existing infrastructure etc.

➢ ***Catchment characteristics***

Some of the important characteristics that may need consideration include topography and general catchment layout, drainage pattern, type and nature of vegetation cover and land use practices.

➢ ***Flow data***

To assess the water available in a source, an estimation of flow must be made using available historical flow data for the river in question. Time series flow data are generally used to create a flow duration curve (FDC), which is a standard way of understanding the flow of a watercourse. For increased accuracy gauged and measured flow data can be used from a monitoring station installed at or near the proposed intake position. This study notes that there are no installed gauging stations or any other measuring device from the source. This study carried out a one off measurement and made approximation. The flow information for River Malaba was used in order to correlect the ground flow recharge of the dam which is the source of the proposed water supply. The dam discharge was carried out during the lowest flow then there must be a ground water recharge that recharges the dam for sustainability.

➢ CATCHMENT CHARACTERISTICS

➢ **Introduction**

The Kabkara sub catchment is located in the eastern part of Malaba River catchment within Lake Victoria North Basin area. Land use and land management practices have a major impact on natural resources including water. For instance, water bodies in a region that has been deforested or having been encroached thus affecting the quality and quantity of water. Therefore land use has a significant impact on both water quality and the lifespan of the dam.

Silted dam

➢ **Climate of the Sub catchment**

Weather conditions for Kabkara are typical of the weather conditions experienced in western region. Average rainfall is about 1600mm per annum. There is no distinct dry season but there are two distinct rainy seasons, one from March-May (MAM) and the other from late September- November (SON). The mean annual rainfall ranges from 1540-1800mm.The annual reference evaporation of 1300- 800mm with a mean annual temperature range of 21.40-22.3^{0}C. The main market centres in the Kabkara Sub catchment are Lwandanyi, Wamono and Katomei. The markets' sewerage system is very poor and is characterized by open sewages implying a lack of properly established sewer system. As such the sub catchment is heavily polluted and the water sources often contaminated. Access to adequate clean and safe water for both domestic and general irrigation use is a big challenge for the community living in Kabkara sub catchment.

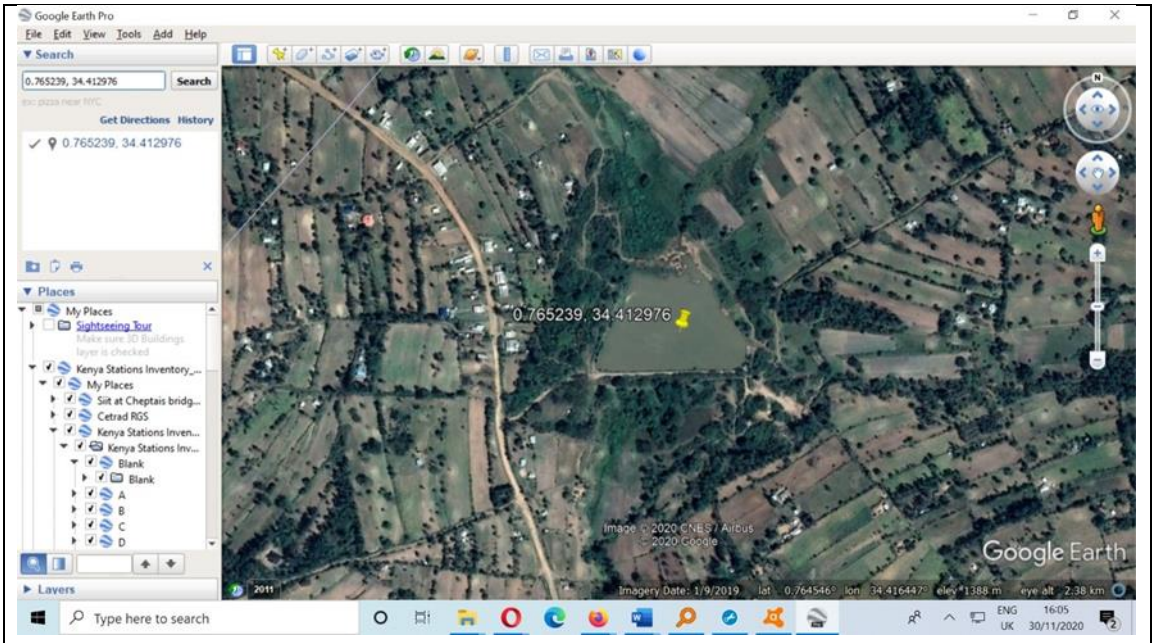
Homesteads upstream of dam

Sand harvesting in the silted dam

Economic activities within the sub catchment

➢ **Geology**

Studies on the geology and geomorphology aims at understanding the sub-surface soil formations and its ability to act as a good foundation for the earth dam. It also assesses the potential influence of the project on the sub-surface behaviour of the area (geomorphology, geology and quality and stability of the soils) as a result of creation of new water reservoir in the area, possible impacts that the proposed facilities and operations will have on the geology and soils and hence guide on the required mitigation measures. The geology differs between upstream and the downstream. The geology is dominated by granite intrusions (Mumias granite) in basin.



Google map showing land use around Kabkara dam

➢ **Soils information**

As soils information is evaluated, it is often beneficial to group soils with similar characteristics. For example, grouping of soils with similar seasonal water table depths can help determine which areas of a residential project are best suited for home construction verses which areas might be used for common areas or greenways. Grouping of seasonal water table depths can also provide insight into which soils have limitations for roads and streets because of frost action.

Part of the data analysis process should include an understanding of state and local regulatory agency on-site waste disposal regulations. While grouping of soils with rapid permeability or slow permeability can help determine overall areas best suited for on-site sewage treatment disposal systems, it is generally recommended that specific on-site soil evaluations be performed on each individual on-site waste disposal system site to determine the soil's adequacy to support such a system.

For this project the soils are brown calcareous loams (chestnut) – pale brown (10YR 6/3) to brown (10YR 5/3) loam with weak subangular blocky structure showing little or no profile development other than a heavier calcareous subsoil. Derived from volcanic ash and occur on plains between 1200-2000m. Rainfall 500-600mm. Therefore it has low retention period for the surface runoff.

➢ **Topographical Information**

Slope gradient and length are the two primary factors to consider when analyzing and interpreting topographic information. This information is critical when designing and laying out the project because it will ultimately affect the decisions that will need to be made when selecting appropriate construction and post-construction water quality management and treatment measures. For example, decisions made in regard to areas of land disturbance and the removal of vegetation on steeper slope gradients will affect the selection, design, and location of storm water management and treatment measures (i.e., as unvegetated slope gradients increase the size and cost of the storm water management and treatment measures will also increase).

For ease of interpretation and comparison of data, slope gradients are typically grouped into the following four general ranges.

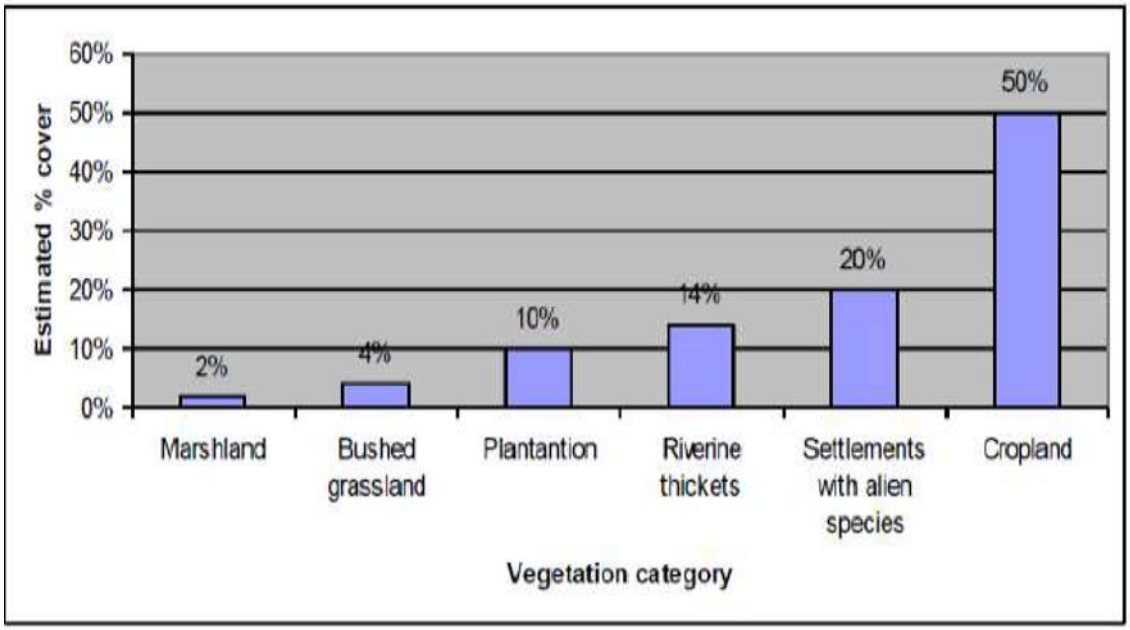
- 0 to 2 percent
- 2 to 6 percent
- 6 to 12 percent

- Over 12 percent

These ranges or groupings can be used to categorize various topographic limitations such as soil erodibility. A slope range of zero to two percent usually has a low erosion hazard whereas a two to six percent slope range has a low to moderate erosion hazard. A six to 12 percent slope range has a moderate to high erosion hazard, and slopes over 12 percent have a severe erosion hazard.
Slope length is another aspect that is important in identification of a site's erodibility hazard. As slope length increases within a slope gradient range, the potential for erosion increases exponentially.

➢ **Vegetation categories classified in the study area**

According to the findings, Vegetation is an integrator of environmental factors in that it reflects the climatic, physiographic, edaphic and biotic features pertaining to the land on which it grows. An understanding of the vegetation and plants of an area can therefore give good insights into the agricultural or biological potential of that area. Some land uses also depend directly on the vegetation resource (Timberlake et al. 1993). Based on physiographic characterization within the proposed project area, six main vegetation categories have were classified namely; Riverine thickets, bushed grassland, Marshland, Crop land, Settlements with alien species and Plantation.



The figure 2 below shows the vegetation typed identified in the area.

The vegetated strip refers to that part of the riparian land that is still vegetated with natural species. Legally, as per WRM Rules (2007) the riparian strip is defined as a minimum distance from the river bank of 6m and a maximum of 30m and is otherwise measured as half the width of the river. For Kabkara dam should be 6m while the observed strips ranged from approximately 0.5m to 2m.
On the upper side of the intake there are agricultural activities going on the planting maize, beans, sugar cane, *suku wiki*, tobacco *and* eucalyptus which in the long run would pose pollution on the dam and the ground water. The pollution will be due to the chemicals used in the farming. Run off water from the storm drain is a potential source of pollution to the dam. There were also interferences of the catchment from animal grazing and watering.

➢ **Economic activities**

More than 85% of the rural population in Kabkara watershed mainly relies on subsistence farming as their main source of livelihoods. The main crops grown are sorghum, millet, sweet potatoes, maize and beans. The main cash crop is tobacco. Agriculture is largely rain-fed and production is entirely dependent on use of traditional implements, with limitations in the quality and quantity of production. The productivity for major crops has been fairly low and has decreased over time, probably due to declining soil fertility and soil erosion. This has created a trend where the farmers resort to opening up new land for agriculture, with wetlands and forests falling target to land use change and degradation.

Livestock farming contributes significantly to the livelihoods of communities in Kabkara watershed. Cattle, goats, sheep are the major domestic animals kept for sale and are mainly indigenous and kept using the free range methods of farming. Most of the grazing is carried out in seasonal wetlands, especially during the dry season. The main source of water for the livestock is wells/dams, rivers and wetlands.

➢ **Area coverage and population**

The project will cover location which consists of two locations namely; Luandanyi and Namubila with a total population of 28,937 people in an area of 66.3km^2. The population density is 436 persons per km^2

Location	sub location	Male	Female	Total	Households	Area in Sq. Km.	Density
Namubila		7,127	7,425	14,552	2,839	36.4	400
Namubila	Wamono	4,587	4,740	9,327	1,811	23.4	399
Namubila	Machakha	2,540	2,685	5,225	1,028	13.0	403
Lwandanyi		7,057	7,328	14,385	2,988	25.8	558
Lwandanyi	Mayekwe	3,169	3,308	6,477	1,317	11.0	588
Lwandanyi	Chebukuyi	3,888	4,020	7,908	1,671	14.8	536

Source: National Bureau of Statistics; population census of 1999

➢ **Water supply, health and sanitation**

The main sources of water include dams, rivers and rainwater. Surface water sources, such as rivers, swamps, reservoirs, are very important for domestic supplies. Methods used to treat water include boiling, decantation and chlorination. Majority of residents, use open pit latrines and dump their wastes in compost heaps instead of burying and burning. Consequently, the area is very prone to water contamination.

Health standards within the region have deteriorated over the years due to high poverty levels, low access to safe drinking water, poor sanitation, gender imbalances and negative socio-cultural norms. Malaria is rampant in the area. Access to health facilities is a problem, as the residents have to walk long distances to access medical services.

➢ **Abstractions and on the dam source**

There are no other abstractions from the dam permitted by WRA. From the site visit, there are no illegal abstractions. This is the only abstraction 143.69m^3/day on the dam and will not have a substantial impact regime.

➢ HYDROLOGICAL CHARACTERISTICS AND ANALYSIS

➢ Introduction

The hydrology of a region depends on its climate, topography and its geology. The climate of the catchment is influenced by its position and altitude within the lake basin. The low-pressure belt which shifts with the apparent movement of the overhead sun, inter-tropical convergence zone (ITCZ) is the main factor and cause of seasons in Africa. It is the major line of convergence of winds leading to the creation of rain and drought generating air flows. The two most important climatic elements for engineering hydrological studies are precipitation, its mode of occurrence and evapo-transpiration. Humidity, temperature, radiation and wind directly affect evapo-transpiration.

Numerous studies suggest that human impacts to ecosystem degradation, climate change, increased population and urbanization must be considered as part of the hydrologic cycle (Vorosmarty et al., 2000; Wagener et al., 2010; Vogel, 2011). Hydrologic investigations that ignore the influence of humans have been shown to perform satisfactorily in relatively undisturbed watersheds (Mendoza et al., 2003); however, recent research indicates that even small disturbances in hydrologic systems, such as human withdrawals (Thomas, 2012; Wang and Cai, 2009) and land-use/land cover changes (Schilling and Libra, 2003), can be important, especially in studies which focus on the low flow response of a watershed which is strongly influenced by groundwater discharge (Wang and Cai,2010; Schilling and Zhang, 2006; Brandes et al., 2005a,among many others). Theis (1940) argued that any newly introduced groundwater withdrawal must be balanced by one or more of the following:
(1) An increase in the recharge to an aquifer,
(2) A decrease in the discharge from a groundwater system to either a surface water system or a deeper groundwater system, or
(3) A loss of storage to the aquifer. Given the water balance component shifts predicted by Theis (1940), it follows that increases in projected water demands require improvements in our ability to characterize low flow behavior of rivers for conjunctive water use management, maintenance of water quality, and ecosystem services.

➢ Riverbank conservation measures

Conservation strategies within water catchment areas should, as a matter of priority, seek to mitigate the transmission of pollutants, (whether they be sediment, agro-chemicals, or other liquid and solid waste) into the watercourses. The most effective measure is the installation
of vegetated buffer zones along the entire length of the water channels, along with the installation of appropriate control systems to stabilize and settle out contaminants from farms and households.
Measures to control upland erosion seek to reduce the effects of channel (gully) and inter-rill (surface or sheet) erosion. Gullying is accelerated detachment and transport of soil aggregates that become entrained in flow within farm drains or ravines after stabilizing vegetation has been removed. In large storms significant quantities of material can be lost due to gully erosion. Sheet erosion is the dislodgement and transport of soil particles due to raindrop impact and overland flow under conditions when the rainfall exceeds the soil infiltration capacity, usually under saturated soil moisture conditions. Upland conservation measures are also recommended for parcels of lands that are adjacent to the dam.

➢ Rainfall analysis

Rainfall impacts greatly on human activity, natural vegetation, surface runoff and groundwater recharge. The period of seasonal rainfall in the study area is characterized by spatially erratic short duration and high intensity rains. The rainy seasons spans parts and for this reason the total annual rainfall is calculated on the basis of calendar year. The following analyses consider the rainfall received in the catchment from representative station catchment of the proposed site. From the results it is indicative that the catchment receives an annual long term rainfall amounts ranging from 1,800 – 2,000 mm per year in the basin. The annual temperature ranges between 21°C – 22°C and the mean humidity is 74%.

The figure below shows annual rainfall in the sub catchment.

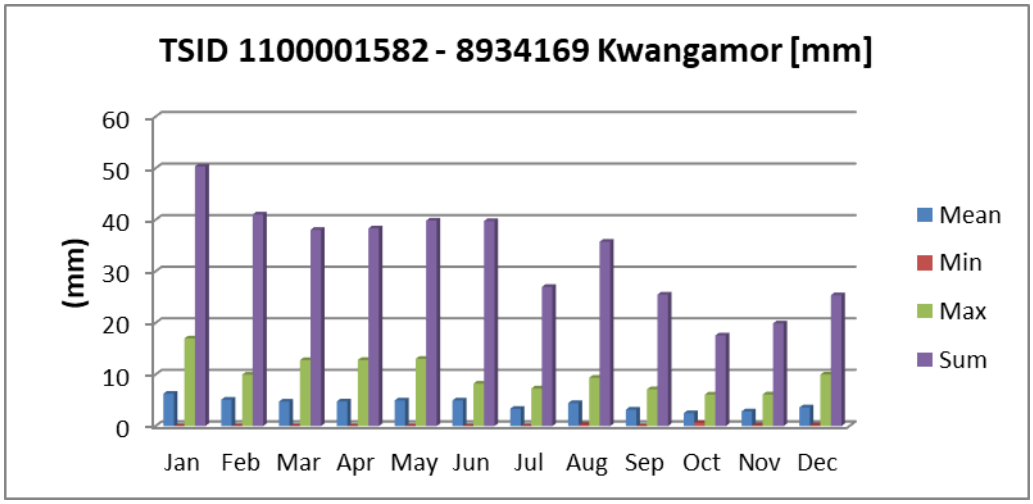


Figure – Rainfall analysis

➢ STREAM FLOW AND ANALYSIS

Data collection and process

The dam is fed by Kabkara stream which is a tributary of Malaba River. The dam could not be gauged because it was totally silted. Therefore there was need to undertake a correlation with river Malaba in order to know both surface flow and base-flow. The stream was gauged and below is the result;

Discharge Measurement Summary

Date Generated: Wed Dec 2 2020

File Information

File Name	KABKARA1.1AB.WAD
Start Date and Time	2020/12/01 14:21:42

Site Details

Site Name	KABKARA STREAM 11220
Operator(s)	OBAM

System Information

Sensor Type	FlowTracker
Serial #	P3077
CPU Firmware Version	3.7
Software Ver	2.30
Mounting Correction	0.0%

Units (Metric Units)

Distance	m
Velocity	m/s
Area	m^2
Discharge	m^3/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.3%	1.4%
Velocity	1.1%	3.6%
Width	0.1%	0.1%
Method	1.6%	-
# Stations	1.9%	-
Overall	**2.9%**	**4.0%**

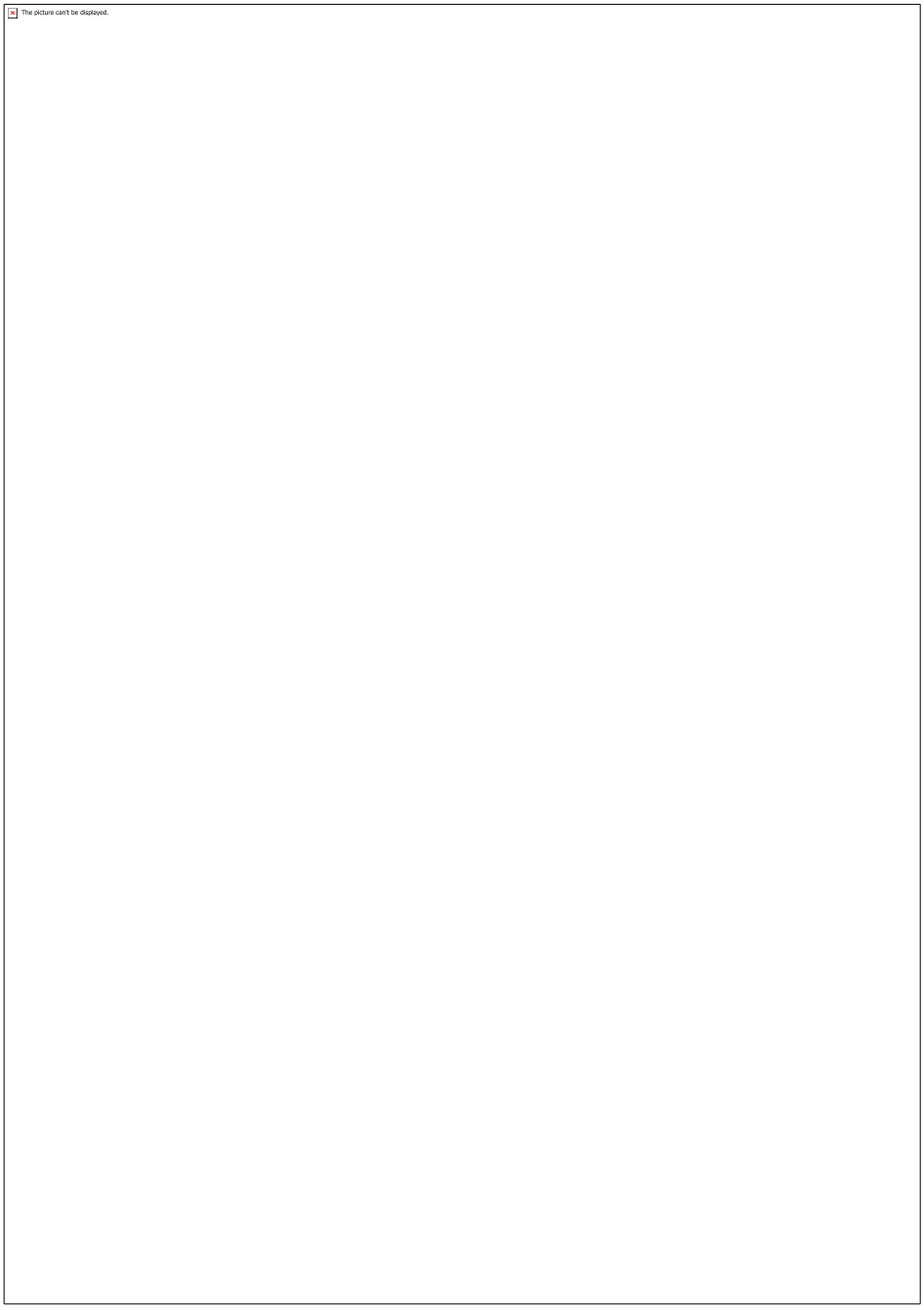
Summary

Averaging Int.	30	# Stations	27
Start Edge	LEW	Total Width	2.600
Mean SNR	41.5 dB	Total Area	0.287
Mean Temp	28.58 °C	Mean Depth	0.110
Disch. Equation	Mid-Section	Mean Velocity	0.1600
		Total Discharge	**0.0459**

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	14:21	1.00	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0
1	*14:25*	*1.10*	*0.6*	*0.120*	*0.6*	*0.048*	*0.0000*	*1.00*	*0.0000*	*0.012*	*0.0000*	*0.0*
2	14:27	1.20	0.6	0.120	0.6	0.048	0.0250	1.00	0.0250	0.012	0.0003	0.7
3	14:28	1.30	0.6	0.120	0.6	0.048	0.1437	1.00	0.1437	0.012	0.0017	3.8
4	14:29	1.40	0.6	0.120	0.6	0.048	0.1467	1.00	0.1467	0.012	0.0018	3.8
5	14:29	1.50	0.6	0.120	0.6	0.048	0.1336	1.00	0.1336	0.012	0.0016	3.5
6	14:30	1.60	0.6	0.120	0.6	0.048	0.1125	1.00	0.1125	0.012	0.0014	2.9
7	14:31	1.70	0.6	0.120	0.6	0.048	0.0953	1.00	0.0953	0.012	0.0011	2.5
8	14:33	1.80	0.6	0.140	0.6	0.056	0.1251	1.00	0.1251	0.014	0.0018	3.8
9	14:34	1.90	0.6	0.140	0.6	0.056	0.1119	1.00	0.1119	0.014	0.0016	3.4
10	14:35	2.00	0.6	0.140	0.6	0.056	0.1387	1.00	0.1387	0.014	0.0019	4.2
11	14:36	2.10	0.6	0.140	0.6	0.056	0.1540	1.00	0.1540	0.014	0.0022	4.7
12	14:38	2.20	0.6	0.100	0.6	0.040	0.1960	1.00	0.1960	0.010	0.0020	4.3
13	14:39	2.30	0.6	0.100	0.6	0.040	0.2265	1.00	0.2265	0.010	0.0023	4.9
14	14:39	2.40	0.6	0.100	0.6	0.040	0.2152	1.00	0.2152	0.010	0.0022	4.7
15	14:41	2.50	0.6	0.090	0.6	0.036	0.2371	1.00	0.2371	0.009	0.0021	4.6
16	14:42	2.60	0.6	0.080	0.6	0.032	0.2559	1.00	0.2559	0.008	0.0020	4.5
17	14:43	2.70	0.6	0.100	0.6	0.040	0.2285	1.00	0.2285	0.010	0.0023	5.0
18	14:44	2.80	0.6	0.100	0.6	0.040	0.1433	1.00	0.1433	0.010	0.0014	3.1
19	14:45	2.90	0.6	0.100	0.6	0.040	0.1743	1.00	0.1743	0.010	0.0017	3.8
20	14:46	3.00	0.6	0.100	0.6	0.040	0.1629	1.00	0.1629	0.010	0.0016	3.5
21	14:48	3.10	0.6	0.100	0.6	0.040	0.2210	1.00	0.2210	0.010	0.0022	4.8
22	14:48	3.20	0.6	0.100	0.6	0.040	0.1850	1.00	0.1850	0.010	0.0019	4.0
23	*14:50*	*3.30*	*0.6*	*0.130*	*0.6*	*0.052*	*0.1640*	*1.00*	*0.1640*	*0.013*	*0.0021*	*4.6*
24	14:51	3.40	0.6	0.130	0.6	0.052	0.2837	1.00	0.2837	0.013	0.0037	8.0
25	14:52	3.50	0.6	0.140	0.6	0.056	0.2210	1.00	0.2210	0.014	0.0031	6.7
26	14:52	3.60	None	0.000	0.0	0.0	0.0000	1.00	0.0000	0.000	0.0000	0.0

Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.



Discharge Measurement Summary

Date Generated: Wed Dec 2 2020

File Information

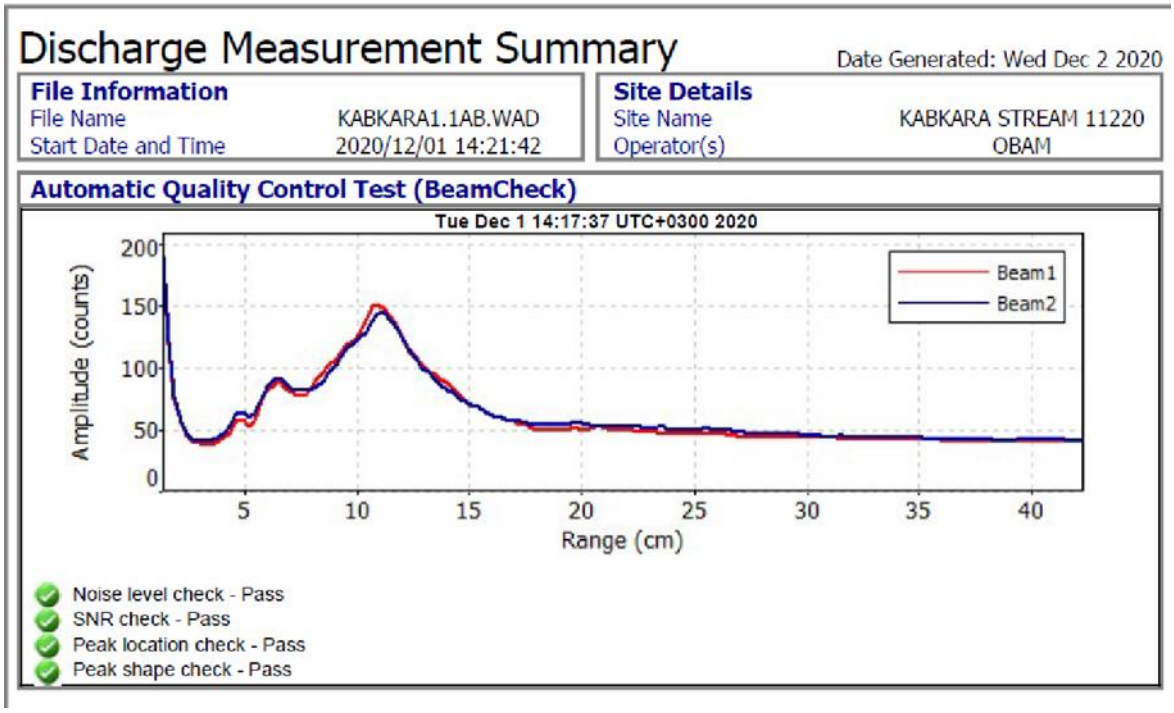
File Name	KABKARA1.1AB.WAD
Start Date and Time	2020/12/01 14:21:42

Site Details

Site Name	KABKARA STREAM 11220
Operator(s)	OBAM

Quality Control

St	Loc	%Dep	Message
1	1.10	0.6	High differences in beam SNR: 50.3,39.1
23	3.30	0.6	SNR (53.1) is different from typical SNR (41.5)
		0.6	High SNR variation during measurement: 14.2,11.2



Summary of one time discharge measurement

Total discharge (TQ) = 0.0459m^3/s

Mean velocity (Vmean) = 0.160m/s

Maximum Velocity (Vmax) = 0.284m/s

Width = 2.63m

Area = 0.287m^2

Depth mean = 0.110m

Depth max = 0.140m

Temperature = 28.6^{0}C

This would help understand the ground water recharge for the dam. Table gives the daily total water demand for the project area for initial (2020), future (2030) and ultimate (2040) design periods.

Total water demand for the project

Category of Consumer	Initial (2020) demand m^3/d	Future (2030) demand m^3/d	Ultimate (2040) demand m^3/d	Duration (Days)	Total Demand m^3
Human	36.83	46.26	58.11	150	8,716
Livestock	63.40	73.66	85.58	150	12,837
Total			143.69		21,553

➢ **Analysis of the reserve**

The draft Rules and Regulations (The Water Resources Management Rules, 2007) have proposed the following definitions for defining the Reserve in a water resource:

i. For streams and rivers; the Reserve Quantity shall, unless specifically stated to be otherwise, not be less than the flow value that is exceeded 95% of the time as measured by a naturalised flow duration curve at any point along the water course;

ii. For lakes and naturally occurring stagnant waters; the Reserve Quantity shall unless specifically stated to be otherwise not be less than the water volume that is exceeded 95% of the time as measured by a naturalised volume duration curve or failing bathymetric data, a naturalised level duration curve;

iii. For aquifers; the Reserve Quantity shall be 40% of the aquifer flux in the case of aquifers whose recharge rate has been determined by the Authority.

iv. For aquifers whose recharge rate has not been determined by the Authority; the Reserve Quantity for each point of abstraction shall be 40% of the tested yield based on test pumping analysis.

v. If the Authority considers that the Reserve Quantity and/or Quality is threatened, it shall cause to be placed in or near the water resource or in a public place frequented by the water users of a particular resource a legible signboard displaying the current condition of the resource and action required by the water users to safeguard the Reserve.

Therefore in this assessment we deployed the aquifer reserve quantity be 40% to assist us determine the base flow and recharge of the dam.

➢ **Flow analysis**

When evaluating sites to assess availability of water resource, it is important to determine the probability that the river/stream will have sufficient flow to meet the need for the proposed project and sustenance of the ecological environment. While instantaneous maximum discharges are used for flood frequency analyses, low frequency analyses usually specify a flow duration (for example 7-day). The instantaneous discharge is used with high flow because damage often occurs even if the site is inundated only for a very short period of time. Thus, the duration, such as seven days or one month, is specified in establishing the policy.

The deference between low-flow and flood frequency analyses is the data for low-flow analyses consist of the annual events that have the lowest average flow of the required duration 'D' each water year of record. Thus, the records of flow for each water year are evaluated to find to find the period of 'D' days during which the average was the lowest; these annual values are used as the simple data. The record of *'n'* years is then evaluated using frequency analysis. The log-normal distribution is commonly selected for low-flow frequency analyses.

A flow duration curve (FDC) for a particular point on a river shows the proportion of time during which the discharge equals or exceed certain values flow duration curve for long periods of runoff are useful for deciding what particular purposes, since the area under a curve represents volume. For many rivers the ratio of peak to minimum discharges may be two or more orders of magnitude and FDCs for points on them are often more conveniently drawn with the ordinate (Q) to a logarithmic scale and a normal probability scale used for the frequency axis. The slope of the line of the FDC gives an indication of the character of a river. The frequency – duration analysis was the method used to analyze the characteristics of a stream flow. It shows the percentage of time that a given flow rate is equaled or exceeded (Lyne and Hollick 1979; Smakhtin 2000). The FDC is constructed from the flow data of fixed time period (e.g. Daily, monthly and annually) by using the following relations;

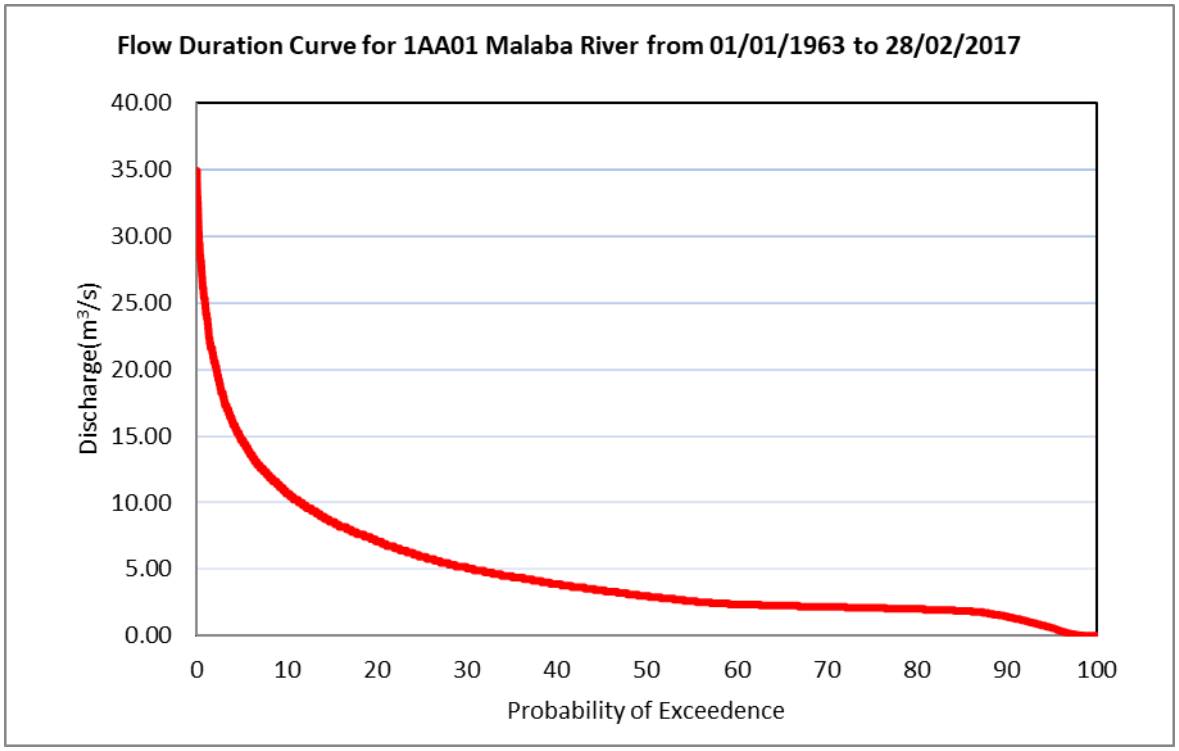
$$P = 100[\frac{m}{n+1}]P = 100[\frac{m}{n+1}]$$

Where:

p = the probability of a given flow that will be equaled or exceeded

m = the rank number when daily or monthly flows are arranged in descending order and

n = the total number of observations (i.e. 365 or 366 for daily data within a year.)



Long term flow duration curve for 1AA01 Malaba River upstream of Kabkara dam catchment- major contributor to the watershed's base flow.

	Discharge (m^3/s)	**Kabkara Dam Stream's discharges are**
Flood flow Q50	2.99852	0.041158195
Normal flow Q80	2.01670	0.027681567
Environmental flow Q95	0.574464	0.00788519
Catchment Area for 1AA01 is (km2)	577	
Catchment Area for Kabkara is (km^2)	7.92	

E flow duration curve we derive the allocatable water by getting the difference between Q80 thus normal or design flow and Q95 thus the environment flow.

Allocatable flow = Q80 – Q95

= 2.01670- 0.574464= 1.44224m^3/s

This translates to 124609.54m^3/day.

➢ **Daily flows**

Statistical analysis was performed on the data in order to determine the general pattern of stream flow for Kabkara at the project site. This was done by plotting mean daily discharges flow versus time for the period of record figure below. The natural flow variability is best described by daily discharge time series. Hydrological statistics for Malaba near the proposed site that can be inferred include instantaneous peaks, maximum and daily minimum discharges. Highest instantaneous peaks are essential for assessing regulation requirements while the maximum discharges indicate the range of water availability. Therefore we had to use the correction method so as to understand the source of the dam recharge in order to maintain the flow into the dam at all time. From the figure below, we can see the how the daily discharges varied for over a long period. River Malaba at the proposed project site has a mean daily flow of 1.44224m^3/s that translates to 124609.54m^3/day.

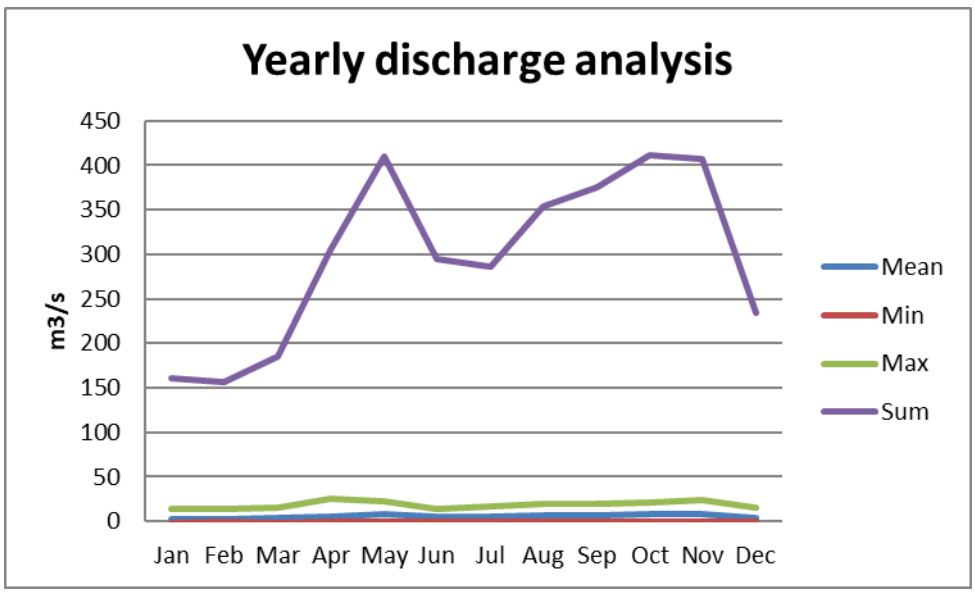
TSID 1100000962 - 1AA01 MALABA DISCHARGE m^3/s

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1963								7.49	4.85	4.76	7.58	15.61
1964	4.18	2.54	2.35	6.41	5.46	5.15	5.7	13.13	9.9	15.02	4.65	3.8
1965	2.41	1.25	1.13	2.66	4.96	1.57	1.79	2.17	2.97	7.65	11.71	5.18
1966	2.04	1.98	1.73	8.38	5.89	3.07	3.01	3.79	8.24	7.93	15.17	3.72
1967	1.64	1.24	0.96	3.45	13.76	8.66	10.89	8.64	7.42	9.85	12.21	8.87
1968	2	5.45	9.52	17.69	20.89	14.33	12.12	17.4	8	8.02	8.86	4.89
1969	2.57	4.75	3.94	1.94	9.49	4.9	5.5	8.26	12.08	5.48	5.72	2.69
1970	4.05	2.47	4.58	11.77	15.78	8.14	8.33	14.98	14.52	14.9	8.81	3.07
1971	2.37	1.24	0.8	1.98	6.67	8.77	7.1	12.94	11.48	11.29	7.51	2.68
1972	1.48	0.1	1.79	1.33	0.23	7.21	14.1	0.5	12.8	16.18	22.88	5.6
1973	2.67	1.94	1.03	1.07	2.37	4.26	2.62	9.2	10.03	11.95	16.31	4.43
1974	1.91	1.13	1.29	2.52	4.1	4.39	16.78	7.48	16.33	17.19	8.57	1.89
1975	0.94	0.64	0.95	2.07	4.79	6.17	6.13	19.67	15.94	16.95	8.69	2.59
1976	1.36	0.98	0.84	1.64	9.09	6.67	6.77	6.76	9.45	4.5	1.97	1.85
1977	2.15	1.68	1.62	11.63	10.83	7.61	8.18	6.83	12.34	14.06	20.88	7.05
1978	2.36	3.86	15.17	8.78	13.98	4.46	8.81	6.8	7.52	7.64	9.63	5.53
1979	5.42	14.04	6	10.76	10.25	11.21	5.76	4.77	4.44	5.07	3.32	1.78
1980	1.11	0.88	1.1	2.62	12.96	8	13.07	7.02	10.33	6.25	7.15	3.1
1981	1.29	0.97	9.87	25.28	22.49	8.87	7.62	15.97	19.36	15.01	11.96	5.48
1982	2.43	1.87	1.32	6.1	14.1	7.16	6.15	13.5	8.48	11.49	23.5	11.37
1983	2.71	1.57	1.05	2.82	7.98	8.12	6.54	10.5	11.3	20.69	15.25	5.67
1984	2.57	1.23	0.89	3.43	6.5	4.44	3.42	5.14	5.71	7.35	5.8	4.4
1985	1.82	1.35	1.35	9.45	14.38	5.07	5.3	6.95	5.58	5.64	8.19	3.31
1986	1.55	1.2	1.23	7.83	20.32	10.67	4.51	8.95	12.88	9.8	6.68	3.42
1987	2.42	3.05	3.64	4.68	9.8	10.86	2.88	4.41	3.72	4.47	13	4.77
1988	2.13	1.71	2.54	11.54	11.07	6.03	10.26	15.6	13.4	12.42	8.5	2.35
1989	1.06	2.97	1.84	5.52	10.65	9.91	3.94	4.89	6.59	10.95	7.5	4.86
1990	8.3	4.87	7.56	20.93	5.84	6.74	2.89	4.85	7.85	6.16	7.2	2.57

1991	0.06	0.13	5.29	6.38	11.03	9.7	7.69	11.01	8.17	9.77	7.77	7.72
1992	7.67	7.63	7.58	7.53	7.48	7.44	7.39	7.34	7.29	7.25	7.2	7.15
1993	7.1	7.06	7.01	6.96	6.92	6.87	6.82	6.77	6.72	6.68	6.63	6.58
1994	6.53	6.49	6.44	6.39	6.35	6.3	6.25	6.2	6.15	6.11	6.06	6.01
1995	5.96	5.92	5.87	5.82	5.78	5.73	5.68	5.63	5.58	5.54	5.49	5.44
1996	5.39	5.35	5.3	5.25	5.2	5.16	5.11	5.06	5.01	4.97	4.92	4.87
1997	4.82	4.78	4.73	4.68	4.63	4.59	4.54	4.49	4.44	4.4	4.35	4.3
1998	4.25	4.21	4.16	4.11	4.07	4.02	3.97	3.92	3.87	3.83	3.78	3.73
1999	3.68	3.64	3.59	3.54	3.5	3.45	3.4	3.35	3.3	3.26	3.21	3.16
2000	3.01	2.24	2.08	3.23	5.98	3.84	5.38	9.85	10.95	18.08	12.25	5.08
2001	3.93	2.35	3.36	3.88	5.57	5.69	2.87	3.7	2.7	4.74	9.4	2.81
2002	2.17	2.12	2.09	2.17	8.18	2.32	2.29	2.26	2.32	3.78	2.46	2.29
2003	2.76	2.04	2.07	2.61	6.71	3.67	4.37	4.86	4.9	3.33	2.14	2.2
2004	2.05	2.13	2.06	4.16	7.65	3.04	1.92	4.14	3.29	6.73	11.01	15.51
2005	13.3	11.72	10.13	8.49	6.85	5.21	3.57	1.9	2.59	3.16	2.6	0.15
2006	0.01	0.01	0.12	0.9	1.39	0.45	0.29	2.09	2.05	2.28	6.49	4.05
2007	0.77	0.8	0.09	0.67	0.71	1.76	4.14	4.76	3.64	2.76	0.63	0.03
2008	0	0.57	0.23	1.84	0.82	2.06	0.33	0.28	0.23	0.17	0.12	0.07
2009	0.04	0.18	0	2.14	3.16	0.37	0.16	0.26	0.77	1.58	0.1	1.59
2010	2.16	4.33	10.25	6.87	13.8	3.22	1.8	1.3	1.94	7.3	4.34	1.19
2011	0.13	0.02	0.35	0.07	0.1	0.22	0.34	0.46	0.57	0.69	0.81	0.93
2012	1.05	1.16	1.28	1.4	1.51	1.63	1.75	1.87	1.99	2.11	2.22	2.34
2013	2.46	2.58	2.69	2.81	2.93	3.04	3.16	3.28	3.4	3.52	3.63	3.75
2014	3.87	3.99	4.1	4.22	4.34	4.45	4.57	4.69	4.81	4.93	5.05	5.16
2015	5.28	5.4	5.51	5.63	5.75	5.86	6.12	5.18	5.18	5.18	5.18	5.18
2016	4.83	2.13	2.14	8.12	4.25	2.28	2.65					

Long term Monthly discharges for Malaba River near the project site

A further analysis had to be undertaken to determine the variation of the annual discharges in terms of mean, minimum and maximum flows. This would assist in the projection of the availability of flow in the dam thus maintaining the water level as shown in figure below.



Flow Percentiles

Percentiles are computed using gauged daily flow data only for those years with five days, or less.

- Q50 (the 50 percentile flow): The flow in cubic metres per second which was equalled or exceeded for 50% of the flow record. Q 50 flows greater than zero but less than 0.005 m^{3s-1} appear as '>0.0'.
- Q80 (the 20 percentile flow): The flow in cubic metres per second which was equalled or exceeded for 80% of the flow record. Q 80 flows greater than zero but less than 0.005 m^{3s-1} appear as '>0.0'; for 20% of the specified term – a high flow parameter which, when compared with the Q 95 flow provides a measure of the variability, or 'flashiness', of the flow regime.
- Q95 (the 5 percentile flow): The flow in cubic metres per second which was equalled or exceeded for 95% of the flow record. The Q 95 flow is a significant low flow parameter particularly relevant in the assessment of river water quality consent conditions. Q95 flows greater than zero but less than 0.005 m^{3s-1} appear as '>0.0'. Q95 values should be used with caution in view of the problems associated with both the measurement of very low discharges and the increasing proportional variability between the natural flow and the net impact of artificial influences, such as abstractions, discharges, and storage changes as the river flow diminishes.

At the time of the study, there was no flow over the spillway thus posing a danger that the design flow was in put into consideration during the design and implementation period. It was impossible to measure the flow. This already interferes with both aquatic lives and downstream users which could lead to conflict.

➢ **Ground water resources**

The ground water resources within this catchment are vast and of good quality. Groundwater in this catchment occurrence within aquifers that are, within the permeable zones, as well as in the fractured and jointed zones and in the contact between the fractured zone and impervious units. The catchment characteristics such as morphology, topography, pedology and vegetation (crop) cover are important in determining the recharge to the said aquifers and seepages to the sub/surface water –dams/rivers.

Hydrograph separation techniques generally divide total stream flow into a quick component and a delayed component called the base flow index. Base flow index represents the portion of flow that origins from stored sources. A high index of base flow would imply that the catchment is able to sustain the river flow during extended dry periods. BFIs are generally correlated with hydrological properties of soil, geology and storage-related descriptors. The calculated base flow Index (BFI) is indicative of the nature of interaction between groundwater aquifer and the surface water flow in the river which in this study is 0.75 against a maximum of 1.0. This implies that approximately 75% of the total annual river flow is supplied by base flow indicating a stable flow regime and a high storage capacity.

➢ **Water quality**

In view of the fact that the watershed will likely continue to be an important water supply for communities in the north of the island, and is a possible demonstration site area for watershed management practices, a long-term hydrologic monitoring programme is being recommended. Parameters to be monitored should include:

- Discharge – assess hydrologic regime of the watershed.
- Rainfall – assess rainfall depth, duration and intensity; correlate pollutant loading (erosion) to storm intensity.
- Fecal coliform – assess levels of sewerage contamination.
- Turbidity (suspended solids) – assess severity of soil erosion; both channel and sheet.
- pH – indicator of possible chemical loadings (for further detailed analysis).
- Temperature – indicator of possible chemical loadings (for further detailed analysis).
- Macro-organism aquatic diversity – presence or absence are indicative of general water quality

The quality of water determines the extent to which it can be used for various purposes. Water is influenced by three main factors within the catchment, namely agriculture and related activities, settlements and urban centres. The quality of drinking water is different from the livestock and irrigation purposes while research and certain processes require water of higher quality. The examination of the physical, chemical and biological characteristics of any water resource is an important undertaking as this enables the determination of the physical, chemical and biological constituents in water and the determination of the extent to which a particular water resource can be utilized for variety of purposes.

In this study water quality analysis for the dam was carried out by WRA Laboratory in Kakamega. The results indicated as follows; the analysis revealed that the water had 30 MPN of coliform organisms per 100ml and 15 E-coli per 100ml therefore does not meet the criteria for drinking water. The water is therefore contaminated and is not suitable for human consumption without treatment. (Appendix 1)

➢ **Impact of the project on water resources**

While acknowledging the benefits that rural dams provide, they can cause significant environmental costs. The dam's location, size, function and permeability of the banks and base will influence the impacts it has on the local environment. Typically, the larger the dam the greater the potential for adverse environmental. However, small dams built near highly sensitive ecosystems may also cause significant impacts. A number of small dams built on one waterway will also have a similar effect to a large dam on total stream flow. How the proponent operates the dam could also affect how much of a risk the dam poses to water resources. Catchment land use practices have a strong influence on the quality of surface water sources.

The potential environmental impacts of rural dam construction on water resources include:

- Changes in waterway flow regimes and water quality as a result of dam construction.
- Impacts caused during the operation of the dam e.g. release of contaminated water.
- Formation of a waterway barrier that impedes the movement of aquatic fauna.

Dam owners should make themselves aware of the potential downstream impacts of their dam. These impacts can affect both the quality and quantity of a water resource. Water quality has both aesthetic (e.g. taste, appearance and odour) and health related components (e.g. pathogens, chemical and physical contaminants). For example, ensure that the water quality of the dam is suitable for the receiving environment before any discharges occur.

Environmental water provisions (EWPs) are an important component in determining if dam construction is likely to threaten aquatic ecological values within a catchment. EWPs are the water regimes defined via the water allocation planning process taking into account ecological, social and economic impacts. Water in excess of the EWPs may be available for consumptive use and defines the sustainable yield of water taken from managed waterways. If there is concern that a dam will diminish this yield and threaten the sustainability of downstream ecosystems, then Water Resources Authority (WRA) may decline to issue a licence to build the dam. Unfortunately, the dam is already constructed and is affecting the environmental water flows.

In summary, impacts may come from changes in ecosystem hydrology, release of sediment, land clearing, changes to aquatic species migration patterns, seepage, dam failure, translocation of aquatic organisms (particularly in aquaculture) and changes in water quality parameters including nutrients, turbidity, salinity and pathogen levels.

The assessment of potential development impacts may include, but is not limited to, a description of the following potential impacts:

✓ There is interference of initial environment flow due to lack of flow through the spillway before the dam is full to allow water pass through the spillway

✓ There is like change in groundwater flow direction if the catchment area will be interfered with.

✓ With the cultivation going on at the upstream, there is a likelihood of reduction to infiltration/recharge/discharge rates and volumes on varying time scales (i.e., daily to annual depending upon proximal environmental features)

✓ Poor farming practice in the sub catchment is the major cause of siltation in the dam

✓ The watering of animals directly poses a risk of contamination and siltation od the dam that is why from the sample test results indicate that the water is contaminated by both coliform organisms and E-coli

✓ The eucalyptus planted at the upstream of the dam poses a risk of reducing both runoff and base flow.

The above impacts would be mitigated through proper integrated water resource management thus conserving the water source, sensitizing the community on the importance of conserving this resource. The client should provide watering troughs to the community so that the animals cannot drink water from the dam. The client and the community should plant water friendly trees around the dam and the wetland.

➢ **Conclusion and recommendations**

The results of the hydrological assessment show that the available water is enough to meet the current and the future demand of the client based on the community population data, water allocation per person vis- a Vis the dam discharge at the time of the assessment as the client intends to abstract 143.69m^3/day. The embankment of the dam around the spillway should the lowered to allow the environmental flow especially during the dry period.

It is therefore recommended as follows;

1. On farm conservation structures should be encouraged to in order to control runoffs, soil erosion and vegetative cover
2. The water must be treated before being supplied to the community and Water quality parameters need to be monitored regularly.
3. Conservation of Kabkara Dam catchment should be encouraged and enhanced to protect the source from pollution (human interference, erosion, and agro-chemical input) and sustenance of the quality to meet both human and ecological demands.
4. The client should provide watering troughs to the community so that the animals cannot drink water from the dam.
5. The eucalyptus trees upstream of the dam to be removed and replaced by the water friendly trees.

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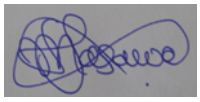
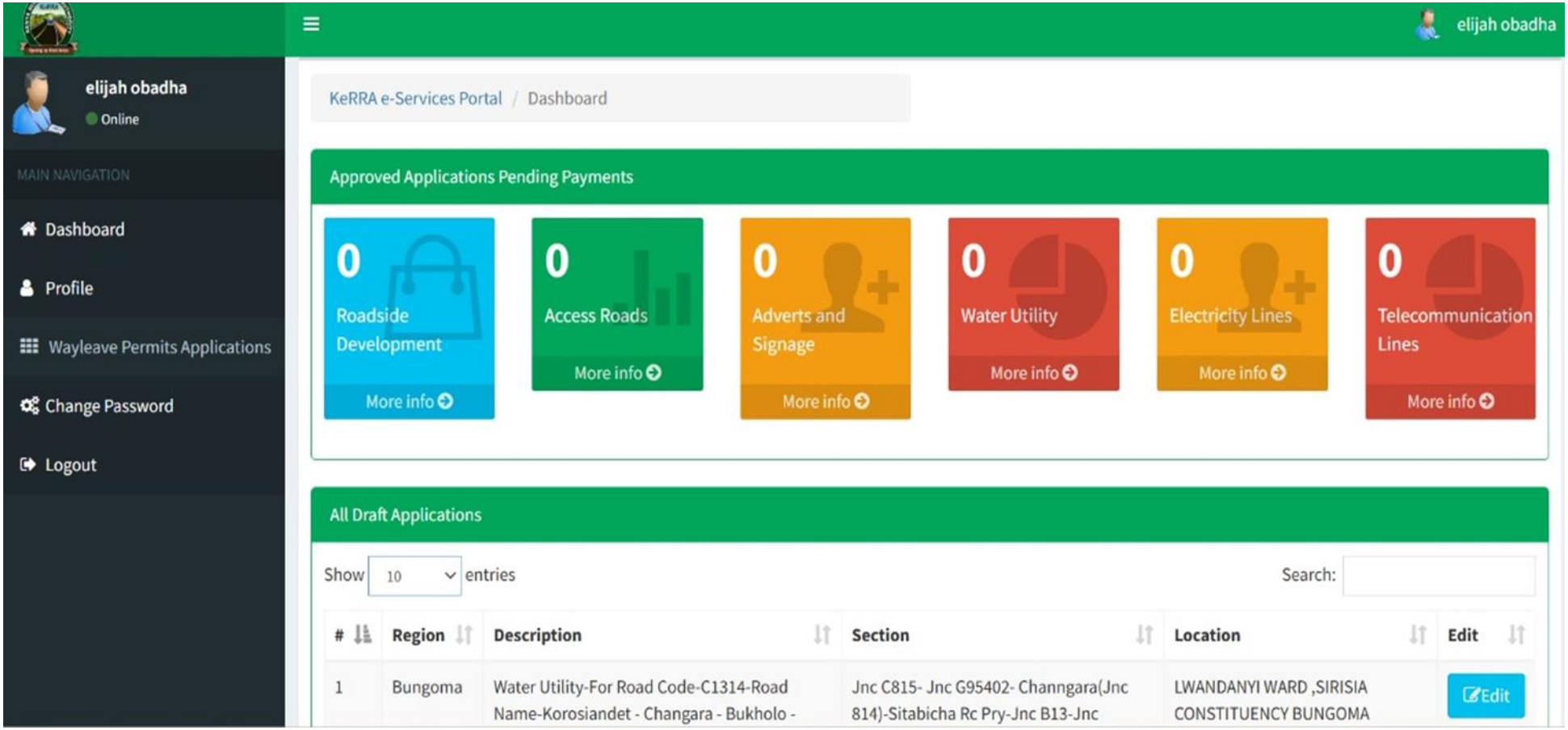


Joab M. Obam

Senior Surface Water Office

Annex 19: Evidence of Way leave Application from Kenya Rural Roads Authority (KERRA)



Annex 20: Design for Kabkara Earth Dam

COUNTY GOVERNMENT OF BUNGOMA

Department of Agriculture, Livestock, Fisheries, Irrigation and Co-operatives Development

County Project Coordinating Unit - Component 3

Kabkara water pan Rehabilitation Project

Capacity 133,480 m^3

Funded By: National Agricultural and Rural Inclusive Growth Project (NARIGP)

June 2020

EXECUTIVE SUMMARY

Kabkara water pan is located in Bungoma County, Sirisia Sub County, Lwandanyi Ward. The Kabkara water pan was identified under component 3 for rehabilitation during the participatory integrated community driven (PICD) process so as to avail water for dairy cow and other economic use. The water pan is completely silted due to soil erosion that has also caused land degradation and low soil fertility within the catchment. There is need for integrated sustainable land management measures to be put in place to mitigate on the silting of the water pan, land degradation and low farm productivity. The aim of this project is to rehabilitate Kabkara water pan of capacity 133,480 cubic metres in order to avail water for dairy production and other economic use within one year. This will target 2,905 beneficiaries. The project objective will be achieved through a number of activities that include capacity building of the community, bush clearing, excavation of reservoir, construction of embankments, construction of spillway and construction of silt trap. These interventions are within the County 2018 - 2022 CIDP's planned projects.

To ensure sustainability of the project, a project management committee will be put in place that will work in collaboration with the community driven development committee (CDDC) and other stakeholders to oversee the management of the dam. In addition, the County Government has committed itself to support the operation and maintenance of the project. The total project cost is Kenya shillings 66,468,859.60

Table of Contents

Rehabilitation of Kabkara water pan will increase productivity and profitability through availing of water for dairy cow and other economic use. Based on the theory of change arrived at in a participatory process, if the SLM interventions proposed in this document are implemented, runoff from the farms will be controlled thus reducing erosion and increasing water infiltration. The effect of this will be improved soil water retention capacity and soil fertility, leading to increased yields and quality of pasture and fodder. Subsequently, the farmers are likely to experience increased milk yields, better profits and enhanced livelihoods for the community.
These interventions are in line with sustainable development goals (SDG) No. 1 on no - poverty, 2-zero hunger, 3-good health and well being and 6-on clean water and sanitation, food security in line with Vision 2030 and the Country's Agenda 4. Further, the County Integrated Development Plan (CIDP, 2018-2022) highlights on the need for catchment conservation that will partly be intervened by this project.
The project will create employment opportunities for the youths and vulnerable and marginalized groups through short term employment program.
Protection of springs in the catchment will make clean water available for health and economic activities.

Project Objective
To increase the storage capacity of Kabkara water pan from 0 m^3 to 133,480 m^3(100%) by November, 2021

LITERATURE REVIEW

Literature Review on Earth Dams
The successful design, construction, and operation of a reservoir project over the full range of loading require a comprehensive site characterization, a detailed design of each feature, construction, supervision, measurement and monitoring of the performance, and the continuous evaluation of the project features during operation.
The design and construction of water reservoir is complex because of the nature of the varying foundation conditions and range of properties of the materials available for use in the embankment.
The first step is to conduct detailed geological and sub surface explorations, which characterize the foundation, abutments, and potential borrow areas.
The next step is to conduct a study of the type and physical properties of materials to be placed in the embankment. This study should include a determination of quantities and the sequence in which they will become available.
The design should include all of the studies, testing, analyses, and evaluations to ensure that the embankment meets all technical criteria and the requirements of a dam.
Other key design considerations include the influence of climate, which governs the length of the construction season and affects decisions on the type of fill material to be used, the relationship of the width of the basin and its influence on the type of earth dam , the planned utilization of the project (for example, whether the embankment will have a permanent pool or be used for short-term storage), the influence of basin configuration and topographic features on wave action and required slope protection, the seismic activity of the area, and the effect of construction on the environment.
Once construction commences, supervision, management, and monitoring of the embankment and appurtenant structures are a critical part of the overall project management plan. After the successful implementation and operationalization of the project observations, surveillance, inspections, and continuing evaluation are required to assure the satisfactory performance of the water reservoir.

Design Criteria for Earth Dams
The basic principle of design is to produce a safe and stable functional structure through all phases of construction and operation. To accomplish this, the following technical criteria considerations are made before and during the construction period.
The embankment is designed so as not to impose excessive stresses on the foundation material.
Seepage through the embankment, foundation, and abutments are controlled so that no internal erosion takes place and there is no sloughing of the slopes. This is accomplished through thorough compaction of the embankment
The upstream slope of the embankment is protected against wave action. The downstream slope and crest are protected against wind and rain erosion.
The freeboard must be sufficient to prevent overtopping by waves and include an allowance for settlement of the foundation and embankment.
The spillway and outlet capacity are designed sufficiently to prevent over-topping of the embankment by the reservoir by ensuring it is sufficient enough to carry the capacity of the peak flood.
Adequate impervious core to act as water barrier to prevent serious seepage.
The above criteria, once satisfied, the dam embankment is believed will be safe provided proper construction methods are adopted.

Earth Dam Construction Procedure
The materials should preferably be taken from the reservoir area; different parts of the side of the valley should be examined so that the most suitable soils are located (soil textures will vary according to position in the valley).
During construction, the following materials should be avoided: organic material including topsoil — decomposing material, material with high mica content, calcite clays, fine silts, schist sand shale, cracking clays and sodic soils.
Avoid material with roots or stones.

Other construction points to consider
Construct during the dry season
Divert any flow into working area; block it with a temporary low dam, or divert it through a culvert (which could become part of the outlet works or spillway later).
Strip topsoil because it contains organic matter (such as roots) which prevents proper compaction and may provide seepage routes (piping) once the organic matter has decayed.
Pay attention to people's safety — avoid hazardous practices and dangerous equipment.
Place material on the embankment:
In layers 100 to 200mm deep;
At the optimum moisture content — when material can be rolled to pencil thickness without breaking, and is as wet as possible without clogging the roller; then
Compact with a heavy roller, or by driving across vehicles or animals.
Cover the whole embankment with topsoil:
Plant strong grass (such as Kikuyu grass, star grass or Bermuda grass) to protect against erosion;
Maintain the grass (water in the dry season if necessary), but prevent trees taking root, and keep out animals such as rats and termites.
Protect the catchments of the basin by establishing soil conservation structures
Along the inlet channel: Lay a stone or brush mattress (for example bundles of saplings between 25 and 50mm long) on the slope, and tie it down with wire anchored to posts;
Secure a floating timber beam 2 m from the dam — these need replacing every 10 years or so.

Embankment Construction
An embankment of the earth dam is composed of suitable soils obtained from borrow areas or required excavation and compacted in layers by mechanical means. Following preparation of a foundation, earth from borrows areas and from required excavations is transported to the site, dumped, and spread in layers of required depth.
The soil layers are then compacted by tamping rollers; sheep-foot rollers, heavy pneumatic tyre rollers, vibratory

INTRODUCTION

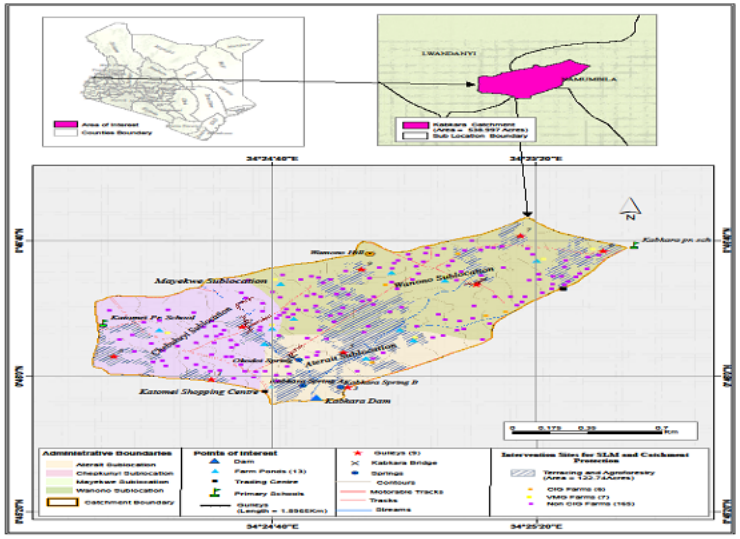
Background Information

Bungoma County covers an area of 3,023.9 Km2. It receives annual rainfall range of 1,110 -1,800 mm and temperatures of 18 – 22^{0} C. It has 9 Sub Counties including Sirisia Sub County in which the project in located. Sirisia Sub-County lies at the Northern part of the former Western Province and boarders Teso North Sub County to the West, Neighboring Uganda to the North West at the Lwakhakha boarder point, Mt Elgon Sub County to the North, Kabuchai Sub County to the East and Bumula Sub County to the South. Sirisia lies in the lower and upper midland ecological zones with its economy being generally agricultural that involve crop production, livestock production with an average farm size of 2.5 acres. It is one of the 5 Sub Counties in Bungoma that was identified to implement the National Agricultural and Rural Inclusive Growth Project (NARIGP) that is a Government of Kenya initiative supported by the World Bank.

Location

Kabkara water pan is located in Lwandanyi Ward of Sirisia Sub County. The plot area of the water pan site is approximately 10.8Ha and owned by the County Government of Bungoma on Plot no. L.R.No. Malakisi/S.Wamono/430. The project site is on latitude 0.765239°, longitude 34.412976°.

Figure 1: Map Area, Project Location, Kenya and Bungoma County



and August is the driest month of the year. The annual temperature ranges between 21°C – 22°C and the mean humidity is 74%. Evaporation rates range between 1,800 – 2,000 mm per year.

Topography

The altitude ranges from 1,116 m a.s.l in the South and Central parts to about 1,400 m in the central and northern regions. Generally, the Kabkara basin is part of the undulating plateau, consisting of hills from the foot hills of Mt. Elgon and Amukura inselbergs. Sirisia Sub County is generally hilly encompassing major Kulisiru hills with a slope of upto 35%. The hills are more concentrated towards the North East side of the Sub County in the wards of Namwela and Lwandanyi while North Kulisiru of Malakisi South Kulisiru Ward is characterized by hills in the central part of the Ward.

Soils

The soils are predominantly sandy loams with pockets of clays in low lying areas. The soils are described as Orthic Ferralsols with Orthic Acrisols, and on the bottom low lying land there are Pellic Vertisols, Humic Gleysols and Plinthic Acrisols. The soils in Lwandanyi ward are clay loams in the Northern parts of Mayekwe sub location but mainly shallow sandy loams in the Kabkara watershed. The soils are low in organic matter/carbon and hence are degraded and of low fertility leading to very low crop and pasture yields.

Socio-economic

Most of the agricultural activities are rain-fed, meaning that farmers only plant during the rainy seasons. Dependency on rain-fed agriculture exposes families to instances of food insecurity because of unpredictable weather patterns. The economy of the Sub County is generally agricultural that involve crop production and livestock production (mainly dairy cow and local chicken). The main crops grown are classified into three major categories namely; food crops, industrial crops and horticultural crops. Livestock sector comprises of dairy cow, poultry, pig, sheep and goat, bee keeping, rabbit and emerging livestock.

Problem Statement

Kabkara water pan has been used by the community for provision of water for human and livestock since 1950s. The area experiences acute shortage of water during the dry period. Lwandanyi Ward lies on slopes of between 5% -20% with predominantly sandy-loamy soils, which makes the area prone to land degradation. Human activities including cutting of trees for charcoal burning, farmland, human settlement; over grazing, low use of organic manure and neglected soil and water conservation structures over time have resulted in vast areas with low vegetation cover and therefore exposing the soils to agents of erosion. Runoff emanating from the hilly and bare farm lands wash away the top fertile soils rendering them poor and unproductive. Consequently, there are low yields of fodder material and over reliance on natural pastures.

Previous efforts by the GoK in the late 80's to mid 90's under the soil and water conservation program did not yield the desired effect in a sustainable manner. This is partly due to increase in population and land fragmentation with a generation that lacks knowledge and skills on soil and water conservation. This resulted in neglect and destruction of SWC structures.

Owing to the aforesaid, there is low milk yield in the dairy cow value chain. Currently, the average milk production stands at 2.5-5 litres per cow per day against a potential of 12 litres per cow per day. This is reflective of other value chains across the ward that leads to low profitability and hence sustained poor livelihoods.
During the dry season the area experiences acute shortage of water leading to the community walking long distances in order to access water for livestock and domestic use. The access roads to support marketing of the value chains are in poor state due to damage from road runoff.
The project aims at addressing the stated issues through mitigation on soil erosion and land degradation through laying of soil conservation structures, water harvesting, enhancing catchment protection by planting

List of Abbreviations

USCS	:	Unified Soil Classification System
FAO	:	Food and Agriculture Organization
HFL	:	Highest Flood Level
USBR	:	United States Department of the Interior- Bureau of Reclamation
MWI	:	Ministry of Water and Irrigation
FSL	:	Full Supply Level
SI	:	International Standards
Fig	:	Figure
FB	:	Free Board
Pg	:	Page
T_c	:	Time of concentration
K_r	:	Runoff factor
CPCU	:	County Project Coordinating Unit
CTDs	:	County Technical Departments
SLM	:	Sustainable Land management
VMGs	:	Vulnerable and Marginalized Groups
CIGs	:	Common Interest Groups
PDO	:	Project Development Objective
CDDCs	:	Community Driven Development Committees
PICD	:	Participatory Integrated Community Development
CDP	:	Community Development Plans
ASL	:	Above Sea Level

PROJECT DATA SHEET

Location	
Project	Rehabilitation of Kabkara water pan
County	Bungoma
Sub County	Sirisia.
Ward	Lwandanyi Ward
Location	latitude 0.765239°, longitude 34.412976°

Catchment	
Annual rainfall	1,270 -1,800 mm
Raw water source	Stream
Watershed area	7.9 km²
Sedimentation allowance	1000m³/year
Design life	30 years

Reservoir	
Active Storage	133,480 m³
Full reservoir Area	41,359 m²
Design yield	143.69m³/day

Embankment	
Dam type	Homogenous
Maximum Added Wall Height	3.5m
Embankment Volume	5,680 m³
Embankment length	340 m
Embankment crest width	5 m
Embankment slope upstream	1:2.5
Embankment slope downstream	1:2.5
Embankment freeboard	2 m
Source of core materials	Near Dam site
Estimated total capital cost of additional works:	kshs. 66,468,859.60

Spillway	
Spillway width at Control	19 m
Design flood discharge	34.855 m3 / s
Flood returns period	100 years
Spillway length	173m

Population and supply area

Population served (by 2040):	2,905
Supply area:	Kabkara

Rehabilitation of Kabkara water pan will increase productivity and profitability through availing of water for dairy cow and other economic use. Based on the theory of change arrived at in a participatory process, if the SLM interventions proposed in this document are implemented, runoff from the farms will be controlled thus reducing erosion and increasing water infiltration. The effect of this will be improved soil water retention capacity and soil fertility, leading to increased yields and quality of pasture and fodder. Subsequently, the farmers are likely to experience increased milk yields, better profits and enhanced livelihoods for the community.
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The basic principle of design is to produce a safe and stable functional structure through all phases of construction and operation. To accomplish this, the following technical criteria considerations are made before and during the construction period.
The embankment is designed so as not to impose excessive stresses on the foundation material.
Seepage through the embankment, foundation, and abutments are controlled so that no internal erosion takes place and there is no sloughing of the slopes. This is accomplished through thorough compaction of the embankment
The upstream slope of the embankment is protected against wave action. The downstream slope and crest are protected against wind and rain erosion.
The freeboard must be sufficient to prevent overtopping by waves and include an allowance for settlement of the foundation and embankment.
The spillway and outlet capacity are designed sufficiently to prevent over-topping of the embankment by the reservoir by ensuring it is sufficient enough to carry the capacity of the peak flood.
Adequate impervious core to act as water barrier to prevent serious seepage.
The above criteria, once satisfied, the dam embankment is believed will be safe provided proper construction methods are adopted.

Earth Dam Construction Procedure
The materials should preferably be taken from the reservoir area; different parts of the side of the valley should be examined so that the most suitable soils are located (soil textures will vary according to position in the valley).
During construction, the following materials should be avoided: organic material including topsoil — decomposing material, material with high mica content, calcite clays, fine silts, schist sand shale, cracking clays and sodic soils.
Avoid material with roots or stones.

Other construction points to consider
Construct during the dry season
Divert any flow into working area; block it with a temporary low dam, or divert it through a culvert (which could become part of the outlet works or spillway later).
Strip topsoil because it contains organic matter (such as roots) which prevents proper compaction and may provide seepage routes (piping) once the organic matter has decayed.
Pay attention to people's safety — avoid hazardous practices and dangerous equipment.
Place material on the embankment:
In layers 100 to 200mm deep;
At the optimum moisture content — when material can be rolled to pencil thickness without breaking, and is as wet as possible without clogging the roller; then
Compact with a heavy roller, or by driving across vehicles or animals.
Cover the whole embankment with topsoil:
Plant strong grass (such as Kikuyu grass, star grass or Bermuda grass) to protect against erosion;
Maintain the grass (water in the dry season if necessary), but prevent trees taking root, and keep out animals such as rats and termites.
Protect the catchments of the basin by establishing soil conservation structures
Along the inlet channel: Lay a stone or brush mattress (for example bundles of saplings between 25 and 50mm long) on the slope, and tie it down with wire anchored to posts;
Secure a floating timber beam 2 m from the dam — these need replacing every 10 years or so.

Embankment Construction
An embankment of the earth dam is composed of suitable soils obtained from borrow areas or required excavation and compacted in layers by mechanical means. Following preparation of a foundation, earth from borrows areas and from required excavations is transported to the site, dumped, and spread in layers of required depth.
The soil layers are then compacted by tamping rollers; sheep- foot rollers, heavy pneumatic tyre rollers, vibratory

Even with compaction, earthen embankment settle as the weight forces air and water from voids (consolidation) hence the need to allow for this settlement in the design. This settlement height should be taken into consideration due to the fact the embankment height reduces after some time and may lead to overtopping.
For small dams (where the embankment carries water), well-compacted settlement should be between 5 to 10 per cent of the height of the dam.

Depth of the Earth Dam

The depth of the earth dam will depend on the storage required in the reservoir. To calculate the depth of excavation the following steps can be undertaken:
Determine the water requirement per day (R litres per day);
Estimate the area of the reservoir (A m2), the evaporation and seepage losses per day (E mm per day) and, hence, the volume of losses per day (A x E litres per day);
Estimate the length of the critical period (T days), during which the reservoir less than the water requirement and losses, when requirements would be met using the storage in the reservoir;
Estimate the average catchment during the critical period (Q Litres per day); the effective storage required (S litres) = (water requirement per Day plus evaporation and seepage losses per day minus average inflow per day) multiplied by the length of critical period:

S = (R + (AxE) – Q) x T
The earth dam must be deep enough to store this quantity of water. The storage capacity of the reservoir (C litres) is best determined from cross-section surveys across the valley/basin, but can be estimated from the area of the reservoir (Am^2) and the maximum depth of water at the reservoir (Dm) when full:
C = 330 A x D
The site should then be surveyed to estimate the area (A) of the reservoir for different values of D, and a trial-and-error method will then give the reservoir capacity (C) which meets the storage required (S) and provides a safety margin. The value 330 is used as corrective factor for the changing values of A across the reservoir profile.
The resulting value of A should then be used in the calculation of S to obtain a consistent result.
Another method for the determination of the height of the reservoir is to use the Sharma method.
Based on this method the general principal in determination of the embankment height is based on the following parameters which are crucial to the safety of the embankment;
Highest flood level
Free board
Embankment Settlement allowance owing to rain and reservoir water
Total height of Embankment = Highest Flood Level + Freeboard + Settlement allowance (Sharma)
Alternatively; Height of embankment = D (excavated depth) + 1m.

Water Demand Analysis

The water consumption rates used in this report are those contained in the "Water from ponds, pans and dams (A manual on planning, design, construction and maintenance'', page 33) and Practice Manual for Water Supply Services, Kenya, 2005.
This process involves determination of the projected population in the year desired at the salvage period of the reservoir. The livestock requirement is also determined for the stock in the area which will be served by the reservoir.
The critical parameter in this calculation is the individual consumption of water for both human and the livestock. This gives the daily off take from the reservoir which is through a community water point (CWP).

Table 1 Estimating water demand

Item	Population	Consumption rate (litres/day)	Total (litres/day)
People		x 20	
Camels		x 15	
Cattle		x 15	
Sheep/goats		x 3.5	
Donkeys		x 15	
Irrigation		x 20 l/buckets/day	
Other		+ 10% (seepage+ evaporation loss)	
Total (litres/day)			
Total (m^3/day*) *divide total litres by 1,000.			

Source: Water from ponds, pans and dams

Human Population and its Projections

The population projection adopted in this report is based on the population growth rate of 2.28% per year (average figure for the country), census 2019. Assuming the factors of population growth are uniform, it is expected the population for both humans and livestock grows exponentially. The formula for predicting the growth is:

$$P_t = P_p e^{rt}$$

Where P_t - Future Population
P_p - Present population
e - Natural logarithm to base 'e'
r - Growth percentage per year
t - Time in years

The initial population within each sub-location is established using local key informants (e.g. local administration), field surveys or is based on the supply area within each sub-location using Equation below: (Source Practice Manual for small dams, pans and other water conservation structures in Kenya - Equation 3-1)

Equation 3-1

$$P_i = (P_T \div A_T) \times A_i$$

Where P_i = Population of sub location 'i' in the supply area
P_T = Total population in sub location i
A_T = Total of sub location in km^2
A_i = Supply area within sub location i (as established by GIS (eg ARCGIS, MAPINFO), manually from a map or through Google Earth in km^2.

Net Evapo-Seepage Loss (NES)

This design is based on the assumption that at the beginning of the critical period (the number of months of the dry period) the storage will be full. The storage is then to satisfy all losses and the demand for the duration of the critical period. These losses were of two main types, evaporation and seepage. For this earth dam, these two were combined into the '' net evapo-seepage loss'' (NES) which is simply calculated from:

$$NES = \left(E/12 + S\right)N(mm)$$

[Linsley&Franzini] where

N = Number of months in the critical storage period
E = Average annual open water evaporation (mm)
S =Monthly seepage loss (mm)

ENGINEERING DESIGN

The survey work was undertaken for the site and the data was used to calculate various parameters
Determination of storage capacity required to meet demand
The volume of the storage facility was based on water demand for domestic use, Livestock consumption and net evapo-seepage losses. Based on various methods described in the literature review, the reservoir volume was determined as below.

Human Water Demand analysis

The critical parameter in this calculation is the individual consumption of both human and the livestock. This gives the daily off take from the reservoir which is through a communal water point
The population projection adopted in this report is based on the population growth rate of 2.28% per year (Census 2019).
Assuming the factors of population growth are uniform, it is expected the population growth is exponential and is predicted by the formula:

$$P_f = P_p e^{rt}$$

Where P_f - Future Population
P_p - Present population
e - Natural logarithm to base 'e'
r - Growth percentage per year
t - Time in years
Human Population for Kabkara Project Area
Current population (P_p) =1,800 Persons for the project area, beneficiaries (2019).
In 2020 after 1 year, the population will be;
$P_f = P_p * e^{rt}$ P_p = 1800
e= Natural logarithm to base e
r= 2.28% (According to Census 2019, the growth rate of the country was 2.28% and assuming all other will remain constant)
t=1 years
Therefore, 2020; $P_f = P_p * e^{rt}$
P_f= 1800× $e^{(1*2.28\%)}$
(2020) P_f= 1842 persons
2030 will be = 1842× $e^{(10*2.28\%)}$ = 2,313
In 2040 after a period of 20 years; the population will be 2,905 persons

Table 3-2: – Population

	Present	Future	Ultimate
Year	2020	2030	2040
Population	1,842	2,313	2,905

Table 3-3: Human water demand projections

Initial (2020)			Future (2030)			Ultimate (2040)		
Popn	Rate (l/h/d)	M³/d	Popn	Rate (l/h/d)	M³/d	Popn	Rate (l/h/d)	M³/d
1842	20	36.83	2,313	20	46.26	2,905	20	58.11

Livestock Water Demand

Below see livestock population from Kabkara Statistics 2019

Goats	412

Assuming number of livestock increases at a rate of 1.5% which includes livestock influx due to high returns from cattle farming; the livestock population will be, using the above formulae for population projection:

Table 3-4: – Livestock population and Projections

	Present		Future		Ultimate	
Year	2020		2030		2040	
Population	Cattle	Shoats	Cattle	Shoats	Cattle	Shoats
	1,236	451	1,437	524	1669	608

Note:
For the purposes of projection, the following conversion factors have been adopted:
1 cattle consumes 50 litres per day for dairy (Practice manual for water supply services 2005, and for sheep and goats it consumes 3.5 litres per day.

Table 3-5: Livestock water demand projections

	Initial (2020)			Future (2030)			Ultimate (2040)		
Livestock	No	Rate (l/d)	M³/d	No	Rate (l/d)	M³/d	No	Rate (l/d)	M³/d
Cattle (local)	1236	50	61.82	1437	50	71.83	1669	20	83.45
Shoats	451	3.5	1.58	524	3.5	1.83	608	3.5	2.13
Totals			**63.40**			**73.66**			**85.58**

Summary of Water Demand

Table 3-6: Total water demand

Category of Consumer	Initial (2020) demand m³/d	Future (2030) demand m³/d	Ultimate (2040) demand m³/d	Duration (Days)	Total Demand m³
Human	36.83	46.26	58.11	150	8,716
Livestock	63.40	73.66	85.58	150	12,837
Total			**143.69**		**21,553**

This demand is based on the envisaged period of storage for the driest period when water demand will be critical. This period is 150 days (5 Months) for this selected site, this was taken from table 8-11 below from Practice manual for small dams, pans and other conservation structures). Hence based on the projections on livestock and human demand, the projected demand after 30 years will be, **21,553m³.**

Table 8-11: Estimated Length of Dry Period

Mean Annual Rainfall (mm)	Length of Dry Period (month)
1200-1000	5
1000-800	7
800-400	9
<400	11

period. These losses were of two main types, evaporation and seepage. For Kabkara, these two were combined into the " net evapo-seepage loss" (NES) which is simply calculated using the formula:

$$NES = \left(E/12 + S\right)N(mm)$$ [Linsley&Franzini] where

N = Number of months in the critical storage period

E = Average annual open water evaporation (mm)

S = Monthly seepage loss (mm)

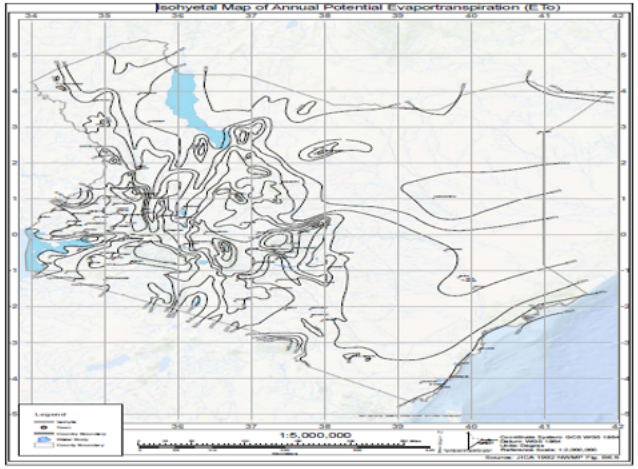
Allowance for seepage loss in earthen dams

Table 3-7: Seepage losses

Main soil type on floor of storage	Drop in water level (mm/month)
Heavy clay	Negligible
Medium clay loam	12
Silty loam, sandy loam with some silt sealing	25
Light sand soils, sand or gravel seams, exposed broken rock or shale	75

Source : Water Resources Engineering, Fourth Edition by Linsley &Franzini)

From the table above, the monthly seepage loss is taken as 12mm since the soils are medium clay loam category and Average annual open water evaporation was determined from below Isohyetal map;



Source, JICA NWMP, Fig. B6.5 (Practice Manual for small dams, pans and other conservation structures)

Therefore:

$L = NES \times Ae \times 10^{-3}$ (Linsley, et al), where

Ae=Effective storage area (m²) $= 0.6\ x\ (Area\ at\ the\ top\ water\ level)$

Approximate area= 41,359m²

Ae = 0.6*41,359= 24,815.4m²

Loss = 810*24815.4*10⁻³ m³

=20,101m³

Since water will be reserved for the entire dry period, then the

Required storage = Total water demand + Net evapo-seepage losses

= 21,553m³+ 20,101m³ = 41,654m³

Therefore required storage =41,654m³ (Human and livestock)

Note:

The community intends also to use the dam during the dry months to supplement other domestic needs such as supplement irrigation for the value chains within the project area. Hence, the design was done to utilize the whole area provided by the community as reservoir land, giving a total storage volume of **133,480m³**

Embankment Design

The embankment height was determined by considering the following parameters which are crucial to the safety and the life of the dam; Highest flood level, Free board and settlement allowance owing to rain and reservoir water, hence;

Total height of dam = Highest Flood Level + Freeboard + Settlement allowance

Highest Flood Level (HFL)

From the survey data and using the contour levels for the site, the actual height was determined getting the difference of reduced level of the highest flood level and the reduced level of the bed surface (See the design map attached).

Freeboard (FB)

This is the height of the embankment provided as a safety factor to prevent waves and runoff from storms greater than the design frequency from overtopping the embankment. It is the vertical distance between the elevation of the highest flood level and the top level of the dam after all settlement has taken place. It depends upon the height as well as length of the dam.

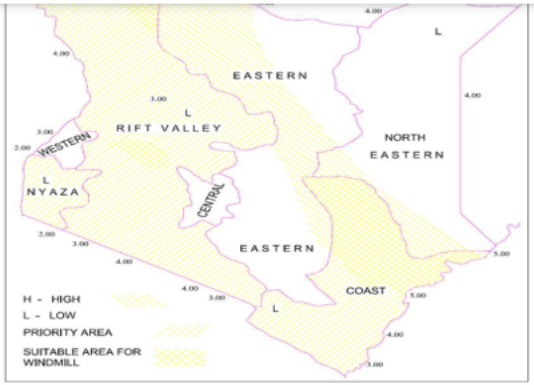
According to Molitor Stevenson et al formula - Irrigation Engineering by T.K. Sharma, freeboard is given by:

$$FB = 1.5\left[0.032 \times (FV)^{\frac{1}{2}} + 0.763 - 0.271(F)^{\frac{1}{4}}\right]$$ - For a fetch less than 32 km.

Where: FB Freeboard (m)

F Fetch (km)

V Wind velocity (km/hr) (Figure No. 10.2: Annual wind speed in meters per second, practice manual, Ministry of Water and Irrigation, 2005)



The fetch(F) for the site under consideration is 238m (0.238Km)
The average Wind Velocity (V) is (3m/s) 10.8 Km/hr
Hence;

FB=1.5[0.032*(0.238*3) ^1/2 +0.763-0.271(0.238) ^1/4]

FB≈0.901m adopt a minimum freeboard of 1.0m

Below are recommended fetch and minimum freeboards (Practice manual for small dams, pans and other conservation structures)

Table 12-1: Fetch and Minimum Freeboard

Fetch (Km)	Minimum Freeboard (m)
0 – 0.10	0.80
0.10 – 0.50	1.00
0.50 – 1.0	1.10
1.0 – 3.0	1.30
3.0 – 5.0	1.60
> 5.0	Reference should be made to publications for the required minimum freeboard

Embankment Crest width

This was determined through use of Sharma and Sharma method.
Using this method, crest width is taken to be a function of embankment height using the formula

$$W = \frac{5}{3} \times H^{1/2}$$

Where, W is Crest width and H the embankment height.
Therefore, taking an embankment height of 7.5m (from profile F – F, the maximum height from the bottom of the embankment to the crest level

$W = 5/3 \times 7.5^{1/2} = 4.564m$
$\approx 5m$

Table 12-2: Crest Widths

Depth of Water (m)	Minimum Crest Width (m)	Comments
0 – 3.0	3.00	Note: minimum width for machinery access is 4.00 metres. A comfortable roadway width is 6 metres
3.1 – 5.0	4.00	
Greater than 5.0	5.00	

Embankment side slopes

Embankment slopes are required for stability of the embankment on stable foundations. Pervious foundations may require the addition of upstream blankets for stability against seepage forces if the water level rises to the embankment. Weak foundations require the addition of stabilizing fills at either or both toes of the embankment although for the earth dam the water is stored at the excavated depth. Only after settlement can the embankment hold water. Side slopes depend primarily on the stability of the material in the embankment. The greater the stability of the material, the steeper will be the side slopes or vice versa. The recommended side slopes for earthen embankments are presented in the table 3-8;

Table 3-8: Recommended Slopes for Earth Embankments

Embankment Height	Fill Material Type	Casing Slopes (H : V)	
		Upstream	Downstream
< 5m	Well distributed granular/clay mix (GC, SC, CL, CH)	2.5 : 1	2.0 : 1
5 m to 10m	Well distributed granular/clay mix (GC, SC, CL)	2.5 : 1	2.5 : 1
10 to 15 m	Well distributed granular/clay mix (GC, SC, CL)	3.0 : 1	2.5 : 1

From the above recommendations; a slope of 2.5:1 on both upstream and downstream
Computations of the volume of earth works
Not all the excavated materials will be utilised for the construction of the embankment. Only **5,680 m³** will be used for the embankment and the rest be deposited to a nearby land identified during the survey. The total excavation was calculated from the survey data, being an excavation volume of **120,080 m³.**
The Volume of the reservoir in this case **133,480 m³** represents the total storage capacity of the Earth dam; any more inflow from the catchment must be discharged through outflow channel (spillway).

Spill Way Design

The spillway is the safety valve of the dam structure which safely passes surplus water downstream thus preventing both the failure of the dam and damage downstream. Surplus water flows over a spillway crest at the top water level, and into an open channel around the side of the embankment, discharging safely into the stream below the dam. A safe water delivery structure (spillway) is therefore a must to save the embankment from overtopping and failure. For this reason, an effort was done during the design to determine size of the spill way and the volume it will discharge at the highest flood flow.
General Spillway Design Guidelines
For small earth dams, it is imperative to determine the flood flow (Q) with a probability of being exceeded once in 50 to 100 years (Q_{50} or Q_{100}) for the purpose of determining the spillway dimensions. Q_{100} was recommended for

The Peak Discharge:

The watershed area for Kabkara earth dam is about 7.9 Km², this was determined using GIS Arc Map, see fig 3-10; this was used to determine the size of the spillway and was used to determine peak floods for Q100.

The Table 3-9; below gives a tentative conservative estimate of 100 years flood flows for small catchments.

Table 3-9: Tentative values for Q_{100} for small catchments

Catchment area in km²	Q_{100} (m³/s/km²)
1	15
1-5	12-10
5-25	3-6
25-100	3-2
100-1000	1-0.4
>	<0.3

Source: Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015,

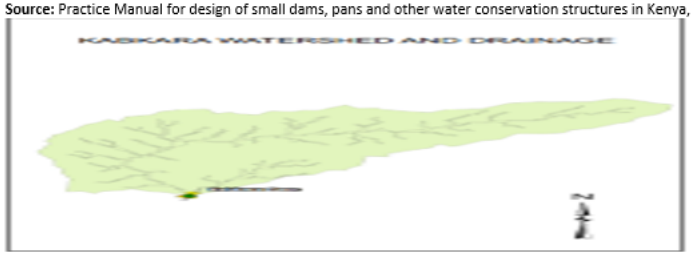


Fig 3-10 showing Kabkara Watershed Drainage

However, using the Richards' Method for estimating Flood Flows, (refer to Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015) which is an empirical method well suited for Kenya conditions was used for this design.

This formula is used to calculate the time of concentration **Tc**, which is the time it takes for the rain falling on the furthest point of the catchment to reach the river at the point where the peak flow is to be estimated. The method takes into account the rainfall pattern and intensity, catchment's characteristics, run-off, shape, slope, soil and vegetation type.

Generalized values of the runoff factor, Kr are as shown in the table 3-10: below:-

Table 3-10: Runoff factor, Kr

Catchment soil type	**Kr**
Rocky and impermeable	0.8 to 1.00
Slightly permeable, bare	0.6 to 0.80
Slightly permeable, partly cultivated or covered with vegetation	0.40 to 0.60
Cultivated, absorbent soil	0.30 to 0.40
Bare sandy soil	0.20 to 0.30
Heavy forest	0.1 to 0.2

Source: MWI, Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015.

$$\frac{T_c^3}{T_c+1} = \frac{CL^2}{Kr \times R \times S \times f(a)}$$

Where:

T_c = Time of concentration in hours

L = the longest path of the catchment in km

C = a coefficient function of (Kr,R) which can be obtained from Figure 8-5 (MWI, Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015)

Kr = Run-off factor, which can be obtained from Table 8-7

R = Rainfall coefficient R = [(t+1)] / t] F

F = Total rainfall in mm for the selected storm duration, is obtained from the rainfall intensity maps in Appendix A or from the Rainfall Frequency Atlas of Kenya (KMS). (MWI, Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015)

t = Selected storm duration (usually 12 hours can be adopted)

S= the average slope of the catchment

f (a) = ratio of the average (i) to the maximum rainfall intensity (I) over the catchment area, obtained from Figure 8-6 (Richard's method i/I, (MWI, Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015).

a = the area of the catchment in Km²

Once the time of concentration T_c has been found, the estimated maximum rainfall intensity can be calculated as follows:

$$I = \frac{R}{Tc+1} mm/hr$$

and the average rainfall intensity i as

$$i = I \times f(a) mm/hr$$

Finally, the rational formula is used to calculate the expected maximum flood flow

$$Q = \frac{K \times r \times i \times a}{3.6} m^3/s$$

Calculation for Peak Floods

Based on (MWI, Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015), figure 2-35, the hundred year 12 hour rainfall intensity for Kabkara (Bungoma) is 12.5 mm/hour

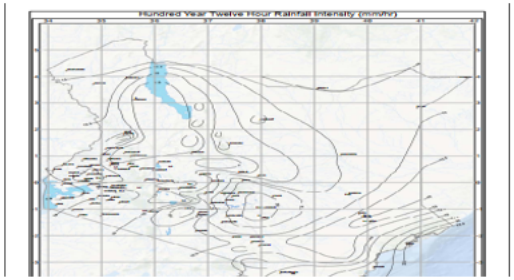


Fig. 2-35 (Practice Manual for small dams, pans and other conservation structures, 2015)

Total rainfall (F) = 12.5 mm/hr × 12hr = 150mm

Rainfall coefficient R = ((t+1)/t) × F = ((12+1)/12) ×150

= 162.5mm

From table 6-2 above, Runoff factor

Kr = 0.4

Kr R = 0.4×162.5 = 65mm

From figure 8-5, Practice Manual for small dams, pans and other conservation structures, 2015, C= 0.140

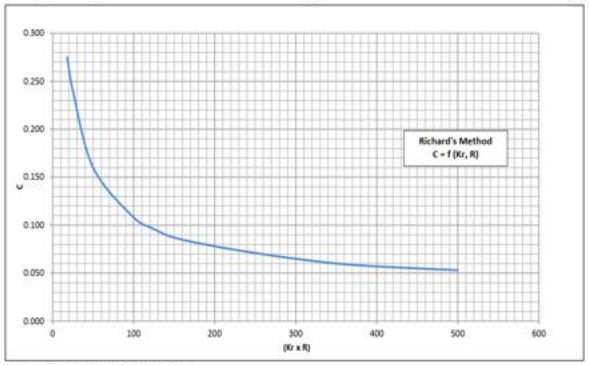
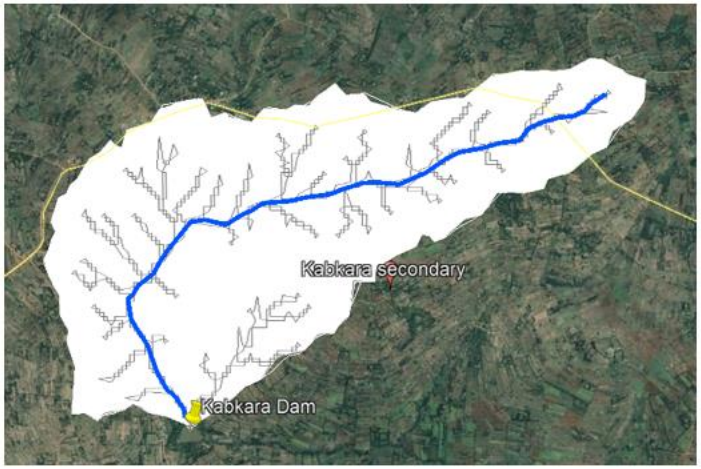


Figure 8-5: Coefficient C, Richard's Method

Below see fig 3-12 showing the longest path and the area characteristics

Longest path (L) = 5.68m



Slope (S) = 0.027

Fig 3-13, Average watershed slope, 2.7%

Catchment Area (a) = 7.9km^2

From fig. 8.6 in Practice Manual Dam, pans and other conservation structures, 2015, f (a) = 0.78

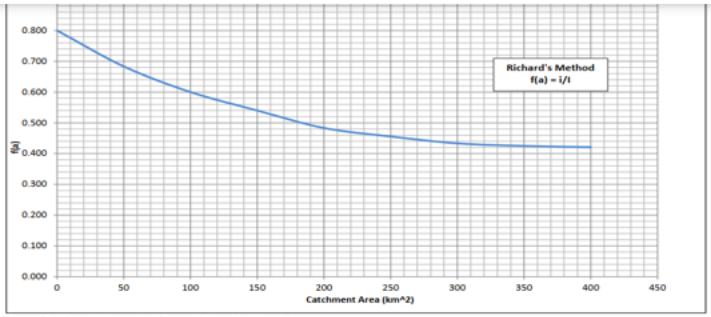


Figure 8-6: Rainfall Intensity Factor, Richard's Method

Using below,

$$\frac{T_c^3}{T_c+1}=\frac{C.L^2}{Kr.R.S.f(a)}$$

Iteration was used to determine T_c

Calculation by substitution and iteration

Hence,

$$\frac{C.L^2}{Kr.R.S.f(a)}$$

= (0.140x5.68²)/ (0.4x162.5x0.027×0.78) =**3.299536854**

1. Take Tc = 1; T³c/ Tc+1= (1)³/ (1+1) = 2

$$\frac{T_c^3}{T_c+1}-\frac{C.L^2}{Kr.R.S.f(a)}$$

=2-3.299536854 = -1.2995

The rest of the values were determines as above by selecting values of T_c each time and finding the difference with the constant=3.299536854

Table 3-11: Using iteration (trial and error) to determine T_c

No.	Tc	(Tc^3)/ (Tc +1)	(Tc^3)/ (Tc +1) – (CL^2)/ (Kr.×R×S×f(a))
1	2	2.666666667	-0.6329
2	2.5	4.464285714	1.1647
3	2.1	2.987419355	-0.3121
4	2.15	3.155039683	-0.1445
5	2.18	3.257934591	-0.0416
6	2.192	3.299580792	0.0000

Therefore, i= I × f (a)

= 50.9085213×0.78 = 39.70864662 mm/hr

The expected maximum flood (Qp) from the catchment by rational formula is given by:

$$Q_p=\frac{K_r\times i\times A}{3.6}$$

Q_p = (0.4×39.70864662×7.9) / 3.6 = 34.85536759 m³ / s

Computation of catchment Runoff yield

The catchment from which Kabkara dam draw most of its water from is estimated to be 7.9 Km², the land has characteristic of being cultivated, absorbent soil, hence the runoff Coefficient (R_c) is averagely 0.4. The mean annual rainfall in the area is 1535 mm which has reliability of about 60% (probability of occurrence).

Using the formula below;

$V=R_c*A*R$

Where V =yield from the catchment in m³

R_c =Catchment coefficient=0.4

A =Catchment area; 7.9km²

R =Rainfall (Annual rainfall x rainfall at probability of 60%)

= (1.535m*60%)

Therefore V =0.4*7,900,000m²*(1.535m*60/100) =**2,910,360m³**

The yield from the catchment surpasses the storage requirement as well as the reservoir capacity hence the excavated reservoir will be filled to capacity at 60% probability of rainfall.

Inflow Spillway Channel

The inflow leads the flood to the crest and the water flowing to the crest remained far enough from the earth embankment.

The recommended inflow channel slope varies between 0.3 – 1%, with a widening water inflow inlet or mouth. In our case 0.5% has been adopted as the inflow channel slope up to the spill way crest.

Outflow Spillway channel

The outflow channel discharges the flood water back into the riverbed / discharge natural stream at acceptable velocities that do not cause erosion. For spillways excavated in undisturbed earth, a maximum velocity of **2.5** m/s is usually acceptable under Kenyan conditions. Control of the outflow channel water velocity is usually achieved through adequate slope selection. Otherwise lining of the channel (or parts thereof) with riprap will be required. In such cases velocities up to **6-7 m/s** can be accepted.

In case of unacceptably long outflow channels, the possibility of incorporating a gabion or concrete drop structure can offer a solution.

This is mainly done through slope selection (See table 14 below)

Table 3-11: Outflow Channel slope

Recommended Values for outflow channel slope	
Type of soil	$i_{\%}$
Earth	<0.5
Murram	0.5-1
Hard Rock	1-2

Table 3-11: Manning n Values for Typical Spillway Channel Material

Type of channel and material	Minimum n value	Normal n	Maximum n

Masonry line with cemented rubble	0.017	0.025	0.030
Straight, uniform channel excavated in clean earth	0.018	0.022	0.025
Straight, uniform, earth channel with short grass, few weeds	0.022	0.027	0.033
Straight, uniform, earth channel not maintained with dense weeds	0.050	0.08	0.12
Rock cut – smooth and uniform	0.025	0.035	0.040
Rock cut – jagged and irregular	0.035	0.040	0.050

Determination of Outflow Spillway channel Dimensions

The flow characteristics in the outflow channel will correspond to Manning's equation which is used to calculate the safe outflow channel slope and velocity that should convey the maximum flood out of the dam reservoir and hence safeguard the dam embankment from being washed away.

$$V = \left(\frac{1}{n}\right) R^{\frac{2}{3}} i^{\frac{1}{2}} m/s$$

Thus Where

V = water velocity in m/s

n = channel roughness factor equal to 0.025.

(MWI, Practice Manual for design of small dams, pans and other water conservation structures in Kenya, 2015)

R = hydraulic radius of channel = channel cross section / wetted perimeter

$$R = (d(d+b)) \div (2\sqrt{(2d^2)} + b)$$

i = Channel Slope

This calculations are based on the principal that rapidly varied flows and eddies are not allowed due to high erosion risks. Equally the water velocities will have to be limited to a maximum of 2.5m/s which is the maximum admissible on earthen channels (Design Manual for Water Supply in Kenya).

The water depth corresponding with the Manning equation was determined by using the Manning's equation in terms of discharge Q in m³/s for adopted return flood.

$$Q = V \times A = \frac{1}{n} \times R^{2/3} i^{1/2} \times A\, m^3/s$$

Where:

Q* = *Discharge

$$A = \text{Channel crosssectional area in m}^2 = d(d+b)$$

$$R = \text{Hydraulic radius of channel} = \frac{d(d+b)}{2(2d^2)^{1/2} + b}$$

V = Water velocity in m/s

Hence ,

$$Q = \left(\frac{1}{n}\right) \times \left(\frac{b \times d}{b + 2d}\right)^{2/3} \times i^{1/2} \times b \times d$$

Where b = spillway width

d = normal water depth

$i = (Vn/R^{\frac{2}{3}})^2$, $Q = A \times V$, $Q = V \times b \times d$, $(Q \div b) = Vd$

Discharge per metre width q (m³/s/m) is given by: $q = (Q \div b) = Vd$

Considering below known values and above formulas:

Max. Velocity (v) < 6 - 7 m/s

Roughness coefficient n < 0.03

Maximum slope on an earthen spillway < 2

A minimum bottom width of 10m as recommended in the Practice manual for small dams, pans and other conservation structures, 2015, section 12.3.2

Use Iteration below to find the values of d (depth) and Bottom width (b) and satisfying the above conditions using an excel sheet below.

v	Q	Q/v	n (Earthen Channels)	vn	
4	34.85536759	8.713841896	0.025	0.1	
ITERATIONS FOR d					
D	**b = (Q/v)/d**	**P= 2*(2*d*d)^(1/2) +b**	**A=d(d+b)**	**R=A/P**	**R^(2/3)**	**i=(vn/(R^(2/3)))^2**
0.2	43.57	44.135	8.754	0.2	0.34	0.086
0.3	29.046	29.895	8.804	0.3	0.44	0.051
0.32	27.23	28.136	8.816	0.3	0.46	0.047
0.35	24.897	25.887	8.836	0.3	0.49	0.042
0.4	21.785	22.916	8.874	0.4	0.53	0.035
0.42	20.747	21.935	8.890	0.4	0.55	0.033
0.45	19.364	20.637	8.916	0.4	0.57	0.031
0.5	17.428	18.84	8.964	0.5	0.6	0.027
0.49	17.783	19.169	8.954	0.5	0.6	0.028

From the above iteration, Taking velocity of 4m/s, depth of wetted perimeter, d to be d= 0.45 and w = 19m. This satisfies the kabkara slope, a control width of not less than 10m and a velocity of less than 6-7 m/s

Channel Geometry

Take the spillway channel to be trapezoidal in shape and the slope to be z = 1

The trapezoidal type is adopted because it shape makes it easier to construct.

Trapezoidal geometrical properties are shown below:

X- sectional area	Wetted perimeter	Hydraulic radius	Top width
$A = bd + Zd^2$	$P = b + 2d\sqrt{1+Z^2}$	$R = \frac{A}{P} = \frac{bd + Zd^2}{b + 2d\sqrt{1+Z^2}}$	$w = b + 2dZ$

From the table above and substituting for area and wetted perimeter then;

W = b + 2dZ

= 19+ 2 * 0.45* 1 = 19.9m

The wetted perimeter dimensions of the spillway are:

Flow per unit width q will be:
$q = [Q/b] = [34.855/19] = 1.8\ m^2/s$
And
Critical depth
$H_c = [q^2/g]^{1/3} = [1.8^2 / 9.81]^{1/3} = 0.69m$
Depth of approach
$H_A = 1.5 \times H_c = 1.5 \times 0.69 = 1\ m$
Normal depth of flow

$$H_N = H_A - \left[\frac{5}{4} \times V^2\right] / [2 \times g]$$

$H_N = 1 - [5/4 \times 4^2] / [2 \times 9.81] = 0.03m$

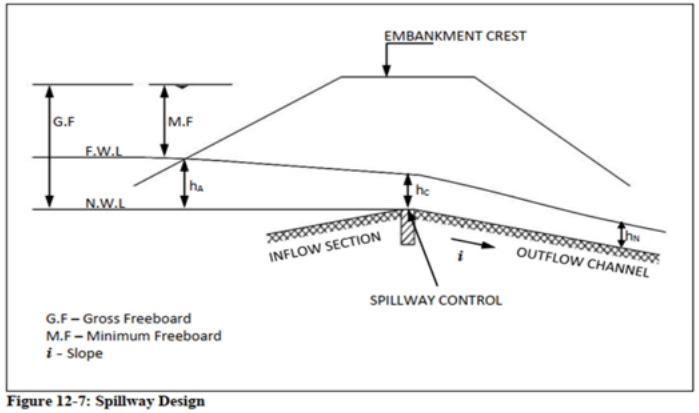


Figure 12-7: Spillway Design

Figure 12-7 Source; MWI, Guidelines for design of small earth dams, 2015
Gross Freeboard = Minimum Freeboard + H_A (water level in reservoir when spillway is passing inflow design flood (m)) (Equation 12-1, practice manual for small dams…2015)
= 1m + 1m = 2m
Excavation of Silt trap
The silt trap increases the lifespan of the reservoir by collecting the sediments from the catchment.

Silt Trap Size Determination
Various sustainable land management interventions will be done around the catchment/watershed area to keep sediment loads levels low enhancing soil fertility, productivity and reducing sedimentation of the earth dam.
Some representative figures for the sediment yield of catchments in Kenya are given in Table 8-12. These figures

Source MWI 2005
From the above, the estimated yield will be $500m^3/km^2/year$
Taking an area of 2 km^2 around the catchment /watershed area Sediment Yield of the catchment per year will be:
$2 \times 500 = 1000m^3/year$
Taking a silt trap depth of 1.5m, the bottom width of 30m×25m and the shape to be a trapezoidal shape, take a slope of 1:1.
Top width will be, 30+2×1.5×1 = 33m, side length, 25+2×1.5×1 = 28m
Computation of Total volume of earth works
Total volume of earth works = (Reservoir excavation + Spillway +Silt trap)
Spillway Volume = (19+20) /2 ×0.45 × 173
$= 1518.075m^3$
Silt Trap Volume = (33+30)/2 ×1.5 × (25+28)/2 = $1252.125m^3$
Reservoir area excavation = $120,080m^3$ (from survey profiles attached on annex)
Total Excavation =120,080+ 1518.075 + 1252.125
=122.850.2 m^3

Note: To maximize use of the reservoir area provided by the community and available water from the run off and streams, the design earth dam capacity volume was taken as **133,480 m^3**
The water storage /earth ratio is then the storage capacity divided by the earthwork volumes; this gives the suitability of the site in terms of its storage capacity.

$$\frac{Storage\ capacity}{Earthwork\ volumes}$$

=133,480 m^3/123,019 m^3=1.08≈ 1

The guide to the storage ratio rating is as given in the table below
Table 5-8: Storage ratio

Storage ratio as a measure of storage economy	
Storage ratio	Rating
Less than 2	Poor
2 to 4	Moderate
4.1 to 6	High
Above 6	Very high

Comments:
From the rating table above the storage ratio was estimated at 1, which in this context means poor ratio of comparison for storage versus earth works but the long term benefits of the project will be more in the long term.

BILL OF QUANTITIES
The bill of quantities is the guiding principles for the works which will be undertaken.
The scopes of works which will be undertaken for this project included the following:
All trees and bushes are to be uprooted and cleared-off the reservoir area
Excavation of the reservoir to create a storage
Excavation of spillway
Excavation of core trench
Embankment construction, by compacting wetted soil

Silt Trap Size Determination

Various sustainable land management interventions will be done around the catchment/watershed area to keep sediment loads levels low enhancing soil fertility, productivity and reducing sedimentation of the earth dam. Some representative figures for the sediment yield of catchments in Kenya are given in Table 8-12. These figures can be considered as conservative values of sediment yield.

Table 8 -12 , Indicative Sediment Yields

Erosive Rate	Sediment Yield (m^3/km^2/year
Low	500
Moderate	1000
Heavy	1500

Source MWI 2005

From the above, the estimated yield will be $500m^3/km^2$/year

Taking an area of 2 km^2 around the catchment /watershed area Sediment Yield of the catchment per year will be:

$2\times500 = 1000m^3$/year

Taking a silt trap depth of 1.5m, the bottom width of 30m×25m and the shape to be a trapezoidal shape, take a slope of 1:1.

Top width will be, 30+2×1.5×1 = 33m, side length, 25+2×1.5×1 = 28m

Computation of Total volume of earth works

Total volume of earth works = (Reservoir excavation + Spillway +Silt trap)

Spillway Volume = $(19+20)/2 \times 0.45 \times 173$

$= 1518.075m^3$

Silt Trap Volume = $(33+30)/2 \times 1.5 \times (25+28)/2 = 1252.125m^3$

Reservoir area excavation = $120{,}080m^3$ (from survey profiles attached on annex)

Total Excavation =120,080+ 1518.075 + 1252.125

=122.850.2 m^3

Note: To maximize use of the reservoir area provided by the community and available water from the run off and streams, the design earth dam capacity volume was taken as **133,480 m^3**

The water storage /earth ratio is then the storage capacity divided by the earthwork volumes; this gives the suitability of the site in terms of its storage capacity.

$$\frac{Storage\ capacity}{Earthwork\ volumes}$$

=133,480 m^3/123,019 m^3=1.08≈ 1

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